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Diverging Perceptions on communal sanitation facilities
A case study of Kibera slum

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Master of Science Thesis
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The findings, interpretations and conclusions expressed in this study do neither necessarily reflect the views of the UNESCO-IHE Institute for Water Education, nor of the individual members of the MSc committee, nor of their respective employers.

Dedicated with love to my sweetheart **Kariuki** and our daughters, **Njambi** and **Nyawira.** A special thanks to you all.

Abstract

Communal facilities are enabling many slum dwellers access to sanitation services. With the increase in population and rapid urbanization, they are expected to play an even greater role. The study aim was to gain insights on the users' and the providers' perception on the appropriateness of the various sanitation facilities that are on offer to the residents.

The study was driven by the concern that no studies have been taken to identify the users and the providers' views on the various options on offer. Yet, the current studies indicate that, for the facilities to be properly used by the community they need to meet the desires of the people. Further, the research shows that often there exists a discrepancy between the providers' and the users' choice of preferred technology. This often leads to lack of proper use or even lack of use of the facilities.

To explore the users' and the providers' views on the communal facilities, a case study of Kibera slum in Kenya was conducted. Four types of communal sanitation facilities were identified namely: pour flush toilets, VIPs, WC and biogas toilets. To collect the views from the providers and the users, semi structured interviews and users questionnaires were employed respectively. The study shows that the users place a high premium on the cleanliness of the facilities. On the other hand, for the providers, the most important criteria for selecting the appropriate sanitation technology is availability of the infrastructure (water and a sewer line) and the operation cost. The

From the study, two conclusions can be drawn: First, users' satisfaction with the facilities is related to the level of the cleanliness. Second, the cost of emptying the facilities is a major criterion for selecting an appropriate technology for the providers.

Keywords: Slums, Perception, Community Participation, Sanitation, Demand, Supply

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List of Acronyms

VIPs	Ventilated Improved Toilets
WC	Water Cistern
AWSB	Athi Water Services Board
NWSC	Nairobi Water and Sewerage Company
NGOs	Non Governmental Organisations
CBOs	Community Based Organizations
JMP	Joint Monitoring Program
UNDP	United Nation Development Programme

1 Introduction

Sanitation is essential for safeguarding public health, environment and the development of a country. Though the benefits of investing in sanitation are not in doubt, sanitation is often not prioritized, particularly in the developing countries.

In recognition of the importance of sanitation, halving the number of people with no access to basic sanitation by the year 2015 is one of the Millennium Development Goals. Indeed, this has provided the developing countries with a drive to increase the sanitation coverage(Jenkins & Curtis, 2005). However, achieving this is a challenge for most developing countries due to the limited finances coupled with rapid population growth. UNICEF and WHO (2008) indicate that approximately 2.5 billion people in the world lack access to improved sanitation. As a result, about 2 million people die yearly from sanitation related diseases (Langergraber & Muellegger, 2004). Provision of sanitation services in the urban areas is proving a challenge for most developing countries due to the rapid urbanization. According to Konteh (2008), more than half of the world populations live in the cities and the rapid urbanization is expected to continue, mostly in the developing countries. This is bound to put pressure on the available cities infrastructure and services provision.

Rapid urbanization in most of the developing countries outstrips the capacity of the government agencies to provide the basic infrastructure. Consequently, most people end up living in the slums; which are characterized by being densely populated, having poor housing conditions, insecurity of tenure, limited basic infrastructure mainly water, sanitation services, solid waste management and roads (Boadi, *et al.,* 2005). Provision of adequate sanitation services slums is complicated by these unique characteristics exhibited by the slums. Nevertheless, current studies show that communal facilities are providing a solution to inadequate sanitation in the slums (McFarlane, 2007).

This research focuses on communal sanitation facilities for slum areas. It seems that communal sanitation facilities may be a solution to inadequate sanitation due to the limited space in slum area. It would therefore be interesting to find out the appropriateness of the current communal sanitation facilities from the users' and the providers' point of view. Moreover, there is little empirical data on appropriateness of various sanitation systems in the slum areas. Further, current research shows that failure to consider the users' preferences often results to failure of the sanitation projects.

