

Pro-Gradu – Master’s Thesis

**USING SUSTAINABLE TECHNOLOGY TO
UPGRADE SANITATION. CASE STUDY:
SOWETO EAST, KIBERA**

Eva Muthoni Kagiri



University of Jyväskylä

Faculty of Science

Department of Biological and Environmental Science

Environmental Science with a specialisation in Development and
International Co-operation

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KAGIRI EVA MUTHONI: Kestävän teknologian käyttäminen sanitaatioon
parantamisessa. *Tapaus: Soweto, Itä-Kibera*

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Työn ohjaajat: Prof. Jukka Rintala, Prof. Liisa Laakso, FT. Anssi Lensu

Tarkastajat: Prof. Markku Kuitunen, FT. Anssi Lensu

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TIIVISTELMÄ

Viimeisimpien YK:n arvioiden mukaan vuoteen 2030 mennessä 4,9 miljardia ihmistä asuu kaupungeissa. Luvun merkitys ympäristölle on huomattava ja voimakkaimmin sen eri vaikutukset tulevat näkymään erityisesti kehittyvien maiden kaupungeissa. Yksi kolmannen maailman hallitusten suurimmista haasteista on sanitaatiojärjestelmien järjestäminen ja ylläpito kasvaville kaupunkilaisväestöilleen. Suurimmassa osassa näistä maista kaupungistuminen (urbanisaatio) on synnyttänyt slummeja kuten Kibera, joka sijaitsee Nairobissa, Kenian pääkaupungissa. Kiberan väkiluku on noin 700 000. Laskelmien mukaan väestötiheys on suurempi kuin 2000 asukasta/ha ja sanitaatio on suuri ongelma.

Käymäläteknologiassa on yleinen käsitys, että paikallistettu sanitaatio on paras ratkaisu tiheästi asutetuille alueille. Uusia, kestäviä vaihtoehtoisia käymäläteknologioita tulee tutkia ja ottaa käyttöön slummien elinoloja parannettaessa. Tämä tutkimus on tehty kyselykaavakkeilla yhdessä Kiberan kylässä, jonka väkiluku on 70 000. Tarkoituksena oli analysoida paras mahdollinen käymäläteknologia, jotta yhteisön tarpeet tulevat tyydytettyä kestäväällä tavalla. Yhteisön jäseniltä kyseltiin kysymyksiä liittyen huonon sanitaatioon syihin, heidän halukkuuttaan parantaa sanitaatiota yhteisössään ja heidän yleistä tietämystään huonon sanitaatioon vaikutuksista, ja mikä ryhmä yhteisössä kärsii huonosta sanitaatiosta eniten. Vastaukset analysoitiin käyttäen SPSS-ohjelmaa, mutta myös käytännön havainnointia tehtiin datan keräyksen ohessa, mikä näkyi keskustelussa.

Tulokset olivat hyvin valaisevia. Tekijät, kuten matala taloudellinen status, liika väestö, resurssien huono järjestely ja huono maanhallintapolitiikka olivat huonon sanitaatioon pääsyyt. Taustalla oli myös muita syitä, kuten epäluottamus yhteisön jäsenten välillä, joka luo esteitä mobilisoinnille ja kestävyydelle. Suurin osa ihmisistä ymmärsi kuitenkin sanitaatioon perusasiat, kuten mitä heikko/huono sanitaatio on, ja mitkä seuraukset huonon sanitaatioon harjoittamisella on etenkin terveyteen. Useimmat ihmiset eivät maininneet vaikutuksista ympäristöön, mutta he ajattelivat sen olevan negatiivinen. Kaiken kaikkiaan yhteisön tarpeet ja odotukset sanitaatiolaitteistolle määriteltiin.

UNIVERSITY OF JYVÄSKYLÄ, Faculty of Mathematics and Science

Department of Biological and Environmental Science. Masters in Environmental Science, specialisation in Development and International Co-operation.

KAGIRI EVA MUTHONI. : Using sustainable technology to upgrade sanitation. *Case study: Soweto East Kibera*

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Supervisors: Prof. Jukka Rintala, Prof. Liisa Laakso, PhD. Anssi Lensu

Inspectors: Prof. Markku Kuitunen, PhD. Anssi Lensu

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ABSTRACT

According to the latest United Nations population projections, by the year 2030, 4.9 billion people will be urban dwellers. The environmental implications of this figure are staggering with perhaps the most adverse being felt in the cities of developing countries. Among the greatest challenges that governments in third world states will face is provision and maintenance of sanitation facilities for their ever growing city populations. In most of these countries, urbanization has caused the emergence of slums like Kibera, which is found in the capital city of Kenya, Nairobi. Kibera houses approximately 700,000 people. It has been calculated that the inhabitant density is more than 2000 people/ha and there is a major sanitation problem.

In toilet technology it is generally assumed that on site sanitation is the best for highly populated areas. However, new sustainable alternative toilet technologies need to be researched further and put into practice in slum upgrading. This research was conducted in one of the villages of Kibera, which has a population of 70,000 people, through distribution of questionnaires. The objective was to analyze the most feasible toilet technology to satisfy the sanitation needs of the community in a sustainable way by asking community members questions related to the causes of poor sanitation facilities in their community, their willingness to improve their sanitation facilities and their general knowledge of the impact of practicing poor sanitation and which group suffers most negatively due to the poor sanitation in the community. The answers obtained were then analyzed using SPSS. In the discussion, the writer also points out observations that were made during the data collection.

The results were very enlightening. Factors like low economic status, overpopulation, mismanagement of resources and poor land tenure policies were on the forefront of major causes of poor sanitation. There were however other underlying causes like mistrust among community members which create roadblocks to mobilization and sustainability. Most people however understood the general aspects of sanitation, this is, what is good and poor/bad sanitation and the impacts of practicing poor sanitation, more so on health. Most people did not mention environmental implications but they had an idea that it is negative. Overall, the community needs and expectations on sanitation facilities were identified.

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ABBREVIATIONS

EIA	Environmental Impact Assessment
KENSUP	Kenya Slum Upgrading Programme
Ksh.	Kenya Shillings
MDG's	Millennium Development Goals
SEC	Soweto Executive Committee
UN	United Nations
UNDP	United Nations Development Programme
UN HABITAT	United Nations Human Settlement Programme
UNICEF	United Nations Children's Fund
WAC	Water for African Cities Programme
WAC I or II	Water for African Cities Programme phase I or II
WHO	World Health Organisation

1 INTRODUCTION

In the late 20th and early 21st century, the rate of urbanization has increased dramatically in many world cities. The negative impacts of urbanization have not been felt more than in the cities of many third world states which have had to face problems like emergence of slums. UN-Habitat estimates indicate that in 2001, 924 million people, or 31.6% of the world's urban population, lived in slums. By 2030, half of humanity will be slum dwellers (Danida 2006). This issue needs to be brought into the forefront of development strategies by donors, recipient states and intellectuals.

Interventions to improve the situation of people living in low-income areas are gaining importance within the development arena particularly in the context of the Millennium Development Goals (Darkoh & Rwomire 2003). Accessibility to clean water and proper toilets is one of the greatest problems in slums causing and advancing many sanitation related diseases. Researchers have been active in designing and suggesting numerous sustainable toilet technologies that can be applied in third world states, for instance the Swedish Environmental Institute (SEI) and Ecosanres have focused in researching the viability of ecosanitation as a form of on-site sanitation. The sustainability of these technologies however depends greatly on the community in question and the social, political, economic and environmental conditions surrounding it (Franceys et al. 1992).

This research is as a result of UN-Habitats initiative in making slum upgrading one of its priority areas under the Water for African Cities Programme (WAC). As most third world countries continue to fight inadequate water supply and poor urban governance, it has normally been assumed that for populated areas, Ventilated Improved Pit latrines are the best toilet technologies as they are economically and environmentally viable (Francois & Maarten 2003).

2 BACKGROUND

2.1 Environmental technology and the Millennium Development Goals

“We will have time to reach the Millennium Development Goals – worldwide and in most, or even all, individual countries – but only if we break with business as usual. We cannot win overnight. Success will require sustained action across the entire decade between now and the deadline. It takes time to train the teachers, nurses and engineers; to build the roads, schools and hospitals; to grow the small and large businesses able to create the jobs and income needed. So we must start now. And we must more than double global development assistance over the next few years. Nothing less will help to achieve the Goals (United Nations Organization 2000)”.

This quotation was made by the United Nations Secretary General in 2000 when the Millennium development goals were declared. The 7th goal in the millennium declaration is to ensure environmental sustainability. Sustainable development is described by the Brundtland report of 1987 as development that “meets the needs of the present without compromising the ability of future generations to meet their own needs”. To achieve this environmental sustainability would therefore involve sustainable technologies and management methods. Environmental technology stretches to areas of water and waste water management, air pollution control, agriculture, renewable energy, solid waste management etc. As sustainability is made the chore of environmental technology, all solutions for environmental issues must always be socially equitable, economically viable and environmentally sound (NWP 2006). Other than ensuring environmental sustainability, environmental technology has a great role in fulfilling all the other millennium goals. Figure 1 below illustrates an example of the inter-relation between sustainable environmental technology and other MDGs. These are however not all the ways in which the goals are inter-related. In the diagram the goals are written in italics, in over-all, they can be viewed as tools for creating international co-operation in development, which is also one of the Millennium goals.

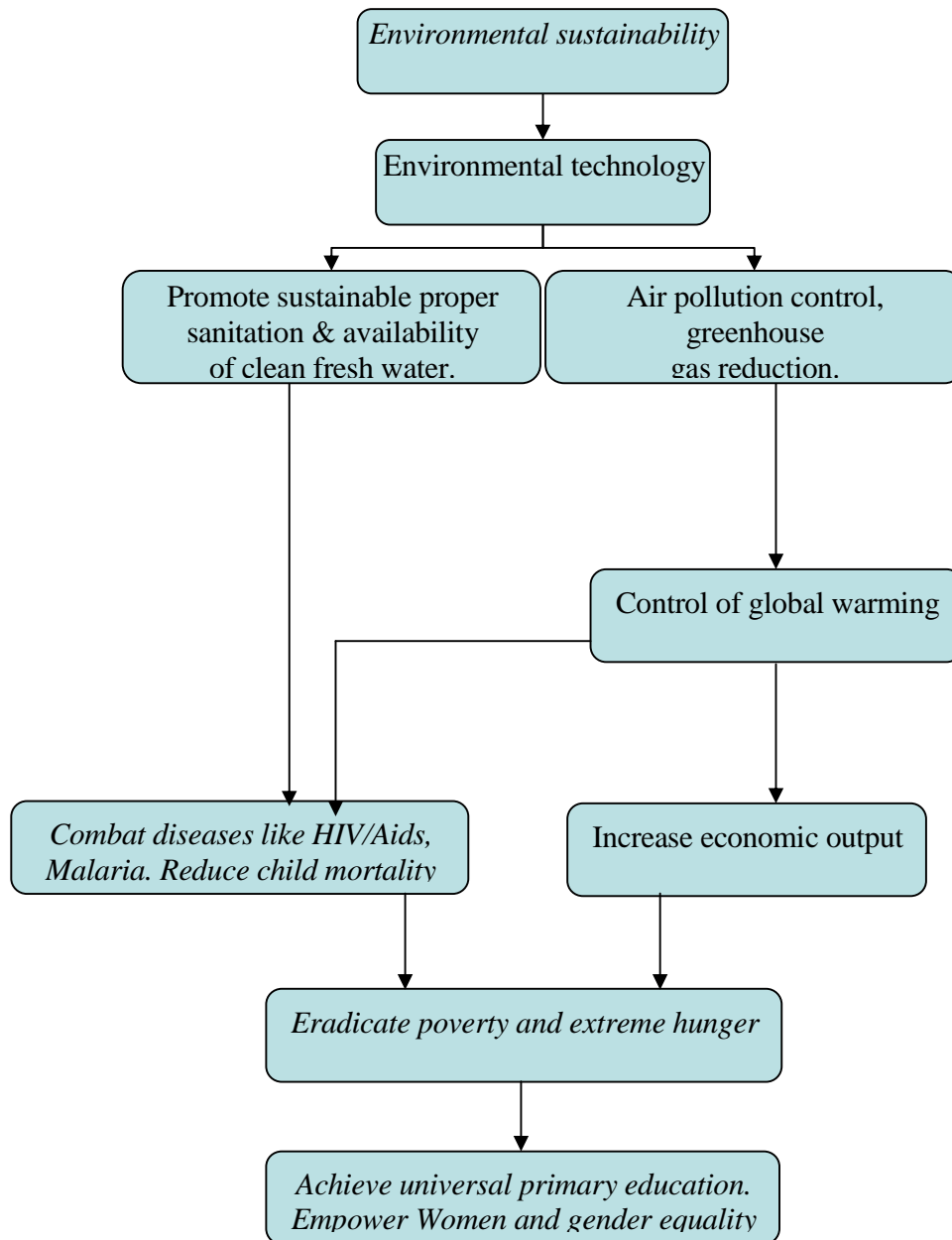


Figure 1. Diagram showing the inter-relationship of environmental technology and Millennium goals, the goals are indicated in italics.

2.1.1 Sanitation in the Development Context

The World Health Organization (WHO) defines sanitation as a group of methods to collect human excreta and urine as well as community waste waters in a hygienic way, where human and community health is not altered. Sanitation methods aim or are supposed to aim at decreasing the spread of diseases by implementing adequate waste water, excreta and other waste treatment methods, proper handling of water and food and by restricting the occurrence of causes of diseases (WHO 1987 San Diego University).

Sanitation is a system that is supposed to increase and maintain healthy life and environment. Its purpose is to assure people of enough clean water for washing and drinking purposes and proper waste disposal. Typically, health and hygiene education is connected to sanitation in order to make people recognize where health problems originate and how to improve sanitation by their actions. Therefore an essential part of sanitation should involve educating the users on building and maintenance of sewerage systems and toilet facilities (Global Dry Toilet Club of Finland 2006).

Basic sanitation was further defined in UN's World Summit on Sustainable Development (WSSD) in 2002 as consisting of (Millennium Project 2003):

- Development and implementation of efficient household sanitation systems.
- Improvement of sanitation in public institutions, especially in schools.
- Promotion of education and outreach focused on children, as agents of behavioural change.
- Promotion of affordable, socially and culturally acceptable technologies and practice.
- Development of innovative financing and partnership mechanisms.

- Integration of sanitation into water resources management strategies in a manner which does not have negative impacts on the environment.

The purpose of setting the MDG's was to provide a blueprint through which states could achieve sustainable development.

Soweto East, the case study in this research, has about 70,000 residents and only 110 toilets which can be considered usable. Sanitation is one of the most prevalent problems in this community. Implementing a sustainable toilet/sanitation technology will go a long way in improving the lives of people in this community and eradicate poverty and its other impacts. The link between sanitation problems and other goals has been researched over the years way before the millennium goals were declared. More so, most sanitation problems have been linked to poverty and economic inequality. Researchers like Johnstone (1997) have evaluated the discrepancies in provision of water and sanitation services between the rich and the poor in urban environments in developing countries. This study has been done to show the depth of the problems that poor people face in trying to attain this basic need.

International organizations were also aware of the strong link between sanitation and poverty before the millennium era, linking poor sanitation to environmental degradation. The most widely held view is that expressed in the Brundtland Report (WCED 1987) which asserts poverty tends to generate various forms of environmental degradation:

“Those who are poor and hungry will often destroy their immediate environment in order to survive: They will cut down forests; their livestock will overgraze grasslands; they will overuse marginal land; and in growing numbers they will crowd into congested cities (WCED 1987 p. 28)”. Poor sanitation practices are already a sign of the creation of an unsustainable environment and therefore implementing sustainable sanitation technologies would reverse the impacts. Sustainable environmental technologies also have great impact on other millennium goals, which are mostly related to social issues.