Jenkins and Scott (2007) argue that the failure to consider the users' preferences is one of the main reasons, for failure of sanitation projects in the developing countries. Traditional approach in provision of sanitation services has mainly been supply driven. In this approach, the users' needs and preferences are often not considered during the designing and implementation of the projects. Thus, often the technology fails to meet the community needs. As a result, the facilities the community fail to utilize the facilities. For example, In Mumbai India, up to the year 1995 BrihanMumbai Municipal Corporation

(BMC) had adopted a supply driven approach to provide public toilets within the municipal informal settlement. Thus, the BMC used to construct and maintain the facilities. A study on these facilities revealed that 1/3 of these toilets failed within 6 months due to inappropriate design, lack of water, electricity and poor maintenance (McFarlane, 2007). To address the weakness of this approach, BMC adopted a demand driven approach in provision of the communal sanitation block in partnership with private agency, NGOs and the community. The communities participated from planning stage and are responsible for operation of the facilities. So far, the results indicate that majority of the community blocks are operating well (McFarlane, 2007; (Nitti & Sarkar, 2003). This study shows the importance of taking into consideration the users' perception and underscores the importance of my study.

This research aims to get insight of the appropriate communal sanitation facilities for the slum areas. To undertake this research, a case study of Kibera slum was employed. Information was collected from the users of facilities and the providers involved in provision and management of the sanitation facilities. The findings from this research can be useful to stakeholders involved in provision of sanitation facilities in slum areas and also within the area of the study to improve the effectiveness of the sanitation services. In addition, this information is useful to the policy makers in Kenya in developing policies that reflect the local conditions.

The thesis report is organized as follows: The current chapter gives an introduction of the thesis, which includes the thesis problem statement, the research questions, hypothesis and the objective of the study. The second chapter consist of literature reviewed on urbanization, sanitation options, supply and demand driven approaches and empirical studies on the different sanitation provision approaches. Chapter 3 is about research design and analytical framework, chapter 4, 5, and 6 are the results and discussion. Chapter 4 describes the study area and the communal sanitation facilities in Kibera. Chapter 5 describes the providers' views with regard to the communal facilities. Chapter 6 presents the users' views and finally Chapter 7 presents the synthesis of the providers and the users' views, conclusion and recommendations.

1.2 Problem statement / Justification

Although a lot of effort has been made to increase the sanitation services in Kenya, a large number of urban dwellers particularly in the slum areas, have no access to the sanitation facilities. In slum areas, most people rely on the pit latrines which are poorly constructed, overused and poorly maintained. Majority of these pit latrines discharge human waste content into the storm water drains due to the inaccessibility and high cost of emptying. Previous studies indicate that up to 150 people share a single pit latrine (Gulis *et al.*, 2004). Moreover, a large number of the residents result to using polythene bags for defecation due to the poor condition and inadequate facilities. The human waste is thrown away with other solid waste in open places.

Unhygienic means of human waste disposal degrade the environment and expose the residents to a high risk of contracting sanitation related diseases. A study undertaken in Kenya showed that prevalence of diarrhoea among the children was highest in the slums (32%) compared to Nairobi as a whole and rural areas with 13% and 17% respectively (Kimani et al., 2007). Communal sanitation facilities are increasingly being advocated to address the sanitation problems in Kibera by both the government and the NGOs. Actually, AWSB is financing communal sanitation facilities in the area.

In Kenya, communal facilities are playing a great role in enabling access to sanitation services in the slum areas. Provision of individual facilities is unfeasible due to lack of space. Due to the expected population increase, communal facilities are expected to be prominent in meeting sanitation needs in the slum areas. In Kibera, several community sanitation facilities have been implemented and are currently in use. So far, no studies have been undertaken to investigate the appropriateness of these facilities. Recent scholarly investigations show two things with regard to this study. First, the community desires for sanitation system is motivated by the need for cleanliness, safety, comfort, privacy, convenience and elevation of the social status (Jenkins and Curtis, 2005; (Dellström Rosenquist, 2005). Thus, for a community to properly utilise and maintain the system, the implemented technology need to meet these expressed desires. Second, the providers' perception of the community need and preferred technology often differ. Thus, there is need to undertake a research on the implemented facilities to establish the perception of the users and the providers of the current communal sanitation facilities.

This research intends to gain insight on the users' and the providers' views with regard to the current communal facilities with an aim of identifying the most appropriate technology. In addition to making suggestions to improve the existing facilities based on the research findings. The research focuses on Kibera slum for three reasons: First, several different types of sanitation facilities that are quite representative of the available technologies have been implemented in the area. So, it was possible to gather views with regard to the different facilities. Second, the NGOs operating in the area were willing to cooperate for the research. Finally, it was possible to get secondary data regarding the slum.

1. 3 Overall objective

The overall objective of the research is to gain insight in the appropriateness of the various types of communally shared sanitation facilities in the slum areas with an aim of identifying the most appropriate for a slum context.

1. 3.1 Specific objectives

- To establish the types of communally shared facilities available
- To identify the current sanitation stakeholders in the area and their roles in sanitation provision of communally shared facilities.
- To establish the views and opinions of the residents using the different types of communally shared sanitation facilities.

- To establish the views and opinions of the providers with regard to different types of communally shared facilities.
- To find out potential differences between the providers' and the users' perspectives and also among the users of the different technologies
- To provide suggestions/ recommendations on the appropriate facilities based on the research outcome.

1. 3.2 Research questions

In order to meet these objectives, the following research questions were formulated.

- What communal sanitation facilities are currently available?
- Who are the current stakeholders involved in provision of communal sanitation facilities and what are their roles?
- What are the views and opinions of the residents on the different communal sanitation facilities?
- What are the views and opinions of the providers involved in provision of communal sanitation facilities?
- Are there differences between providers' and users' perspectives and among the users of the different technologies?

Hypothesis:

There is a discrepancy between the users' preferences for the types of communal sanitation facilities and what the providers' provide.

1. 3.3 Scope of study

The research covers the human excreta management component of sanitation and excludes solid waste disposal, drainage of storm water and drainage of sullage.

1.4 Conclusion

The chapter has provided an introduction to the study and presented the thesis problem statement, hypothesis, thesis objective, specific questions guiding the research and the scope of the study.

2 Background

In this chapter literature was reviewed under two categories. The first part deals with the general issues of urbanisation, slums, reasons for human excreta management, barriers to achieving sanitation, unclear issues with regard to monitoring the MDG goal on sanitation and the characteristics of the current sanitation facilities applicable to the slum areas.

The second part deals with the different approach to sanitation provision. It presents details about the essential features of demand and supply driven approaches to sanitation provision. This part also document the empirical literature on the main findings on the research done on the users' perception and experience with supply and demand driven approach. Findings from the four case studies for Ghana, Pakistan, Benin and Mumbai are documented. The chapter then concludes with a summary.

2.1 General

2.1.1 Urbanisation and slums

It is estimated that over half of the world population live in the cities and the numbers are projected to reach 70% by the year 2050. Developing countries have the highest urbanisation rate and this trend is expected to continue (UN HABITAT, 2008/2009) For example, in Africa annual urbanization rate is estimated to be at 4.6 %(Otiso, 2003). Recent studies indicate that the main drivers of urbanisation are natural population increase and rural urban migration. The rural to urban migration is mainly due to concentration of jobs, resources and services in cities, resulting to people seeking opportunities in the cities (Kwasi Boadi et al., 2005).