It is clear that poor sanitation can be seen as a direct result of poverty, and the link between poverty and disease, gender inequality, poor maternal health, lack of education and child mortality is vivid. In Kenya the impact on the poor in terms of health has been well documented. Each year 2.2 million deaths or 4% of all deaths can be directly attributed to inadequate supplies of clean water and sanitation. The poor not only pay 10-100 times as much as the rich for a little of water, but they also use a much higher proportion of their income to obtain these basic services than the rich (Daily Nation Editorial 6th October 2003). The impacts of poor sanitation discussed below further show how implementing sustainable sanitation technology can help in fulfilling the other millennium goals.

When analyzing the term development, one description is agreed upon with consensus - the purpose would be to improve the current situation of people to enable them to have the basic needs for survival. In his book, *Development as freedom*, this is what Sen (1999) has to say, "Development can be seen, it is argued here, as a process of expanding the real freedoms that people enjoy. If freedom is what development advances, then there is a major argument for concentrating on that overarching objective, rather than on some particular means, or some specially chosen list of instruments. Viewing development in terms of expanding substantive freedoms directs attention to the ends that make development important, rather than merely to some of the means that, inter alia, play a prominent part in the processes".

Sen argues that the way to determine if development is taking place is by the freedom that people have, measuring the extent of poverty, tyranny, poor economic opportunities, systematic social deprivation, and neglect of public facilities, intolerance and over activity of repressive states. In view of sanitation, it can be asserted that lack/poor sanitation is associated with poverty. In light of Sen's description of the word development, poverty can be seen as a block to accessibility of human basic needs and the lack of that freedom to access these basic needs is underdevelopment.

The poverty strain and lack of freedom in an urban setting is perhaps felt most by slum dwellers. The notion of slums emerged in the 1820's as part of the London cant. At that time, the term 'slum' was used to identify the poorest quality housing and the most unsanitary conditions. It was considered a refuge for marginal activities including crime, 'vice', drug abuse and the source for many epidemics that ravaged urban areas. This term has evolved greatly since then and has become loose and deprecatory and can vary considerably in different areas. In developing countries however, the term is used to describe aptly the original connotation. These local understandings of what a slum is have not defined clearly their operational definition. For this purpose, the United Nations Expert Group Meeting (EGM) held in Nairobi, 2002 defined a slum as having the following characteristics for that purpose (UN-Habitat Global Report 2003):

- Inadequate access to safe water
- Inadequate access to sanitation and other infrastructure
- Poor structural quality of housing
- Overcrowding
- Insecure residential status.

It is widely known that severe sanitation problems mostly affect the poor, more so because they cannot afford to pay for the services at the prices they are provided. This high discrepancy in equality of service provision is seen more in third world states where the gap between the rich and the poor is very high. Economic inequality merged with other factors like urbanization and overpopulation are some of the causes of the emergence of slums in cities. In this research, the focus is on Soweto East, a village in Kibera slum. The emergence of slums in cities has seen the increase of sanitation and waste management problems and it is bound to continue unless the negative impacts of urbanization are dealt with. The characteristics that are used to define slums already outline the challenges that are involved in provision of sanitation services in these neighbourhoods.

2.2 Sanitation challenges in slums

Over the past fifty years the world has witnessed an unprecedented increase in urban population that has led to the escalation of urban slums worldwide. The rapid rate of urbanisation in developing countries has given rise to the problem of over-urbanisation. This phenomenon is indicative of the fact that the urban population of a nation is too large vis-à-vis the existing infrastructure required to serve the population. The problem of over urbanization is therefore manifested through inadequate infrastructures to serve urban population such as housing, water, roads, electricity etc (Vago1996).

The rapid growth of cities in developing countries has led to emergence of major slums, of which most are in Africa. As a result, a rapidly increasing category of urban dwellers in Africa lives in poverty and resides in overcrowded slums that lack basic essentials to sustain even a modest living. For example, Nairobi exemplifies rapid urbanisation amidst deteriorating economic and health conditions that characterise African cities (APHRC 2002: xiii).

The characteristics defining slums are so inter-linked that they can be viewed as both impacts and source problems. These characteristics pose major operational sanitation challenges in slums. UN Habitats findings from national and local governments have outlined them as follows (UN Habitat 2003 page 11):

- a) Lack of basic services* – involves lack of access to sanitation facilities and safe water sources as a great feature. This is sometimes supplemented by absence of waste collection systems, electricity supply, surfaced roads and footpaths, street lighting and rainwater drainage.
- b) Substandard housing or illegal and inadequate building structures* – slum areas are associated with a high number of substandard housing built with non-permanent materials unsuitable of housing given local climatic conditions, for example, earthen floors, mud and wattle walls or straw roofs.

- c) *Overcrowding and high density* – overcrowding is associated with a low space per person, high occupancy rates, cohabitation by different families and a high number of single-room units. Many slum dwelling units are over crowded, with five and more persons sharing a one-room unit used for cooking, sleeping and living.
- d) *Unhealthy living conditions and hazardous locations* - these are a result of lack of basic services, with visible, open sewers, lack of pathways, uncontrolled dumping of waste, polluted environments, etc. Houses may be built on hazardous locations or land unsuitable for settlement, such as floodplains, in proximity to industrial plants with toxic emissions or waste disposal sites, and on areas subject to landslip. The layout of the settlement may be hazardous because of a lack of access ways and high densities of dilapidated structures.
- e) *Insecure tenure; irregular or informal settlements* – A number of definitions consider lack of security of tenure as a central characteristic of slums, and regard lack of any formal document entitling the occupant to occupy the land or structure as *prima facie* evidence of illegality and slum occupation. Informal or unplanned settlements are often regarded as synonymous with slums. Many definitions emphasize both informality of occupation and the non-compliance of settlements with land-use plans. The main factors contributing to non-compliance are settlements built on land reserved for non-residential purposes, or which are invasions of non-urban land.
- f) *Poverty and social exclusion* – Income or capability poverty is considered, with some exceptions, as a central characteristic of slum areas. It is not seen as an inherent characteristic of slums, but as a cause (and, to a large extent, a consequence) of slum conditions. They are also areas of social exclusion that are often perceived to have high levels of crime and other measures of social dislocation. In some definitions, such areas are associated with certain vulnerable groups of population, such as recent immigrants, internally displaced persons or ethnic minorities.

g) *Minimum settlement size* – many slum definitions also require some minimum settlement size for an area to be considered a slum, so that the slum constitutes a distinct precinct and is not a single dwelling. Example, the municipal slum definition of Kolkata that requires a minimum of 700 square metres to be occupied by huts, or the Indian census definition, which requires at least 300 people or 60 households living in a settlement cluster.

Slum areas vary in their disadvantages in different parts of the world. For some people, the experience of living in a slum would constitute all these dimensions. Many slum areas may show only a few of these negative attributes, while the worst may have them all. In any case, the above characteristics make accessibility to basic needs like sanitation a challenge.

2.2.1 Impacts of lack/poor sanitation

The impacts of poor/lack of proper sanitation are adverse but perhaps the most identified is health. Environmental degradation occurs mostly due to mismanagement; mismanagement of waste disposal systems, both solid and grey waters, overpopulation, poor planning and other human practices. Environmental negative impacts also lead to health impacts and health impacts cause economic problems and vice versa. Many diseases are associated with inadequate water, sanitation and hygiene. In terms of gender, having no proper means for excreta disposal is a great inconvenience to many women and girls who in particular face problems of distance, lack of privacy and personal safety (IRC 1998).

Poor sanitation is also a serious threat to the cleanliness of the environment and the water resources used for the supply of drinking water both surface and groundwater. Groundwater aquifers are recharged from the surface and as they are slow to accumulate, contaminants are also slow to move out. It is highly possible for untreated waste water to leach into soils thus reaching water tables and also polluting soils. The constant bad odour from excreta both from badly ventilated and unclean toilets or open defecation also cause air pollution and increase the risk of disease (WHO 1999).

Lack of proper sanitation has led to high loads of bacteriological contaminants in surface water resources. In India, estimates are that 70 percent of the surface waters are polluted. Water quality monitoring in China showed that 54 of the 78 major rivers are seriously polluted by human and industrial waste (UN 1990b). In Nepal, the Kathmandu Valley is known for having one of the worst sanitation conditions of the continent (IRC 1998). Figure 2 below illustrates some impacts of poor/lack of proper sanitation.

The World Health Organisation (WHO) has noted that when infrastructure and services are lacking, urban areas are among the world's most life-threatening human environments (WHO 1999). WHO has further noted that at any one time, close to half of the urban population in Africa, Asia and Latin America are suffering from one or more of the main diseases associated with inadequate water and sanitation provision. A high number of these are slum dwellers.

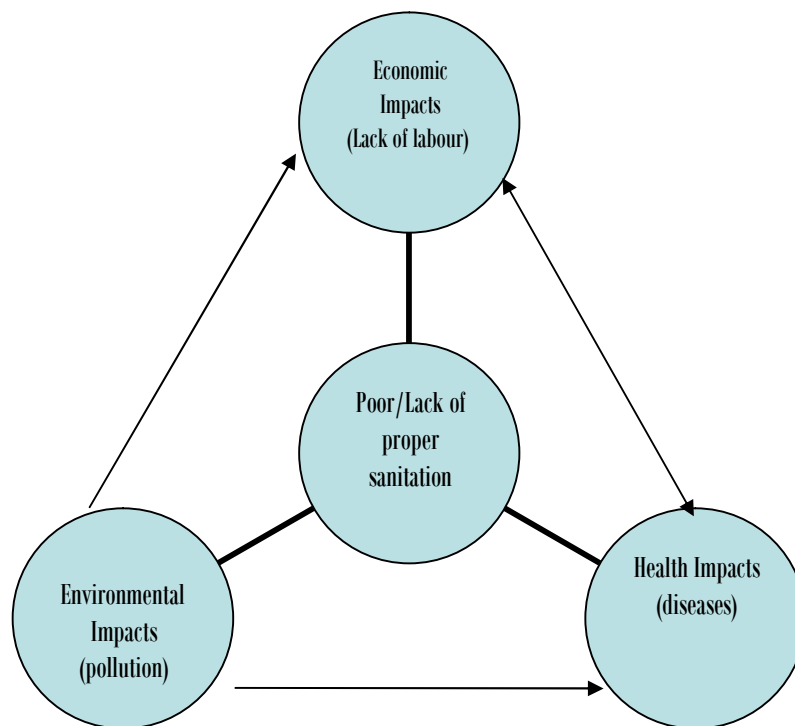


Figure 2. Diagram showing some impacts of poor/lack of proper sanitation.

These diseases are associated primarily with poor water quality while others are more associated with the inadequate quantity of water available to households, or with inadequate hygiene or unhygienic food preparation practices; others are associated with inadequate provision for excreta disposal or wastewater disposal or drainage, which is our main concern in this thesis research. Many case studies in low-income settlements show that a high proportion of the population in those areas have debilitating intestinal worm burdens (Bradley et al. 1991, Mahfouz et al. 1997). As more people get sick, the less they are able to be productive. The table below indicates examples of water and sanitation related diseases and the aspects of inadequacy linked to them.

Table 1. Examples of water and sanitation related diseases and the aspects of inadequacy that are linked to them (WHO 1983).

Disease	Strength Of the link					
	Water Quality	Water Quantity Or convenience	Personal & Domestic Hygiene	Wastewater disposal or drainage	Excreta disposal	Food Sanitation/ hygiene
Diarrhoea						
Viral diarrhoea	Medium	High	High	-	Medium	Medium
Bacterial diarrhoea	Medium	High	High	-	Medium	Medium
Protozoal diarrhoea	Low	High	High	-	Medium	Medium
Poliomyelitis & Hepatitis A	Low	High	High	-	Medium	Medium
Worm Infections						
Ascaris, trichuris	Low	Low	Low	Low	High	Medium

Hookworm	Low	Low	Low	-	High	-
Pinworm, dwarf tapeworm	-	High	High	-	Medium	Low
Other tapeworms	-	Low	Low	-	High	High
Schistosomiasis	Low	Low	-	Low	High	-
Guinea worm	High	High	-	-	Medium	-
Other worms with aquatic hosts	High	-	Medium	Medium	Medium	High
Skin infections	-	High	-	-	-	-
Eye infections	Low	High	Low	Low	Medium+	-
Insect transmitted						
Malaria	-	-		Low	-	-
Urban yellow fever, dengue	-	-	Low*	Medium	-	-
Bancroftian filariasis	-	-		High	High	-
Onchocerciasis	-	-		-	-	-

* Vectors breed in water-storage containers, + Flies which transmit infection breed in scattered human faeces

2.3 Existing toilet technologies

Toilet technologies have been generally classified into two systems, wet and dry. In more developed states, wet systems are the most prevalent and are normally attached to central sewer systems where all the liquid waste, this is, grey water from bathrooms and kitchen and sewage waste from toilets is directed to a central treatment plant. This system requires high technology and good land planning and good governance, three aspects that lack in third world states.

Furthermore, more developed states have toilets in their houses which are normally flush toilets, thus wet systems. This technology requires a good provision and network of water. In less developed countries however, less sophisticated technologies have to be put in place. In most urban settings, like Nairobi, the city council has attached this kind of central system, but as stated earlier, this method requires proper structural planning (Hewett & Montgomery 2002).

In the suburbs however, where individuals live in personal houses and not flats, they have to employ private vendors to empty sewage waste from their septic tanks or pit latrines. The situation gets worse as one goes lower on the social ladder which can be seen in the sewage waste problems in slums. Developed sanitation services are defined in WHO's and UNICEF's Joint Monitoring Program (JMP) 'Global water supply and sanitation assessment 2000' as the methods below (Millennium Project 2003):

- Public sewer
- Pit latrine with slab
- Septic tank
- Ventilated improved pit latrine
- Pour-flush latrine
- Ecological sanitation

Figures 3 and 4 show the various technologies mentioned that are recommended and considered suitable. They are classified into two groups; dry on-plot systems and wet systems (South African Government 2002). The dry on-plot systems do not require water for operation and the wet systems require water for operation.

The implementation costs for different sanitation technologies vary widely depending on the area, availability of materials and technology. Normally, construction costs are less in rural areas because simple solutions can be applied instead of sewerage and water treatment systems. Location of latrines, which are the most common in third world states, is very important in terms of usage, for example, human influence in the region, amount of users, population centralization and population growth areas, geomorphology of the area, ground factors, how deep is the surface of ground water, how deep is bedrock, are there wells and/or surface water

sources nearby, quality and distance to existing sanitation facilities, other defecation sites, refuse tips for solid wastes, places for disposal and how latrine water is utilized. With each technology however, it is important to educate the users on maintenance and use. (Global Dry Toilet Club of Finland 2006).

a) Dry on-plot systems

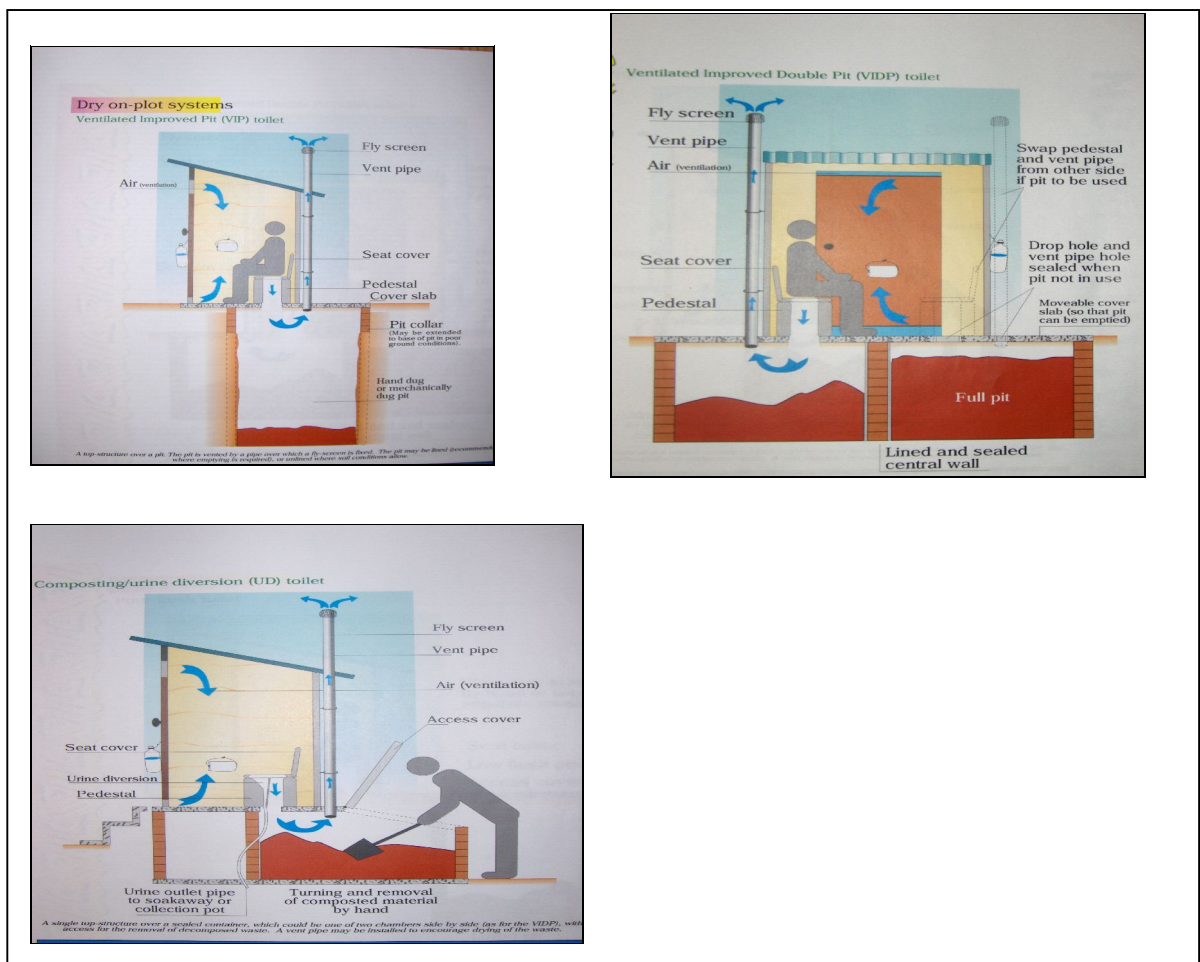


Figure 3. Diagrams showing Ventilated improved pit latrine, Ventilated improved double pit latrine and Composting/urine diversion (UD) toilet from left to right.

b) Wet Systems

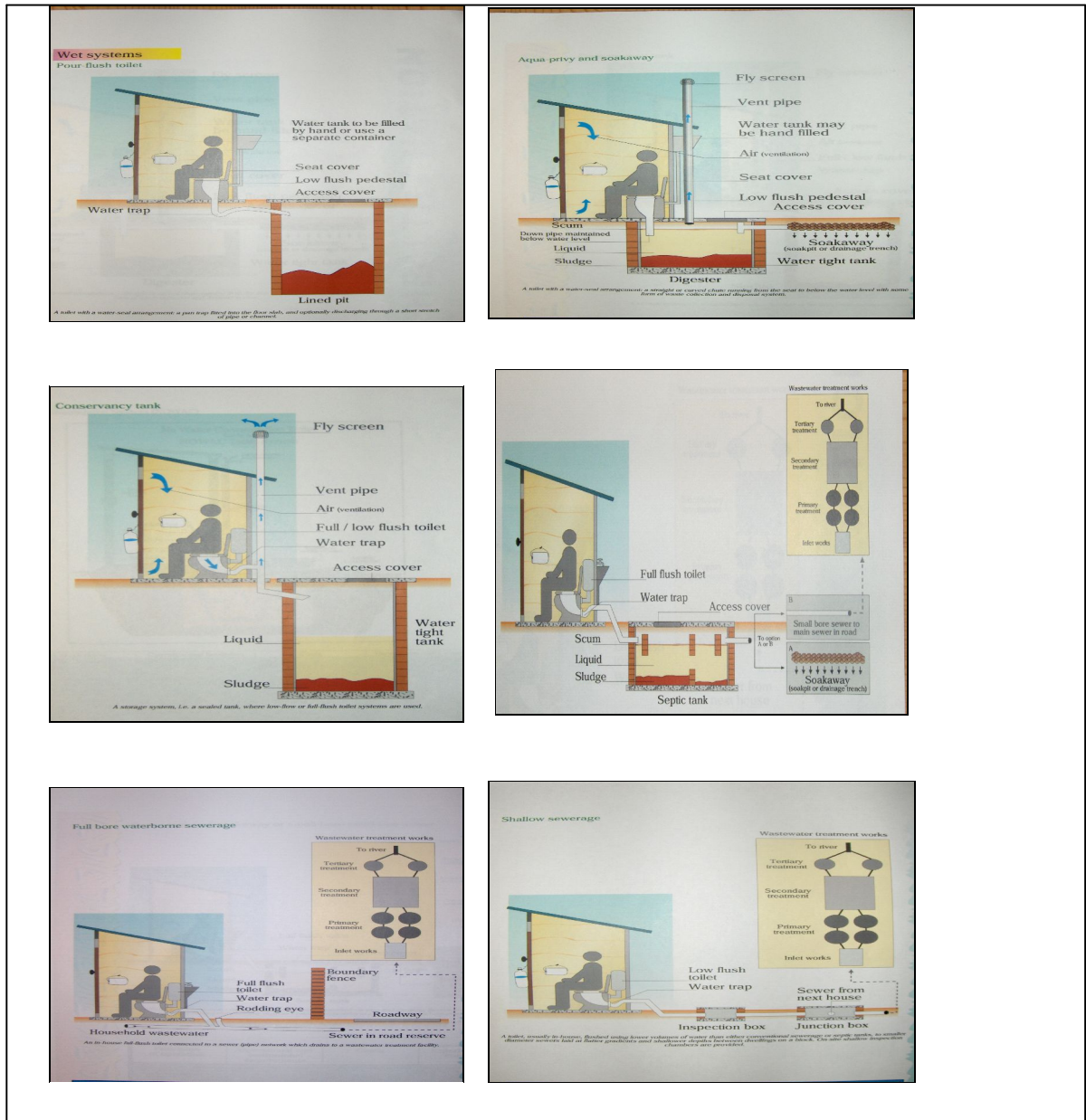


Figure 4. Diagrams illustrating wet systems, from left to right pour-flush toilets, aqua-privy and soak away, conservancy tank, septic tank and soakaway or small bore solid-free and shallow sewerage toilet.

2.3.1 Sanitation in developing countries: implementation guide.

The factors that determine the type of toilet technology vary greatly in different regions due to influencing factors like the economic stability or ability of a community, topography, demography, climate, soil types and technology know how. There is also the aspect of suitability in terms of life-span, for example, is the solution supposed to be immediate (emergency solutions as seen in cases of natural disasters and wars), short-term solutions or long-term solutions. In this case, the solution required is long-term. There are some key guidelines that experts and field workers need to use as blueprints before implementing any toilet technology; technical, environmental, institutional and community. They are described in more detail in the table below.

Table 2. Guidelines for implementing toilet technologies (Franceys et al. 1992)

Factors of general relevance	Factors specifically relevant to Operation & Maintenance
1. Technical factors	
<ul style="list-style-type: none"> - Design preference (substructure, floor slab, squatting or raised seat, superstructure) - Technical standards and expected lifetime of the technology - Availability of construction materials - Cost of construction 	<ul style="list-style-type: none"> - O&M requirements - ease of access - use of decomposed waste - Pit-emptying technique.
2. Environmental factors	
<ul style="list-style-type: none"> - Soil texture, stability, permeability - Groundwater level contamination - Control of environmental pollution 	<ul style="list-style-type: none"> - O&M implications for environmental protection - protection against groundwater - protection from flooding

<ul style="list-style-type: none"> - Availability of water - Possibility of flooding 	
3. Institutional factors	
<ul style="list-style-type: none"> - Existing national/local strategies - Roles and responsibilities of actors implied - Training capacity - Availability of subsidies and loans - Availability of masons, carpenters, plumbers, sanitary workers, pit-emptiers and pit-diggers 	<ul style="list-style-type: none"> - pit-emptying services (municipal/private) - sewerage maintenance capacity - potential involvement of the private sector - national budget allocations for sanitation - training and awareness education - monitoring
4. Community factors	
<ul style="list-style-type: none"> - Sociocultural aspects: taboos, traditional habits, religious rules and regulations, cleansing material, preferred posture, attitude to human faeces, gender-specific requirements; - Motivational aspects: convenience, comfort, accessibility, privacy, status and prestige, health, - Discouraging factors: darkness, fear of falling in the hole, or of the pit collapsing, or of being seen from outside, smells; insect nuisance; - Social organization factors: role of traditional leadership, religious leaders, schoolteachers, community-based health workers - Other factors: population densities, limited space for latrines, presence of communal latrines. 	<ul style="list-style-type: none"> - O&M costs; - O&M training and awareness for sanitation - health awareness and perception of benefits - presence of environmental sanitation committee - women's groups - social mobilization on hygiene and sanitation - environmental cleanliness, ownership; behaviour.

O& M = Operation and Maintenance

2.4 Study Area, Social and Economic Status

2.4.1 Study Area

The study was done in Nairobi which has an estimated 1.5 million people living in informal settlements, roughly 60% of the city's official census population of 2.5 million. These 1.5 million people are confined to an area of less than 5% of total municipal residential land. The emergence and spread of urban slums like Kibera is an outcome of diverse factors that include segregation policies in the colonial era, a post-independence policy of slum clearance, a sluggish growth in the economy of Nairobi, lack of land policies to enhance equitable distribution of land as well as unsuitable urban development policies. (UN Habitat Project Report 2007).

Kibera is one of the biggest slums in Africa housing approximately 700,000 people and with a constant rise in poverty levels. It is situated 7 km Southwest of Nairobi with current dimensions of 3.5 km west to east and 1.5 km north to south and an area of approximately 250 ha. It has been calculated that the inhabitant density is more than 2000 people/ha. It is comprised of 10 villages: Lindi, Soweto East, Makina, Kianda, Mashimoni, Gatuikira, Kisumu Ndogo, Laini Saba and Siranga.

Soweto East is the area chosen to be UN Habitat's pilot project in the slum upgrading programme which is under the Water for African Cities Programme. The first phase of this programme was concluded in 2002 and the second phase (WACII) of the programme has been launched. It is estimated that there are about 110 toilets and 50 bathrooms serving the population in Soweto East. The conditions of these facilities range from acceptable to very bad with most of them lying on the latter. Figure 5 below shows the study area, the paths, rivers and drainages and Figure 6 shows the area allocated for the construction of the 15 VIP toilets.

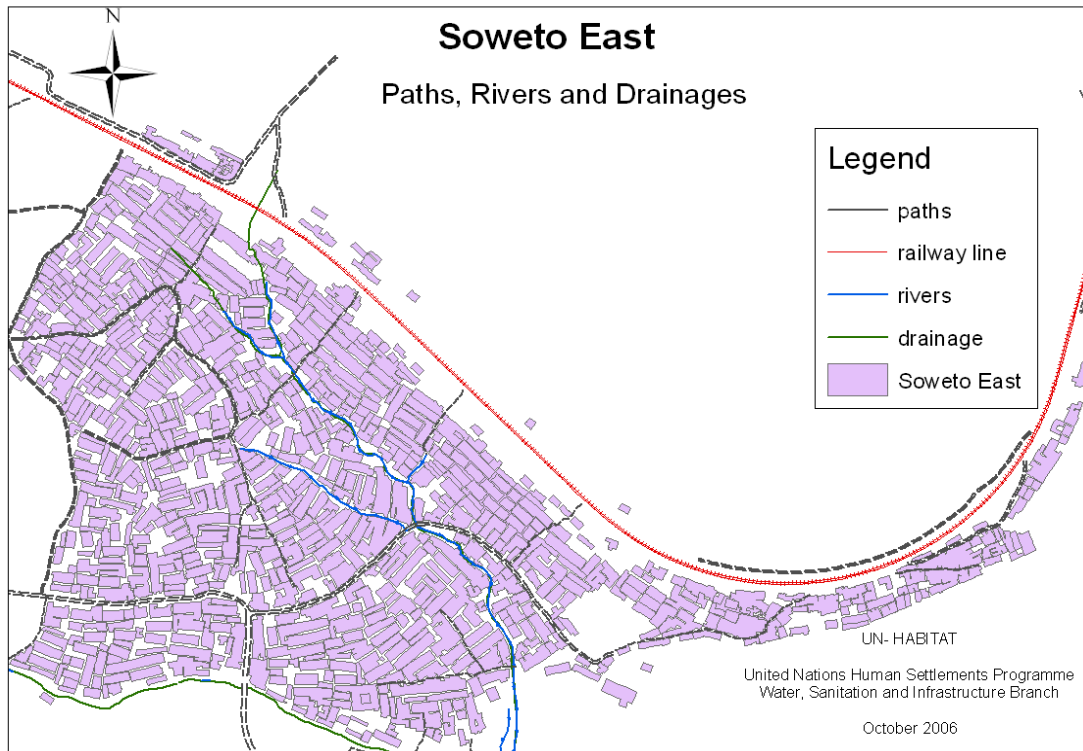


Figure 5. Physical map of Soweto East (UN Habitat 2006).

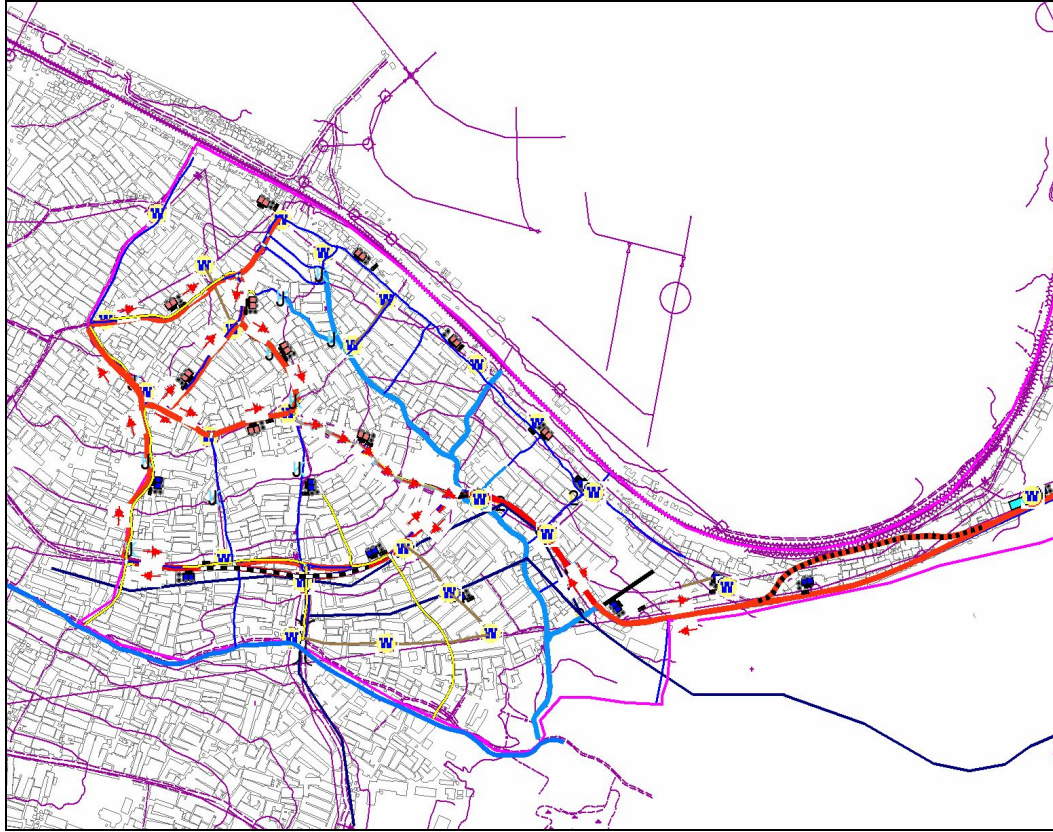







Figure 6. Detailed engineering map of Soweto East, Kibera (UN Habitat 2006).

LEGEND

- Road 
- Drains 
- Toilet 
- Waste 
- Site office 

The community suffers from poor waste disposal systems, drainage and water supply systems; more so because of ignorance, lack of space, over-population, poverty and poor governance. The photos in Figure 7 below show a demonstration of these problems.



a) Solid waste disposal.



b) Water supply pipes



c) Drainage system



d) Site allocated for VIP construction.

Figure 7. Photos taken in Soweto East during data collection, 2007.

2.4.2 Social and Economic status of the residents.

Prior to the slum upgrading project, UN Habitat and the Government of Kenya did a social and economic survey so as to map out the socio-economic activities and lifestyles of those working and living in Kibera. The results of this survey further clarified the key areas that KENSUP needed to focus on in upgrading the slum. The social and economic findings are summarized below.

a) Social Aspects of the Households

Overall, this study reports data on 8,400 household members – obtained from the 2,400 respondents interviewed in Kibera. The following are the highlights of the basic attributes of the 2,400 respondents:

- 54% were male while 46% were female.
- Of the 2,400 respondents, majority (73%) of the sample were married.
- 60% were Protestants, 33% were Catholics and 6% were Muslims.
- Around half (52%) of the sample was less than 24 years old; the bulk of this population is likely to be of primary and secondary school students.
- 17% of the household members had no formal education; 45% had completed primary education while only
- 20% had attained secondary level of education.

With such low levels of education, majority of the slum dwellers cannot access the competitive jobs in the formal (modern) sector.

Data on length of residence in Kibera confirm that the majority of the respondents had lived in Kibera for a reasonable period of time and hence treated Kibera as their permanent residence. Around a third of the 2,400 respondents covered had lived in Kibera for over 10 years while another 25% had lived in Kibera between 7 and 10 years.

Even though there are many different types of social groups in Kibera, findings of the study show that group membership does not generate appreciable benefits to the members. Around 50% of both men and women who were members of groups reported that they derived very little benefits from their groups. Not all members of Kibera are members of groups – indeed, 42% of the respondents were not members of any group.

The findings also revealed that an overwhelming majority (91%) of the sample confirmed that they considered themselves as members of Kibera community. “Living in Kibera” and “being born in Kibera” were cited as two major criteria for defining membership to Kibera community.

As expected, a majority (80%) reported that they lived in Kibera not by their choice. Majority cited the main reason to be cheap rent. This finding suggests that with minimal persuasion and modest offer, most residents could be willing to take up other housing options. Affordability of rent was also found to be a critical determinant of housing options taken by urban residents; a factor that should be addressed while undertaking the slum upgrading project.

Kibera slum is endowed with a range of facilities and amenities such as schools, health facilities, government offices, water points, shops, roads, telephones etc. The study revealed that while such infrastructures are available, many of them are not adequate while others are not even accessible to the residents.

Despite the high demand of the basic infrastructures, some are still under utilized due to the existence of social and economic costs. Most of them were also reported to be in poor conditions.

b) Economic Aspects of the Households

The socio-economic mapping exercise collected income-related data to capture, inter alia, the socio-economic status of those living and working in Kibera as well as their occupational profile. The following are highlights of findings related to these themes:

i) Monthly Income Levels

Of the 8,400 household members covered, about 44% were found to have a regular monthly income; 47% did not report having regular monthly income. The monthly income reported in

Kibera ranged from Ksh. 2,000 to Ksh. 42,000. Of the 3,653 valid cases, about a third (33%) earned less than Ksh. 5,000 per month; these could be the category of urban slum dwellers that live in absolute poverty.

Nearly half (47%) of those with regular monthly income earned between Ksh. 5,000 and Ksh. 9,999 while 13% earned between Ksh. 10,000 and Ksh. 14,999. Only about 8% earned more than Ksh. 15,000. The findings on income levels help to expose explicitly, the limited economic potential of Kibera people as well as underscoring the need to initiate new endeavours to create new opportunities for those who are currently dislocated economically.

The findings show that on the basis of the monthly income reported, there are three distinct categories of people living in Kibera viz.

- (a) The very poor earning less than Ksh. 5,000;
- (b) The medium poor who earn between Ksh. 5,001 and Ksh. 10,000 and
- (c) The relatively better off who earn over Ksh. 10,000.

The first two categories comprise of nearly 80% of the regular income earners covered in Kibera. The proposed up-grading initiative should attend to these facts and cater for the needs of each income group. Findings suggest that a general housing package for all the residents could exclude some groups – unless it is based on the potentiality of the poorest category.

ii) Expenditure Patterns

This study found that the leading expenditure items for households covered in Kibera are as follows; starting from the highest to the lowest: food, housing, health, clothing, and education.

Food comprises the highest expenditure item among the sample covered with 85% of households spending over Ksh. 2,000 monthly on food. The mean food expenditure stood at Ksh. 3,000 per month per household.

41% of the households covered allocate less than Ksh. 400 per month on health and only 8% allocate more than Ksh. 1,200 on health monthly.

Data shows that the majority of the households spend less than Ksh 400 monthly on clothing; only 8% spend more than Ksh. 1,200 on clothing monthly.

Last, the expenditure on education is relatively low as compared to food, health and clothing. Of the households that spend money on education, 29% spent less than Ksh. 800 monthly on this item. The introduction of the Free Primary Education (FPE) since 2003 could probably explain the lower ranking of expenditure on education.

iii) Income Expenditure on Rent

Nearly three quarters (74%) of the sample spent between Ksh. 500 and Ksh. 1,000 monthly on rent. Only a small proportion spent over Ksh. 1,000 monthly on rent.

The mean monthly rent was Ksh. 800 for the sample. This finding suggests that the up-grading initiative should target to recover just around Ksh. 1,000 monthly on rent from the residents. Given their current rent affordable, any attempts to recover more than Ksh. 1,000 monthly after the up grading initiative, is likely to be rejected by the residents.

iv) Ownership of Household Assets

Data on ownership of household assets show that probably due the prevailing poverty, majority of the households covered does not own durable assets but only own consumer assets like kitchenware.

88% owned household furniture such as chairs, stools and tables; but only 3% owned beds (probably due to the limited space).

Surprisingly, nearly half of the households (47%) owned cassette player; 51% owned radios; 35% had TVs and 29% had mobile phones. These data suggest that despite the widespread poverty, Kibera residents give high priority to entertainment – an issue that should be addressed by the up-grading initiative.

v) Nutritional Status of the Households

Data on nutritional status measured by sufficiency of food supplies show that quite a large percentage of the sample (41%) did not access adequate (quantity and quality) food on a daily basis. As a coping mechanism, many of these households (47%) skipped meals; this entailed taking only one meal in a day. Indeed, the frequency of missing meals in Kibera was found to be high; this phenomenon is explained by the limited income potential.

vi) Household Health Status

Malaria is the leading health problem (cited by 69%) followed by HIV/AIDS (cited by 31%). It was explained that poor sanitation in Kibera offered suitable breeding environment for the mosquitoes.

The other common diseases cited include typhoid, TB, respiratory track infection and diarrhoea. The frequency of illness in Kibera appears to vary with age and gender. For example, 31% of women and 21% of men in the sample cited extreme frequency of illness in Kibera. Further, children below 12 years were reported to fall sick more frequently than adults.

vii) Access to Health Care Facilities

Public clinics were the most popular health care facilities reported by 37% of the sample followed by private clinics cited by 24%. Of course, poor patients (like those of Kibera) would only visit private clinics where they are charged relatively higher in a situation where the cheaper public facilities are not easily accessible (e.g., due to distance) or are unreliable.

Overall, less than 30% of the respondents covered were visiting public health facilities when they fell sick (RI 2006).

3 OBJECTIVES

It is generally assumed that VIP latrines are the socially accepted option due to their environmental and economic viability as there is limited space and low economic status of residents in Soweto East. Can this hypothesis be approved or disapproved? What of other

toilet technologies like eco-sanitation, bio-latrines or flush toilets; and how can we determine the most feasible toilet technology? The highest measure is of course sustainability, in all dimensions, beginning with satisfying the needs of the community.

The aim of the research was to do a feasibility test on the most appropriate toilet technology that could be used to improve/upgrade sanitation in Soweto East, Kibera. The measure of determining how appropriate the technology is was based on its environmental, economical, social and technological sustainability. The collection of data in the field through questionnaires was to determine the sanitation needs of the community. Data collection also aided in highlighting the economic, social and educational status of community members and its relation to sanitation.

4 MATERIALS AND METHODS

4.1 Research methodology: Questionnaires

To attain information in this research, three methods were used. The questionnaires were however the main focus. Other information was obtained from books, journals and UN Habitat's data and reports on the slum upgrading project in Kibera. Further information was obtained from internet based articles and reports mostly on sanitation in slums.

The questionnaires played the most vital role in the research as they involved participatory work from the community members. There were 27 questions in total. The questions were formulated in English. Since most community members are not English literate, they were asked the questions in Kiswahili, the 2nd National language in Kenya, which most people understand. Some participants however understood English very well and wrote down the answers themselves. The questionnaires were made with the intent of allowing community members to state their views on the kind of toilet sanitation they would like by stating their expectations in what they would consider a proper toilet. It also helped to determine factors which contribute negatively to the practice of poor sanitation in the community. Moreover there was great interest in finding out the level of community commitment and factors which influence this in

implementing and maintaining sanitation facilities and their knowledge on proper sanitation practices.

This was achieved by asking participants to state health problems they think are caused by poor sanitation, why they are unable to improve sanitation in their community and whether they would be willing to pay for sanitation services and how much; and their willingness to participate in improving sanitation standards in their community. In total, 200 structured questionnaires were distributed within Soweto East. Prior to this research, Soweto East had been divided into four zones by the Kenya Bureau of Statistics, A, B, C, and D. This proved very handy as it enabled us to divide the questionnaires equally among the four zones. Data analysis was done using SPSS.

4.2 Issues studied with the questionnaire

In the data analysis, focus was on various issues that were discussed in the questionnaire.

- a) What do the community members define to be a toilet facility?
- b) How does the distance of their current toilet facility affect them?
- c) What problems do the community members think are being caused by poor sanitation in their community?
- d) What do community members expect of a toilet facility and its location?
- e) How does income availability affect the willingness of people to pay for toilet facilities?
- f) The measure of community commitment defined by:
 - Willingness to relocate (relocation)
 - Participation in sanitation campaigns (campaign)

- Responsibility in maintaining toilet facilities (maintenance)

g) Reasons why community members are unable to emulate existing toilet projects that have been put up in their community by other organizations.

In identifying the answers to the above queries and alongside written literature, it was possible to determine what toilet technology would be most feasible in the community. Other factors that were put into consideration when analyzing the toilet technologies were sustainability in terms of water use and excreta, environmental cost and economic cost.

5 RESULTS

5.1 General findings

All 200 questionnaires that were distributed were answered. Most community members were very willing to answer our questionnaire, and some did so without our help. They portrayed a great interest in discussing the goal of the research after data collection. Working alongside the Soweto Executive Committee (SEC) members did well to break down any hostility or barriers that would have been faced. For those who did not understand English, questions were translated into Kiswahili. One group distributing questionnaires in zone A, later realized that they had misinterpreted question 7. This in part affected the answers obtained in that question and thus the data. Questionnaire distribution was done well to contain both genders (Table 3). This ensured equal participation and ideas from both men and women. 2.0% of participants did not indicate their gender; however, there were 48.5% females and 49.5% males.

Table 3. Indicating gender participation in the questionnaire

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid female	97	48.5	48.5	48.5
male	99	49.5	49.5	98.0
missing	4	2.0	2.0	100.0
Total	200	100.0	100.0	

During the research it was discovered that most community members regarded children as the most vulnerable in regard to poor sanitation and its impacts. Below is a graph indicating the answers obtained from women, men and the 2.0% who did not state their gender on the question of vulnerability. 80 respondents chose children with females being on the lead in choosing that answer, this is not unusual as women spend the most time with children. Next in line with the highest frequency was ‘everyone’, but with a wide gap of 51% from the favourite answer-children. Below in Figure 8 is an illustration indicating answers obtained in dependence to gender.

It was also discovered that about 74.6% of community members were actually employed or were running a business of some sort, and 7.8% were students. However, even with the high percentage of people earning an income 17.6% of the population has no income generation. In the results, it will be determined how these facts affect community willingness to pay for sanitation services. This is illustrated in Table 4.

Table 4. An illustration on the occupations of the interviewed community members.

Occupations

		Frequency	Percent %	Valid Percent %	Cumulative Percent %
Valid	unemployed	34	17.0	17.6	17.6
	students	15	7.5	7.8	25.4
	businessman/woman	98	49.0	50.8	76.2
	employed	46	23.0	23.8	100.0
	Total	193	96.5	100.0	
Missing		7	3.5		
Total		200	100.0		

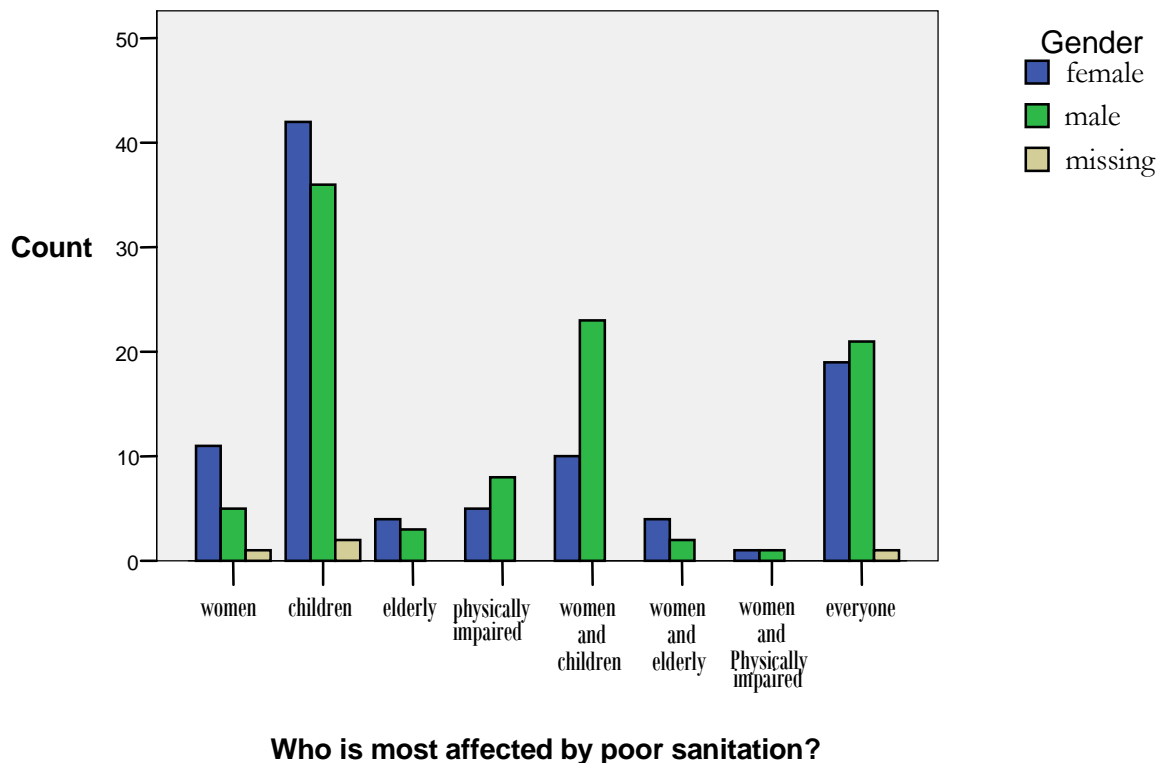


Figure 8. Answers obtained on the most vulnerable group in dependence to gender.

5.2 Definition of a toilet

This question, ‘In your view what is a toilet?’ was aimed at analyzing community conception of what a toilet facility is. How the community views sanitation affects greatly its willingness to improve sanitation in homes and around the environment. More so, it helps to determine whether they consider the facility a necessity or a luxury.

From the frequency table, 78% of the people deemed it as a place to relieve oneself and only 7.5% directly pin pointed it as a basic need. The questionnaire did not have structured responses

that participants could choose from; however, through the researcher’s interpretation, the community views a toilet as a need-whether basic or not- as it is needed for pure human existence, i.e. biological reasons.

Table 5. Frequency table illustration of community definition of a toilet.

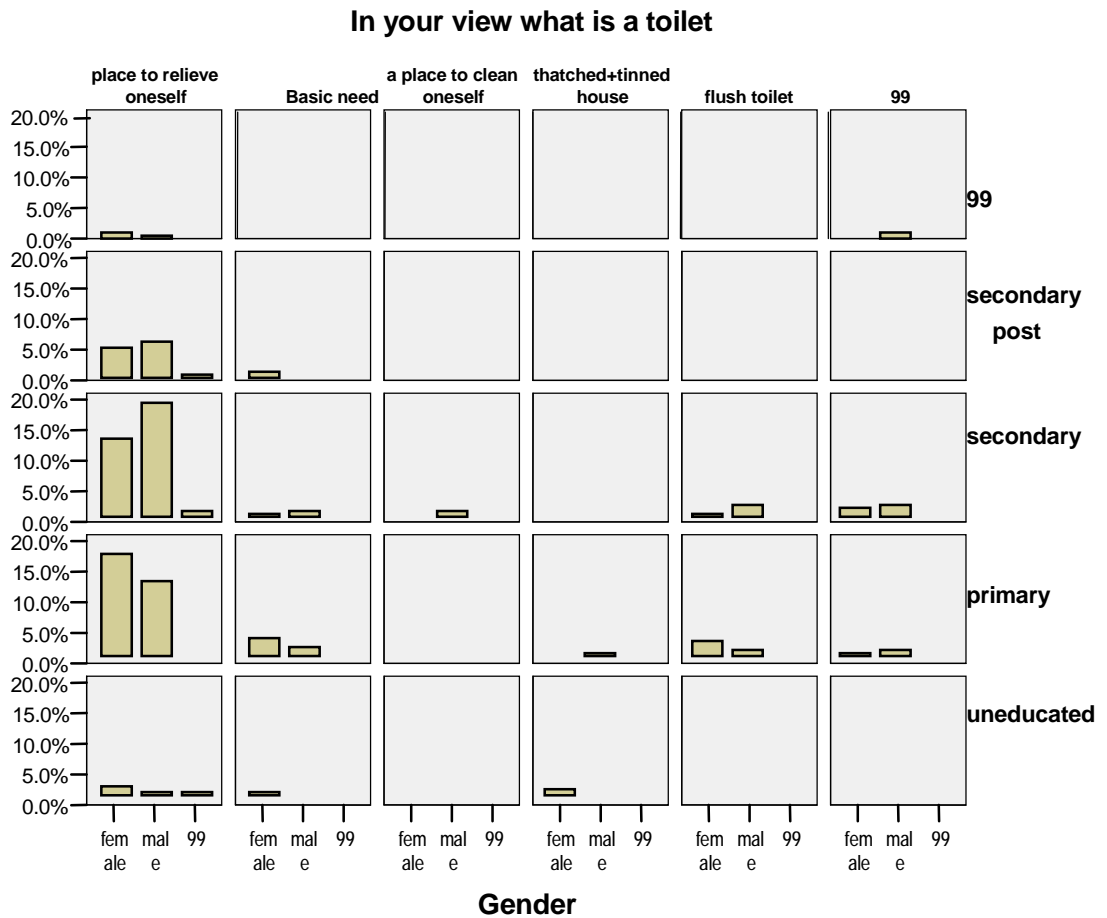
‘In your view what is a toilet?’

	Frequency	Percent %	Valid Percent %	Cumulative Percent %
Valid place to relieve oneself	156	78.0	78.0	78.0
it is a basic need	15	7.5	7.5	85.5
a place to clean oneself	2	1.0	1.0	86.5
Thatched or tinned house	3	1.5	1.5	88.0
flush toilet	12	6.0	6.0	94.0
missing	12	6.0	6.0	100.0
Total	200	100.0	100.0	

Figure 9 shows the answers obtained in dependence to gender and level of education. The highest percentages were all obtained from the answer, ‘It is a place to relieve oneself’ regardless of the level of education. Uneducated people were 4%, primary education 39.5%, Secondary education 41.5% and post secondary 12.5%. There was 2.5%, recorded as number 99 on the y axis, who did not state their level of education but indicated their answers on the question, increasing the percentage of the people who termed a toilet as a place to relieve oneself. Gender did not have much effect on answers obtained either. Both males and females recorded high percentages in answering the same question.

It could then be said that the lack or availability of a toilet affects the community members regardless of sex or education, and all members identify sanitation to be a need. This shows that the community members are well aware of the necessity of having proper sanitation regardless of whether they have been to school or not. In regard to the research objective, it can be stated that the toilet technology to be put in place in this community will be chosen on other factors

like community know how in maintenance and use and where these two are not familiar to community members, the technology should be simple enough so much that members are educated and are able to grasp concepts.



X axis = Gender and toilet definition, Y axis = Percentage and Level of education

Uneducated n=8, Primary education n=79, Secondary education n= 83, Post secondary n= 25, Missing (99) n= 5

Figure 9. Percentile values showing the relation between genders, education level against responses obtained on the definition of a toilet.

5.3 Impacts of distance from toilets: social, environmental

The distance from a toilet facility can have both negative and positive effects on the users. During the research, participants were asked how far or near their current toilet facilities were from them and the impacts they thought were caused by the distance. They pointed out some environmental impacts which they attributed to the proximity. Figure 10 shows the responses.

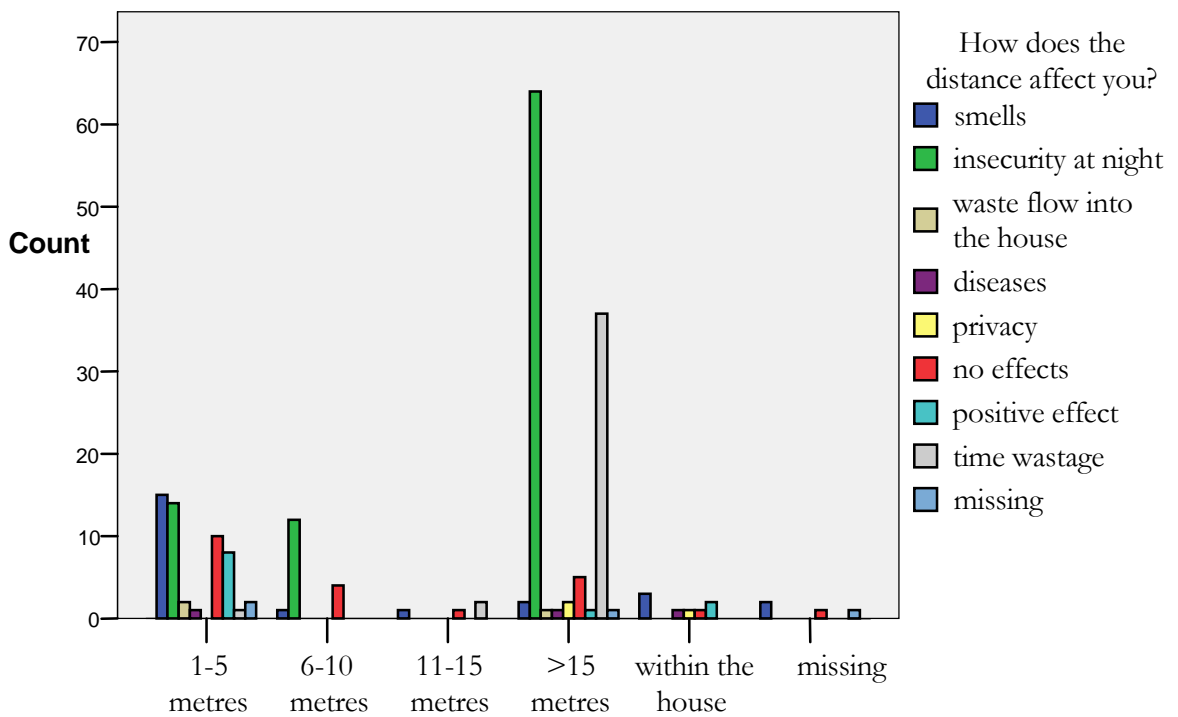


Figure 10. Graph showing the impacts caused by distance from toilet facilities.

The graph above contains some interesting points. For people whose toilets are more than 15 metres, insecurity is a great concern and time wastage is close behind as the next negative

impact. Very few people have toilet facilities less than 15 metres away. The most interesting aspect is that even those with toilet facilities close by (>1<15 metres) still consider insecurity at night as a big hindrance to using toilet facilities. Those within a 1-5 metre range complained of bad odour from the toilet facility.

5.4 Problems caused by poor sanitation in the community

It has been affirmed that the community is well aware of the importance of having a toilet. In the questionnaire, participants were asked what they thought were the most pressing problems being caused by poor sanitation. Part of the research group misinterpreted this question and therefore the results may be affected. Due to this problem, 93.5% of the answers were recorded as valid and the other 6.5% were recorded as invalid. 60% of the respondents identified diseases (variable 1), pest infestation (variable 2), physical danger (variable 3) and bad odour (variable 4) as the impacts of poor sanitation.

These four variables accommodated the other varying responses that were given by the other 33.5% such as, flow of toilet waste into homes during rainy seasons causing diarrhoea, cholera and other diseases (variable 1), toilet inaccessibility for children due to poor structures which may cause accidents (variable 3), poor toilet aeration causing odour (variable 4), mismanagement, for example, lack of toilet waste disposal when full, flying toilets due to lack of toilets or toilets in poor condition (variable 1 and 4) and improper waste disposal causing pest infestation (variable 2). When choosing a toilet technology, these four factors will need to be put into consideration.

Males and females mentioned diseases and physical danger consistently in all education level groups. There was little difference in the male and female responses. The highest percentage of respondents fell under either primary or secondary education level. Under this two, females in the primary section recorded high percentages in naming diseases, physical danger and pest infestation as the most problems, while those under secondary education level recorded high

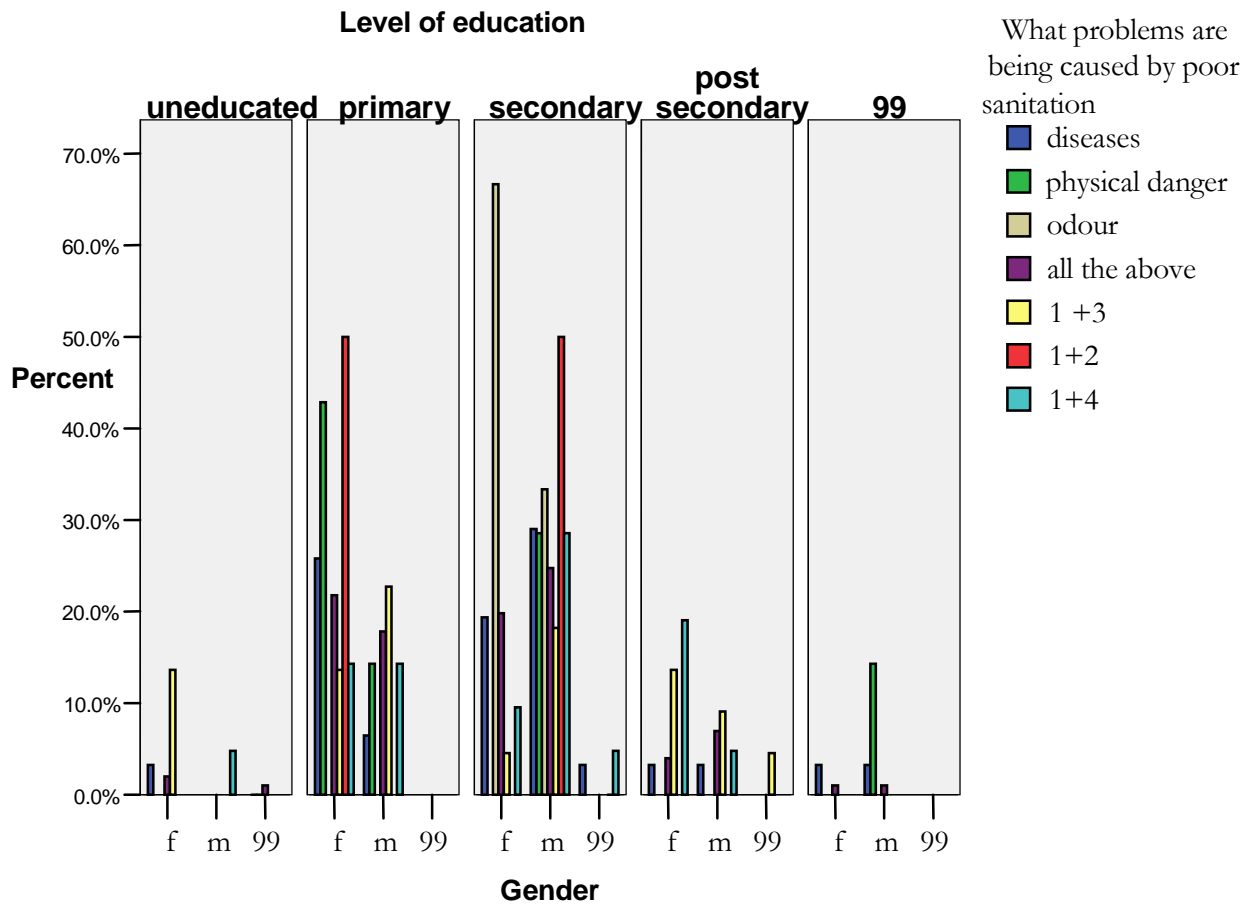
percentage in naming odour. It is difficult however to tell as to whether the varying education levels had impact on this answers.

However, education level may have had effect on responses obtained overall. Respondents who were in the primary, secondary and post secondary education levels identified more sanitation problems than those who were uneducated. Those in the post-secondary level named all the mentioned problems as vital and selected the option 'all of the above'. It could be that the more educated they are, the more the community members are able to identify sanitation problems in their community and the impacts. A visual illustration is shown in Figure 11 in form of a graph.

5.5 Community expectations on toilet sanitation

Members of the community were then asked to identify those things that they would like or expect in what they consider a proper toilet. By stating their expectations they indirectly give solutions to the problems in chapter 5.4. Figure 12 illustrates answers obtained on community expectations on the type of toilet they would like. Both males and females recorded high percentages in the same answer by choosing all options, this is, water, properly constructed, aerated, bathroom availability, accessibility, low costing and security; as important in a toilet facility. Respondents who thought all these factors were important chose the option 'all the above' on the questionnaire. It could be stated that gender had little to do with sanitation preference and the sanitation problems in the community are common to all community members on an almost equal level.

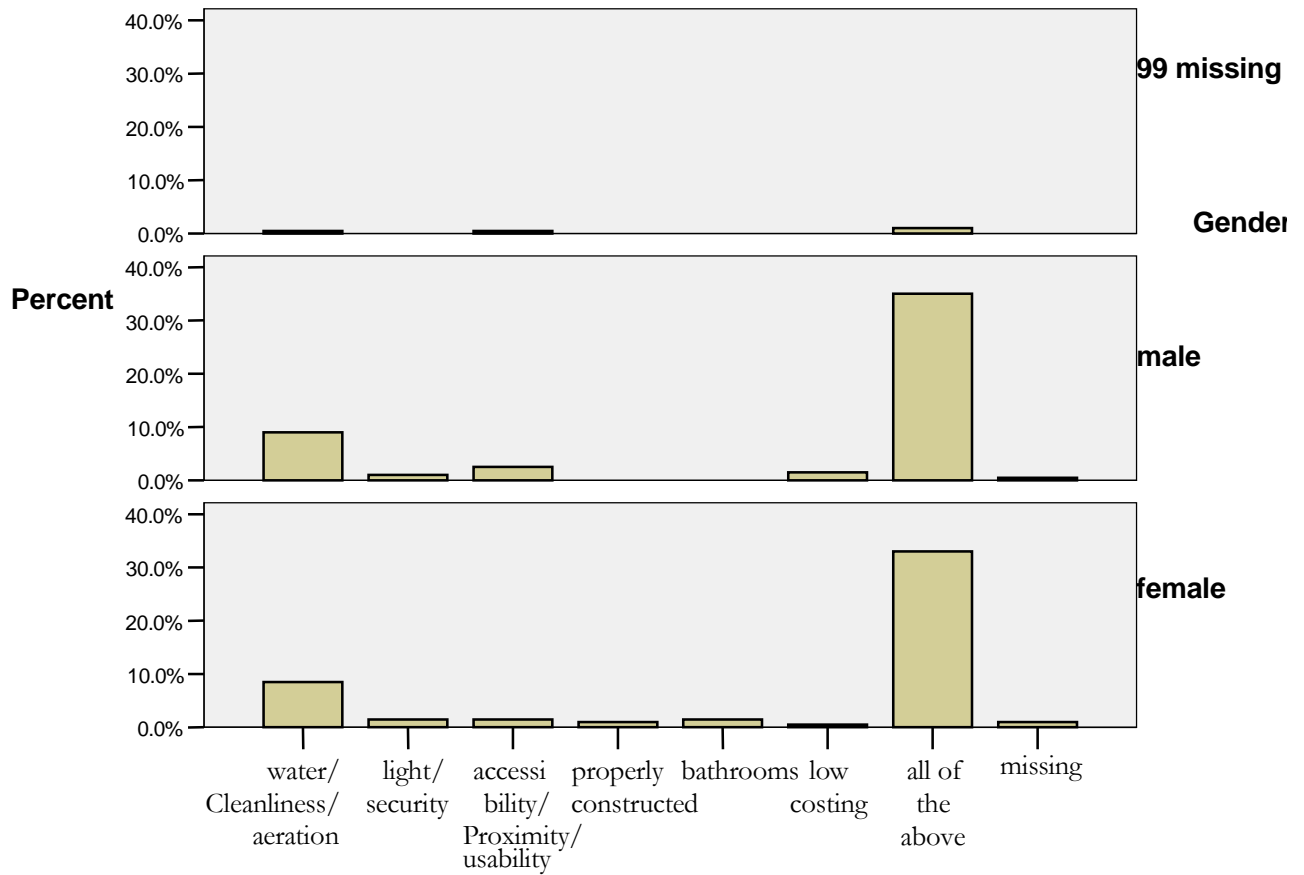
In line with this, members were asked to state where they would like the sanitation facilities to be built, a factor that goes hand in hand with selecting sanitation type; the answers were then analysed in relation to gender. In Figure 13, answers from both males and females have little percentage difference and it can be stated that gender had little influence in identifying preferred locations. In this sense, community members can be said to have equal interest in what they would like and expect of sanitation facilities as far as location is concerned.



1 = diseases, 2 = pest infestation, 3 = physical danger, 4 = odour,

f = female, m = male, 99 = Missing

Figure 11. Graph illustrating problems caused by poor sanitation in relation to gender and level of education.



Expectations when choosing toilet sanitation.

Figure 12. Community expectations on toilet sanitation.

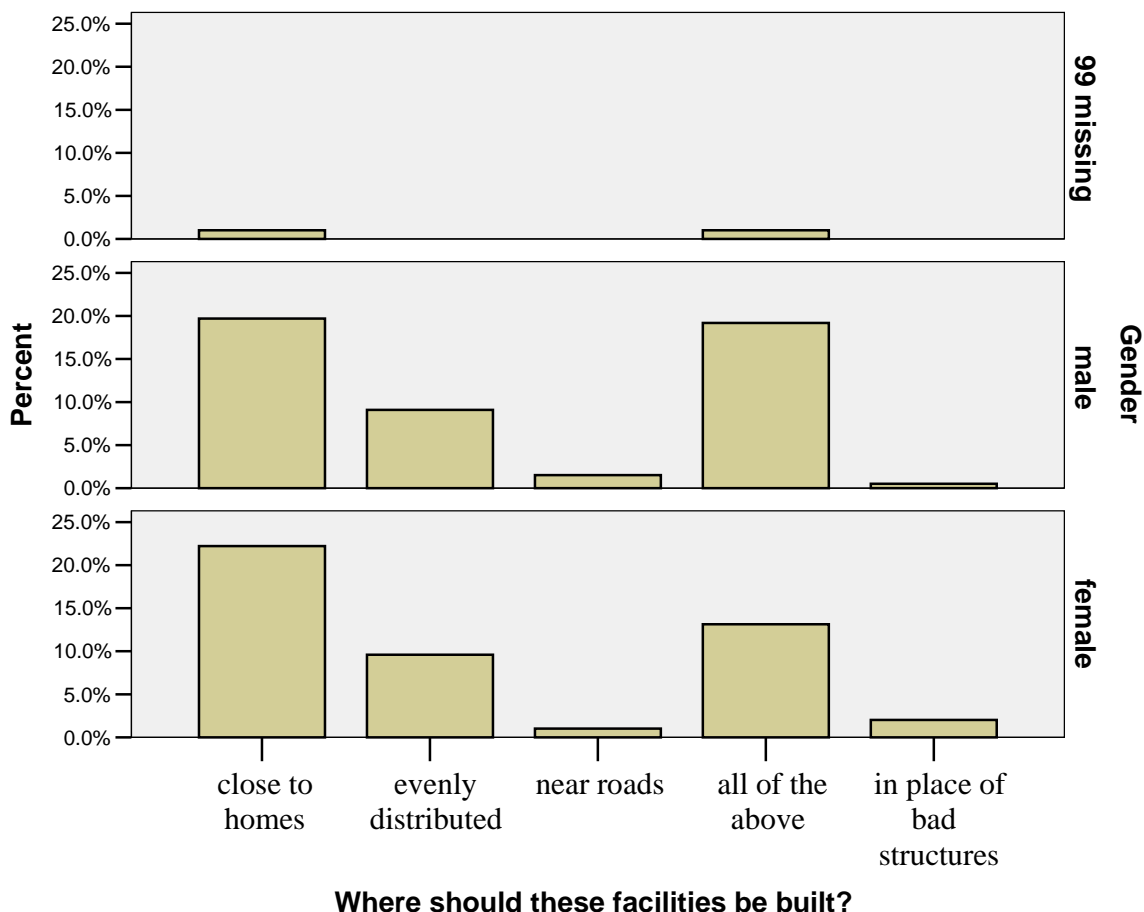


Figure 13. Community response on location of toilet facilities in relation to gender.

5.6 Income availability and willingness to pay for services

The individual financial status has a great influence on affordability and willingness of people to pay for services. In a community like Soweto East, where most people are living below the poverty line, the monetary value of almost all basic services and wants is a priority. Once a basic need is branded costly, it is classified as a luxury, which most people in the community will opt to do without and get alternatives; and so it is even with toilets. When community

members were asked how much they would be willing to pay for toilet sanitation for each time they use the service. These were their responses.

Table 6. Community willingness to pay for toilet services.

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid nothing	56	28.0	28.0	28.0
1-3 Ksh	134	67.0	67.0	95.0
3-6 Ksh	8	4.0	4.0	99.0
missing	2	1.0	1.0	100.0
Total	200	100.0	100.0	

From the table, 28% of the participants said nothing and 67% said 1-3 Kenya Shillings. The fact that 71% stated an amount shows that the community has a sense of responsibility. The choice of the amount, this is 1-3 Ksh. from a majority, according to the researcher, would depend on two things; level of income or availability and influence from the already existing sanitation projects in the area where community members pay 3 Kenya shillings to use facilities. 1%, indicated as 99 did not answer the question.

To further test community willingness to pay for services and factors that might influence it; analysis was done on their willingness to pay for toilet facilities in relation to their occupations. From the results, it was concluded that in actual sense, occupation and thus income does not have a high influence on community willingness to pay as long as the cost is low. In all categories, the highest numbers of correspondents were willing to pay 1-3 Kenya shillings, regardless of occupation.

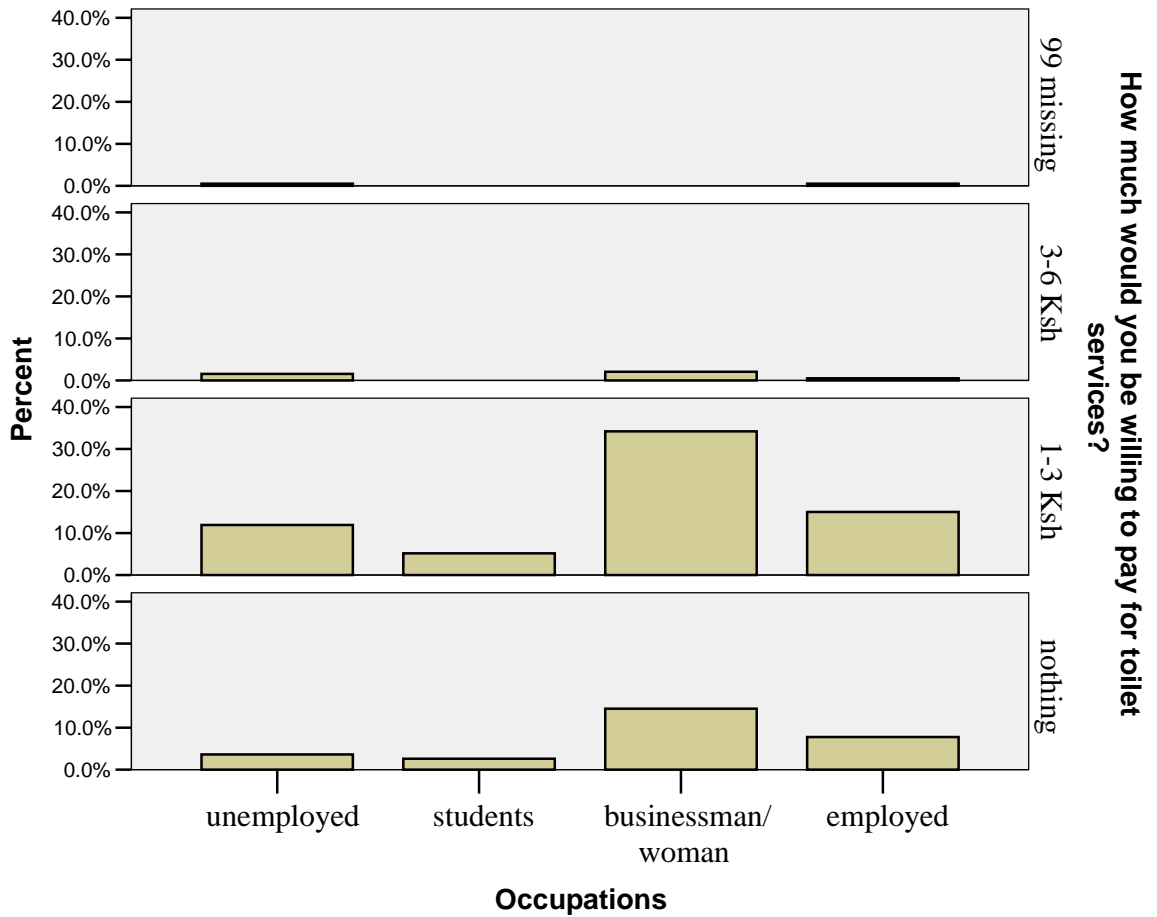


Figure 14. Graph illustrating community willingness to pay for toilet services in relation to occupation.

The 28% of participants who said nothing were asked to give a reason for their answer. Not that it was deemed a wrong reply; it was to give them room to explain themselves. Toilets are a basic need and indeed should be free. Of these respondents, a high percentage stated affordability as their main reason giving such answers as low income and unemployment; only 7.1% stated service payment as something already accounted for in the rent. Perhaps this is because very few structure owners have actually built toilets for their tenants. Most people use

project owned toilets (Ushirika, Government Community Development Fund, Youth Group toilets, etc) which are always accompanied by a fee. Below the responses are shown.

Table 7. Reasons for not paying for toilet services.

If your answer is nothing, state why.

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid affordability	45	80.4	80.4	80.4
expensive	7	12.5	12.5	92.9
rent payable	4	7.1	7.1	100.0
Total	56	100.0	100.0	

The 80.4% respondents gave a clearer picture of the varying social groups that may exist in this community. While the community is made up of poor people, some are even poorer living on the threshold of survival. These aspects of the community increase the urgency for action in upgrading the slum at least in provision of the most basic needs.

5.7 Measure of community commitment in improving sanitation

Once it was determined whether community members are able and willing to pay for toilet services, it also became important to actually note just how interested and committed they are in improving their sanitation. The measure of this commitment was community initiative and the initiative was to be determined through these three points:

- a) Willingness to relocate so as to create space to build a sanitation facility (there is very limited space in the slum and so as to increase facilities in strategic sites, space would have to be created).
- b) Participation in sanitation campaigns in the community.
- c) Who do the community members think should be allocated the responsibility of maintaining the toilet facilities.

Tables 8 to 10 below indicate the answers obtained. In the first two questions – willingness to relocate and participation in campaigns, a high percentage of participants 61% and 97% respectively, responded in the affirmative. In relation to maintaining the facilities once they are in place, a high percentage of community members saw it as their responsibility, this was recorded as 79%. A small percentage sited the landlords and government as the people responsible for maintenance, which from personal opinion could be attributed to the insecurity of land tenure which could reduce the sense of ownership from the Kibera residents.

Table 8. Willingness to relocate for a toilet construction.

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid yes	122	61.0	61.0	61.0
no	77	38.5	38.5	99.5
missing	1	.5	.5	100.0
Total	200	100.0	100.0	

Table 9. Willingness to participate in campaigns for proper sanitation.

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid yes	194	97.0	97.0	97.0
no	5	2.5	2.5	99.5
missing	1	.5	.5	100.0
Total	200	100.0	100.0	

Table 10. Who is responsible for the maintenance of sanitation facilities.

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid landlord/structure owners	26	13.0	13.0	13.0
government	10	5.0	5.0	18.0
Non-governmental organizations	2	1.0	1.0	19.0
community	158	79.0	79.0	98.0
missing	4	2.0	2.0	100.0
Total	200	100.0	100.0	

5.8 Inability/Ability to emulate already existing toilet projects

To measure the ability/inability of the community to emulate already existing toilet projects, members were asked who they thought should be responsible in building sanitation facilities in their area and what reasons they had for having not set up copy-cat facilities as those put in place by outside institutions. The former topic was also a good measure for community commitment and sense of responsibility.

Most toilet facilities in Soweto East have been initiated by private groups, for instance Maji na Usafi, Government Community Development Fund, UN Habitat, faith based organizations and others. Very few structure owners have actually built toilet facilities for their tenants. This perhaps is caused by the issues surrounding land ownership in Kibera. In fact, when asked who the community members thought should build the toilet facilities, the highest number of respondents said the government, with structure owners being second highest. Only 6.0% of the respondents thought the community members should build these facilities and 27% stated structure owners, while 48% stated the government. Figure 15 illustrates the answers obtained in percentage frequency format.

From Table 11, it can be seen that while land ownership and absentee landlords attributes to 10.5% of the inhibitions, 29% is caused by mistrust and lack of co-operation in the community. The slum is made up of people from various ethnic backgrounds but the ethnic ties and bonds surrounding people from one background are still very strong. This fact was very evident during data collection; the SEC members who aided in distributing questionnaires had tendency to do so to people of their tribal group. It might be therefore right to say that even though land were to be made available and a proper land tenure policy put in place, it would still be necessary to institute a very neutral management system that will increase co-operation and trust in community members and discourage community members from seeing themselves individually or as cliques.

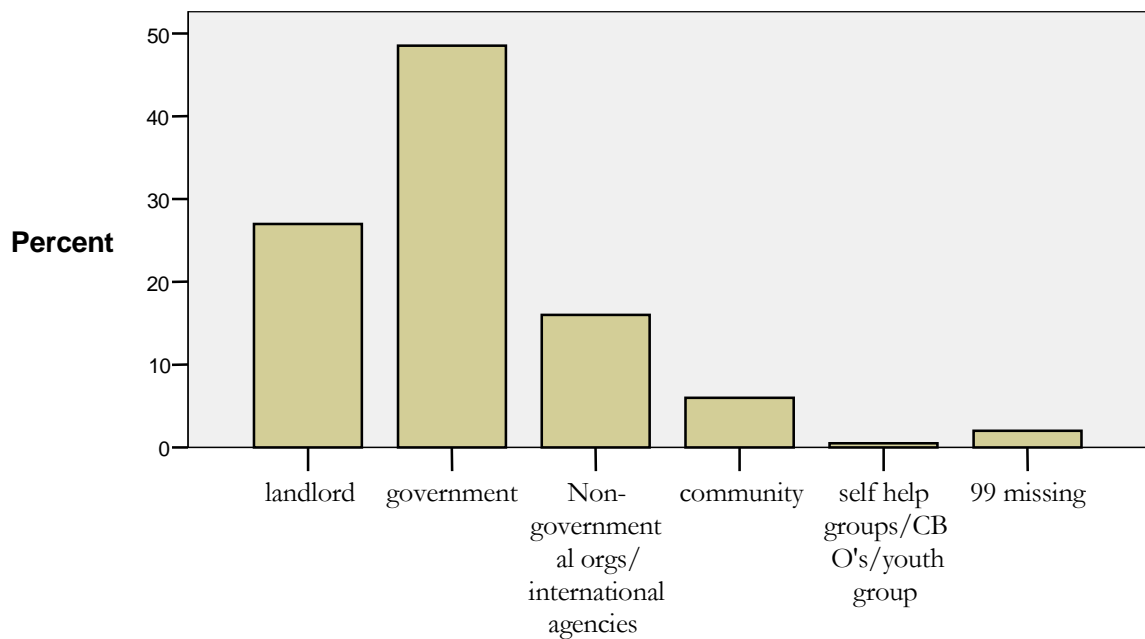


Figure 15. Graph showing community responses on who should build toilet facilities.

Table 11. Issues limiting the community from building their own toilets.

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Ownership of land/absentee landlords	21	10.5	10.5	10.5
new concept	4	2.0	2.0	12.5
mistrust/cooperation/	58	29.0	29.0	41.5
lack of funds	29	14.5	14.5	56.0
all of the above	70	35.0	35.0	91.0
missing	18	9.0	9.0	100.0
Total	200	100.0	100.0	

6 DISCUSSION

6.1 Overall Problems and Recommendations

Sanitation problems in third world states have continued to be prevalent in spite of various efforts to implement projects. These failures have sometimes been attributed to the methods with which the donor agencies and NGO's have employed at grass root levels. In most cases, the main stakeholders, who are always the community members have been left out from all the implementation stages, this is, identification of the problem, planning phase and implementation phase. As a result, the projects have turned out to be unsustainable. (Kanji & Greenwood 2001)

It is also important to note that sanitation problems as discussed earlier are not limited to just provision of adequate water, toilets, bathrooms and waste disposal facilities. It stretches to social factors like health, economic growth and environmental management.

In the data analysis and research findings, the needs of community members were identified as far as toilet facilities are concerned. Issues that are causing the current poor state of sanitation in the community were also identified. In addition, value was placed on just how much the community knows about basic sanitation and the negative impacts of practicing poor sanitation and also their willingness to improve sanitation in their community. In the last part of the analysis, reasons that are limiting the community from being self sustainable in implementing and improving their own sanitation systems were identified. Here is a summary of the findings:

a) Technical Aspects

- Whatever toilet technology is put into place, it has to give great consideration to children and women and all the stated expectations shown in Figure 20, which were:
 - Well lighted/ Security
 - Accessibility/Proximity/Usability

- Properly constructed i.e. solid, spacious
 - Bathrooms
 - Low cost
 - Water/ Cleanliness/ properly aerated
- While occupation may have little to do with community willingness to pay for services, most members are only willing to pay a maximum of 3 Kenya Shillings and others nothing. The toilet technology therefore that is put into place has to evaluate this cost of returns and to reduce losses; it cannot be expensive in either implementation or in service cost.
 - The slum has a high population and there is lack of space. This factor should be put into consideration when choosing the technology.

The guidelines discussed in Table 2 would be of great importance also. Mostly as they focus on all aspects of life – social, economical and environmental. The reason why most toilet waste is not emptied when latrines are full in poor communities is because of lack of funds. As there is no government interest in providing sewage systems for slum dwellers, most people have to rely on private entrepreneurs to empty waste. The prices charged are normally high, thus making this service inaccessible. A toilet technology that would ease this problem, enabling community members to forego this expense and instead turn sewage waste into profitable waste would go a long way to instil social and environmental sustainability.

b) Social Aspects

- There is a great need to put in place a good land tenure policy in Soweto East to give people motivation and desire to improve their surroundings.
- Insecurity in the community is a block to accessibility of sanitation facilities.

- There is a need to instil a system of good governance in the community for the sustainability of any sanitation project that is put in place.
- The problems in the community extend to lack of sustainable energy sources for home use like cooking and lighting, information that was attained through direct observation during data collection.
- There is a need to educate and train community members on how to maintain and use sanitation facilities and this need is motivated by the fact that community members are willing to improve their sanitation status as seen in the data analysis (Franceys et al 1992)
- The technology has to be culturally acceptable and hygienic to avoid spread of diseases and pathogens.

c) Environmental Aspects

- The water resources are strained. The community suffers from inadequate water supply and network, a factor that should be considered in choosing the technology.
- During rainy seasons, there is a great problem of flooding and raised water levels.
- It is important to instil a system that will not create a problem of sewage waste disposal.
- The system needs to be environmentally sustainable, protect underground and surface water sources, odourless.

d) Economic Aspects

- Community members are living below the poverty line. Funds for constructing sanitation facilities may need to come from the government or donors. However, community willingness to participate in sanitation campaigns shows that it is also possible to mobilize members to raise funds.

- The ability of the technology to generate income of some sort or help to improve the economic status of community members would be a step towards poverty reduction and attaining sustainability (UN Habitat 2007).

In chapter 5.3 one of the major complaints from community members who were living close to sanitation facilities was odour and insecurity. It could be assumed that the odour is however not due to proximity but due to poor aeration, construction and maintenance of the toilet facilities. The issue of insecurity is one that has affected the community for a long time. Insecurity here covers issues like rape and robbery for community members at night, making it a hindrance for them to go out to the toilets; it also covers accidents caused by poor street lighting and poorly constructed sanitation facilities. The root cause of this insecurity may be poverty, poor governance, over-population and unemployment which are adverse in this community. Therefore, when choosing any form of toilet technology, there will be a need to put into perspective all these other social aspects, the limitations they pose and whether they can be overcome by, for example, considering the economic advantage to the community of different technologies, maintenance plan of this facilities and how they could affect improvement in governance.

In chapter 5.8, results showed that a high percentage of community members think it is the responsibility of the government to build sanitation facilities in the slum. The researcher attributes these results to the land tenure problems surrounding Kibera. Neither the structure owners nor the tenants have land ownership. The land belongs to the government; furthermore the mismanagement of land in the area has led to over-population leaving very little space to build any basic facilities. The government also does not take responsibility in providing any services to slum dwellers, marginalizing them even further. It is also common knowledge that when a tenant is renting a home, there are certain basic requirements that have to be provided, like a water source at close proximity, a bathroom and a toilet. However, in the slum situation, the structure owners do not deem it necessary to provide these services for various reasons like:

- a) A negative attitude towards slum dwellers and thus marginalizing them.
- b) The rents payable in slums are so low that they are not considered as adequate to cover the cost of providing these basic needs.
- c) Overcrowding and therefore no space to build the facilities.
- d) Corruption and greediness from structure owners in maximizing on space to build structures for renting out rather than bathrooms or toilets.

This line of thought by community members is in fact not misplaced. The community members feel marginalized and as they have no secure tenure, they do not see the reason for putting up a facility which may only serve them for a short-while. People who fear eviction are not likely to operate to their maximum potential, or invest in improving their homes and neighbourhoods. (UN Habitat, 2004).

These findings are further highlighted in the context of UNDP (2002) numerous researches where it identified the problems listed below as the ones posing challenges of environment and development. They are:

- Economic disparity and political instability
- Extreme poverty
- Under-nourishment
- Disease
- Marginalization
- Population Growth
- Consumption
- Global energy use

- Climate change
- Nitrogen loading
- Natural resource deterioration
- Loss of diversity
- Pollution
- Growing water scarcity
- Other urban problems e.g. continued urbanization and industrialization combined with lack of resources and expertise.

During the launch and implementation of the pilot project in Soweto East at the beginning of 2007, Habitat had chosen VIP's as the most appropriate sanitation technology to put into place. Considering the network, population and services available to the slum dwellers, onsite sanitation is normally accounted to be the best. The influencing factors and usability of latrine types are presented as flowcharts in Figure 16 below. From this flow-chart, of all the options, the raised VIP is the best alternative for Soweto East. This is however not the only toilet technology that could work in Soweto East and it cannot be termed as the best toilet technology. In the next topic, there is a comparison between the VIP and the No Water Consumption Toilet which is a considerable alternative for Soweto East.

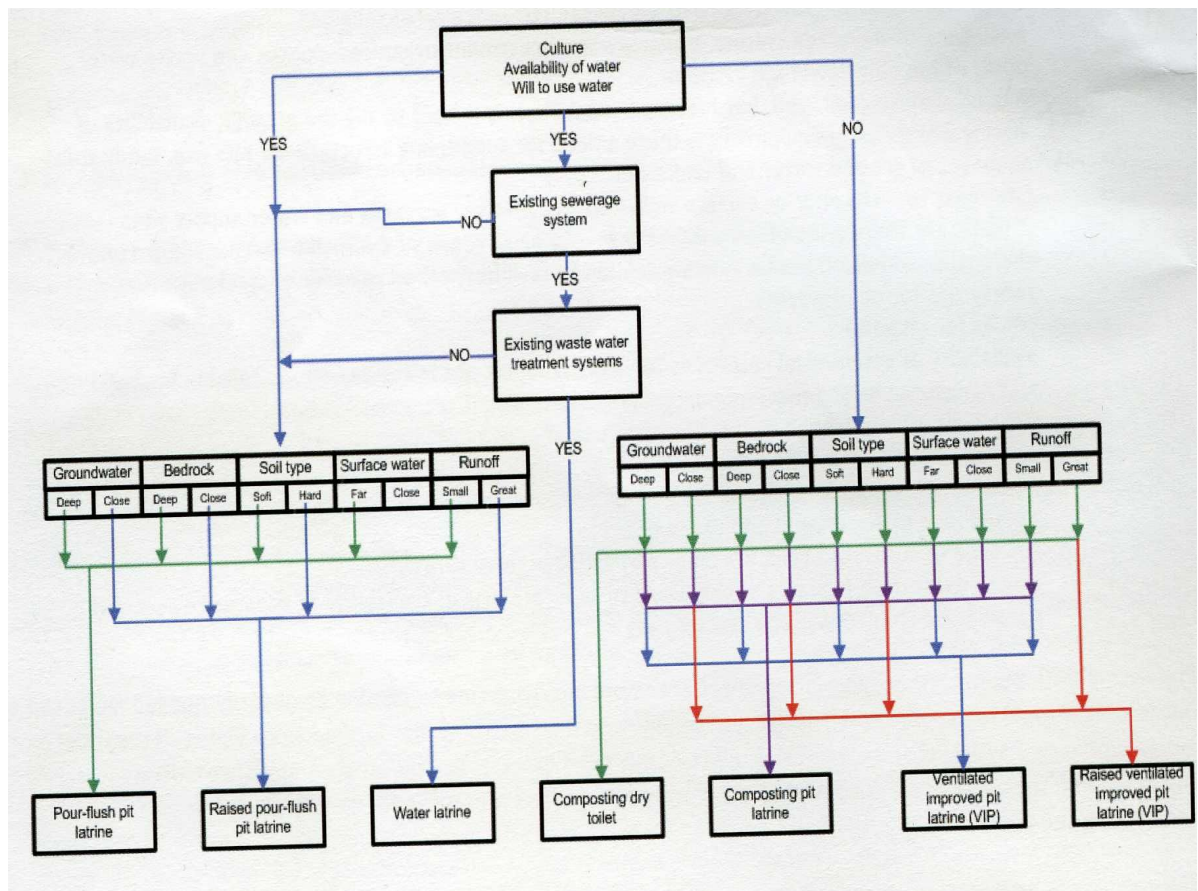


Figure 16. Factors influencing the selection of latrine type (Global Dry Toilet Club of Finland 2006).

6.2 VIP Latrine and the No Water Consumption Toilet

As mentioned above, the raised Improved Pit Latrine is the best in comparison to the other dry sanitation technologies mentioned. It overcomes the problem of water, protects ground water and is cheap to construct. Culturally, the locals view human waste quite negatively and this aspect would make the ecological sanitation option quite difficult to implement though it is quite sustainable. Furthermore, eco-sanitation promotes the use of human excreta as a resource for soil enrichment and material. The surrounding neighbourhood in the slum however, does not have adequate land or space where this waste can be spread. The negative perception of human

waste by locals makes it difficult to sell the waste to farmers living further out of the city as a way of generating income.

This problem, however, of ecological sanitation as a means of sanitation may in time be adopted if locals could be informed and educated and assured that human waste is not toxic when treated properly. The other forms of flush latrines have higher disadvantages beginning with the scarcity of water in the community. There is however, one technology that is not in the flowchart but was earlier discussed as one of the existing toilet technologies. The NOWAC toilet system is accepted internationally in eco sensitive areas and where water is scarce (Franceys et al 1992).

In the Table 12 below we compare the VIP latrine and the NOWAC system in the 3 main areas that need to be considered when implementing a toilet technology; principles of operation (is the technology viable in the community in question), operation and institution (is it environmentally, culturally and socially sound), costs (is it affordable and sustainable in the long run). In summary, this comparison should determine which of the two technologies satisfies the community needs mentioned in topic 9 above. Figure 17 shows the No Water Consumption toilet (NOWAC system).

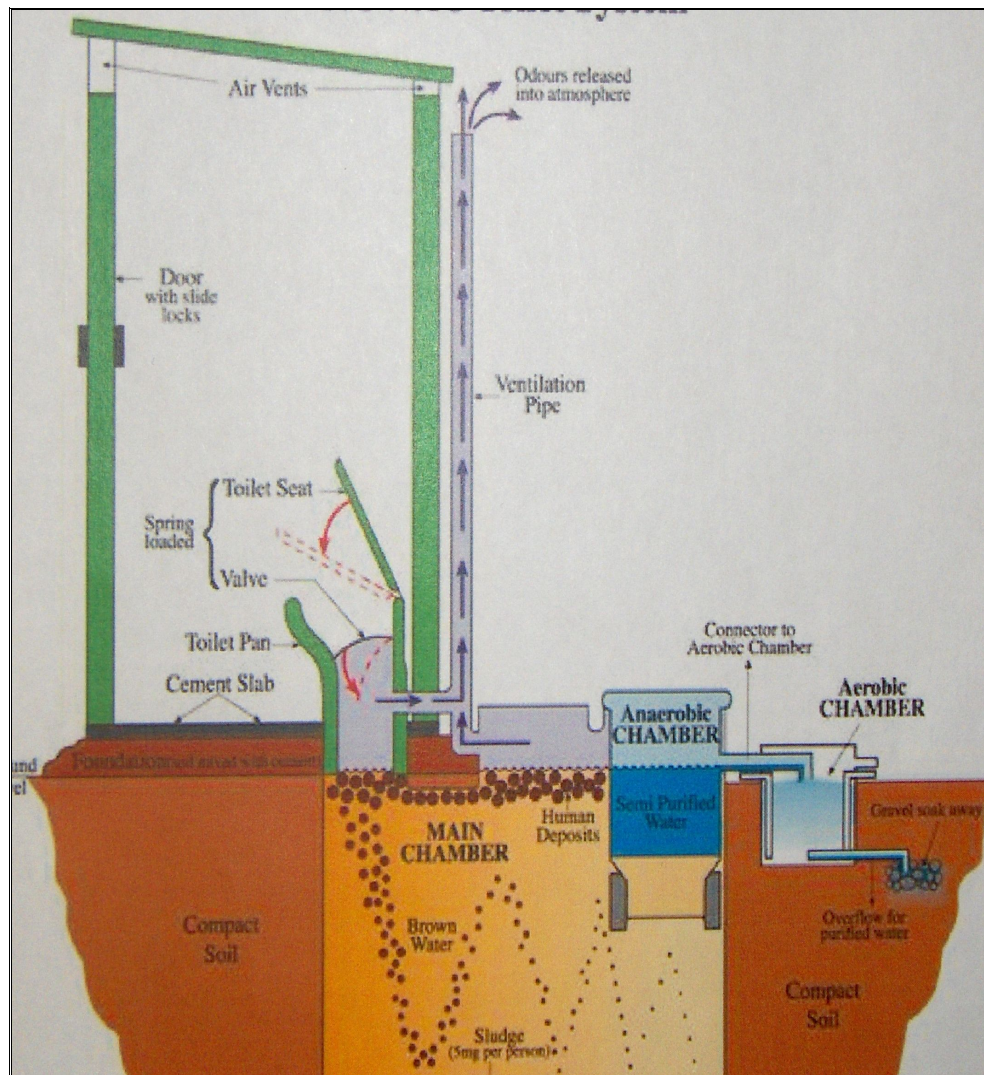


Figure 17. The No Water Consumption Toilet and its operational mechanism.

Table 12. Comparison of VIP and NOWAC toilet systems (South Africa Government 2002)

TECHNOLOGY	PRINCIPLES OF OPERATION	OPERATIONAL & INSTITUTIONAL REQUIREMENTS	COSTS
VIP LATRINE	Waste drops into the pit where organic material decomposes and liquids percolate into the surrounding soil. Continuous airflow through the top-structure and above the vent pipe removes smells and vents gases to the atmosphere. A darkened interior is maintained causing insects entering the pit to be attracted towards the light at the top of the vent pipe and trapped by the fly screen. A separate hand washing facility is required.	Locate to prevent ingress of storm water to pit, as well as in consideration of local groundwater use and conditions. Does not accept domestic, wastewater. Cannot be placed inside house. Ensure access for mechanical pit-emptying and availability of sludge treatment and disposal where required. Ensure repair/replacement of damaged/worn materials.	<p><i>Capital:</i></p> <p>May range from R 600- R3000, depending on householder input and choice of materials.</p> <p><i>Operating:</i></p> <p>R60/year if it is emptied once in 5 years.</p>
NOWAC SYSTEM	Fill chamber with water to activate the system. No additional water will be required in future. Waste drops into the water in the main chamber where the organic material decomposes. This process is natural and executed by organisms. The waste moves around in the main chamber for a period of approximately 100 days. The brown water moves into the second chamber. This chamber is fitted with an anaerobic filter and is situated in the main chamber. It destroys approximately 98% of all dangerous pathogens before it flows over into an anaerobic filter where the remains of the pathogens are destroyed by organisms and oxygen. The volume of the overflow equals the volume of the waste/person. This overflow of uncontaminated water flows into a soak away, which can be seen as an additional filter.	<p>Operates:</p> <ul style="list-style-type: none"> -Without additional water -With only the seat as the mechanical part -Without any chemicals <p>No maintenance required for 15-20 years. After 15-20 years the sand layer at the bottom of the main chamber is removed with a pump after which the system will work for another 15-20 years.</p> <p>Note: only sand and not the water will be pumped out.</p>	<p><i>Capital:</i></p> <p>R5000-6000/Unit which includes:</p> <ul style="list-style-type: none"> -The complete system -The concrete top structure -The transport -The installation -The training of each household <p>Note: Installation costs can increase in rocky areas and against steep slopes.</p> <p><i>Operating:</i> No Costs up to 15-20 years.</p>

1 R ≈ Ksh. 9.6909

From the table above, the NOWAC system seems more suitable than the VIP latrines in terms of sustainability and long-term benefits. Although the cost of installing the NOWAC system is high, the environmental, social and economic advantages are more sustainable and worth more in the long-term than the pit latrine. It satisfies more the needs discussed in topic 9 than the VIP latrine. In the context of our study area, lack of space may perhaps be posed as the biggest inhibitor. As seen in chapter 5.7, we interviewed the community members on their willingness to relocate so as to give space if a suitable, sustainable sanitation facility needed to be installed. Their answers were illustrated in Table 8 and represented as a graph in Figure 18 below.

61% of the respondents said yes while 38.5% of the respondents said no. Only 0.5% did not answer. Most people who said no cited reasons such as lack of alternatives of where to live or fear that relocation would mean they do not get access to the service. Others cited past failed projects in the slum where they felt that the government and some institutions, which had promised change, did not achieve it. The 61% who accepted added on the most part that they would relocate if they were assured access to the service for which they were relocating. The issue of space in the slum therefore continues to be a big challenge in the implementation process of any project.

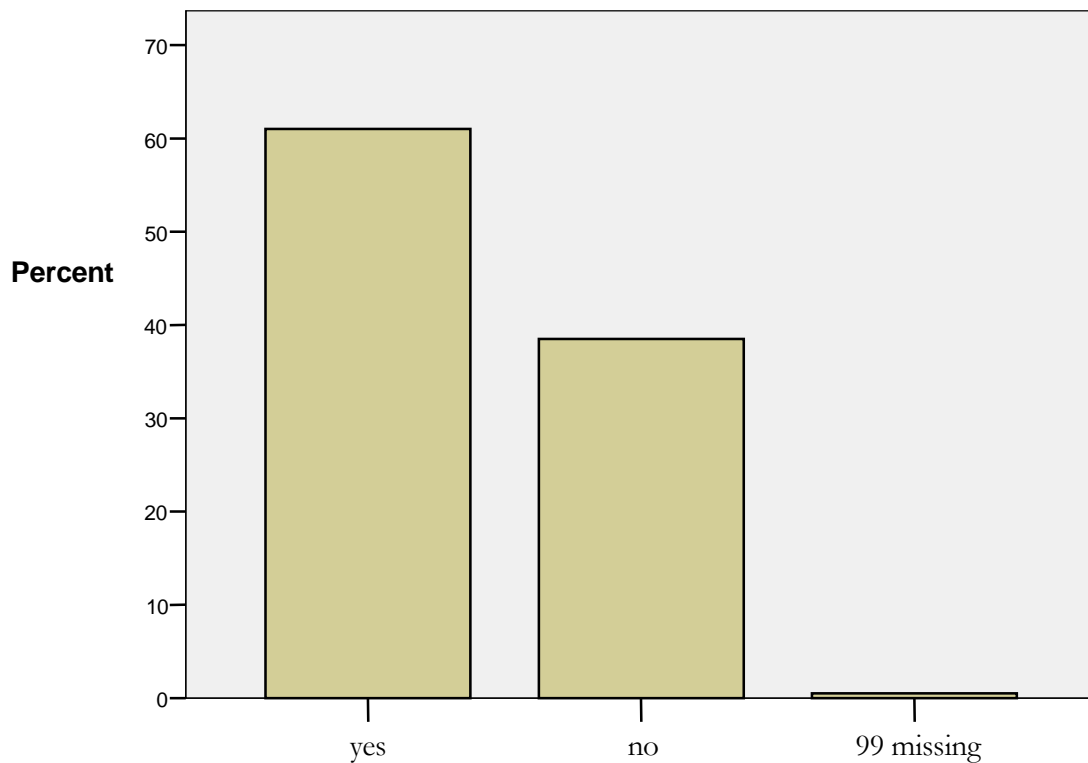


Figure 18 . Willingness of community members to relocate.

7 CONCLUSIONS

The issue of secure land tenure in Soweto East and Kibera as a whole continues to be surrounded by political interests and marginalization systems set in place by individuals in the upper-class of society. Secure land tenure is described as the rights of individuals or groups in relation to land. The nature and content of these rights and the extent to which people have confidence that they will be honoured and recognised by the public authorities and community concerned, is what will have a direct impact on how the land is used.

The problem does not lie on this issue only; there is also a need for adequate housing and structures to be put in place in the community. Improving of houses in Kibera is a difficult thing to do as long as the controversy on land ownership and right persists. However, improving public structures, as Habitat has proposed is a big step towards upgrading the neighbourhood.

Community members have good knowledge of what proper sanitation involves, which can be seen in their stated results on expectations of sanitation facilities and the impacts of poor sanitation in their community. Ignorance is therefore not the biggest problem; it is in fact lack of co-operation and mistrust among community members. It is also perhaps this un-united front that has hindered the slum dwellers from taking action against their absentee landlords and the government, both of whom certain percentages of the interviewees stated as responsible for building sanitation facilities.

The best sanitation technology should be based on all the social, economic and environmental findings of the research. The technology should not be expensive to maintain as the residents are not able to pay high prices to use them, they should be very well aerated and solidly constructed and environmentally sustainable. Other issues like insecurity and location are very dependent on community willingness to provide space and the political influence on the land issue.

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APPENDICES

APPENDIX 1.

COVER LETTER OF THE QUESTIONNAIRE

Dear participants,

I am student in Finland doing a Masters degree in Development and International Co-operation. Currently, I am an intern in UN-Habitat. I am doing a research for UN and for my university on the sanitation problems in Soweto-East. I am focusing on toilets for this research as I see it as one of the biggest problems caused by urbanization. UN-Habitat has proposed the construction of 15 VIP latrines as part of its slum upgrading programme. I am interested in finding out what alternative toilet technologies could be implemented in Soweto East instead of VIP's and still satisfy the needs of the community members. The attached questionnaires will aide me in identifying these needs among other things. The questionnaires are confidential and will only be used for this research.

Wahusika wapenzi,

Mimi ni mwanafunzi nchini Finland ninaposomea degree yangu ya pili katika mambo ya maendeleo na ushirika wa nchi mbalimbali. Kwa sasa hivi, nafanya utafiti kwenye UN-Habitat, moja wapo ya vituo vya muungano wa nchi. Utafiti wangu unatilia maanani matatizo ya vyoo, ukosefu wake na usafi. Kazi hii imejitokeza kufuatia mpango wa UN-Habitat kujitahidi kuendeleza maisha ya waakaji wa Soweto East kwa kujenga viwanda tofauti tofauti. Mojawapo ya viwanda hivi ni vyoo vipya vya aina ya VIP. Kazi yangu itakuwa kutambua teknolojia zingine za vyoo ambazo zinaweza kutimizwa Soweto East bali na hii ya VIP. Teknolojia yoyote nyingine inabidi itimize matakwa ya jamii wa Soweto East. Kwa jambo hili, naomba munisaidie kwa kujibu maswali niliyo andaa. Maswali yote yatatumizwa kwa kisiri na yatatumika tu kwa huu utafiti.

Sincerely,

Eva Kagiri

APPENDIX 2.

QUESTIONNAIRE

1. Please give the following details.

- Age.....
- Gender.....
- Occupation.....
- Level of education.....

2. What is your definition of a toilet?

.....

3. Where do you go to the toilet...?

.....

4. How far or near is the nearest toilet to you?

.....

5. How does question 4 affect you?

.....

6. Would you classify this as a proper form sanitation?

.....

7. List in order of priority, 5 problems you think are being caused by poor sanitation in your community.

-
-
-
-
-

8. As a community member, list 5 things you would like or expect when choosing toilet sanitation

-
-
-
-
-

9. When provided with a toilet facility, how much would you be willing to pay for the service?

Nothing

- 1-3 Kenya shillings
- 3-6 Kenya shillings
- 7-10 Kenya shillings
- > 10 Kenya shillings

If your answer is nothing please state why?

10. What issues do you think limit the community from emulating toilet projects that have been done by other organizations?

-
-
-
-
-

11. Which people in the community do you think are most affected by problems of poor sanitation?

- Women
- Children
- Elderly

- Men
- Physically impaired

12. What would you term as the correct ratio of toilet per person/person?
.....

13. Who do you think should build sanitation facilities?
.....

14. Who should be responsible for their maintenance?
.....

15. Would you be willing to relocate your house if a toilet were to built in its place?
.....

16. If toilets were to built in your area would the old habits of “flying toilets” cease?
.....

17. If these facilities were put into place and you see someone using a “flying toilet” what would be your reaction?
.....

18. Do you know any health risks related due to lack of proper sanitation?
.....

19. Would you participate in a campaign for proper sanitation?
.....

20. Would proper sanitation work in your community?
.....

21. Please state why if yes or no to the above question?
.....

22. What is your attitude towards organizations, persons trying to improve sanitation facilities?
.....

23. How should your ideas of proper sanitation be implemented?
.....

24. How do you view the condition of your existing toilet facilities?

.....

25. Do you term “flying toilets” as ignorance or lack of a proper basic need?

.....

26. Does it bother you that Kibera is popular for its “flying toilets?”

.....

27. Where do you think these facilities should be built?

.....