Rapid urbanization in developing countries creates massive demand for basic infrastructure in the cities. Meeting the demand is a challenge because of limited resources. In addition, the rate of urbanization often exceeds the rate of economic growth. As a result, the rate of infrastructure development lags behind the population growth particularly in the low income areas (Konteh, 2009)Thus, in most developing countries urbanization is characterized by formation of slums. For example, Africa cities are experiencing over 4% annual slum formation rates. Further, most people in the cities lack employment and thus seek cheap houses in the slums. These slums are characterized by overcrowding, rampant poverty among residents, insecurity of land tenure, inadequate housing conditions and basic services namely water supply, sanitation, drainage, solid waste disposal and roads(Majale, 2008). A third of the urban population in the developing countries is estimated to be living in the slums with the highest number being in sub-Saharan Africa, where 62% of the urban population lives in the slums (UN-HABITAT, 2008/9). Thus, the rate of urbanization and rate of slum formation in Africa is almost the same with 4.6 and 4% respectively. This means the high percentage of population increase in Africa cities are seeking houses in the slums in Africa,

Poor environmental conditions in the unplanned settlement impact on the environment and health of the inhabitants. The poor environmental conditions

are as a result of high population in the slum areas coupled with lack of basic infrastructure like sanitation services. This situation exposes the inhabitants to a high risk of contracting sanitation related diseases. With the current urbanisation rates the situation is bound to aggravate unless measures are taken to improve the living conditions in slums.

2.1.2 Why Human excreta management matters

Investing in provision of sanitation is a worthwhile effort for a country. Sanitation is important for social and economic development of a country. In addition to safeguarding health and environment (Gutierrez, 2007; D. D. Mara, 2003); (Ibem, 2009). Investing a dollar in sanitation yields an economic benefit of between 6 to 9 dollars depending on the region (WHO/ UNICEF, 2008). Moreover, poor sanitation has several impacts:

Human health: Majale (2008) points out that there is a correlation between health and sanitation. Poor disposal of human excreta impacts on health. This is because excreta contain pathogens likely to cause ill health. Poor sanitation is a major cause of diarrhoea, and a leading killer in many developing countries. Approximately 6000 children die daily from sanitation related diseases (Dellström Rosenquist, 2005).
Economy: poor health reduces the productivity of the families. This keeps families in poverty thus reducing the development potential of the communities. At a national level, it leads to several costs mainly due to lost productivity, reduced education potential and medicine cost (Gutierrez, 2007).
Environment: poor sanitation results in degradation of environment particularly due to the pollution of the water bodies resulting to risk of diseases.

2.1.3 Sanitation terminologies

Sanitation refers to hygienic way of collecting and disposing solid waste, waste water and human excreta to ensure a clean and a healthy environment (Avvannavar and Mani, 2008). Sanitation provision entails provision of both facilities and software. Software component involves community training on health, hygiene and desired behaviour change. Recent research indicates that diarrhoea morbidity can be reduced by up to 25% by improving water supply, 32 % by improving sanitation and 47% by hand washing.

Basic sanitation refers to the lowest cost option for securing sustainable access to safe, hygienic and convenient facilities and services for excreta disposal. These facilities need to be convenient, to offer privacy and dignity. In addition to ensuring a clean and healthy environment both at home and in the neighbourhood of users (WHO and UNICEF, 2006)

2.1.4 Unclear issues on the sanitation MDG target

The MDG target on sanitation is to halve the proportion of the world people with no access to basic sanitation. However, monitoring progress on this target is on the basis of access to improved sanitation. Thus, there is a likelihood that some of the facilities classified under the improved category may fail to meet the initial target of providing basic sanitation. For example, a pit latrine classified under the improved system may pollute the underground water. Similarly, facilities classified to be improved on the basis of being connected to a sewer

may end up polluting surface water, if the waste water treatment is not carried out. Thus, in both cases both facilities end up polluting the water bodies. So, the monitoring criteria fail to take into account the sustainability of the sanitation systems.

Table 1 shows that the JMP classification of sanitation facilities is on the basis of the technology applied. Improved sanitation facility refers to a sanitation facility that ensures hygienic separation of human excreta from human contact whereas unimproved sanitation facility does not ensure hygienic separation of excreta from human contact (WHO and UNICEF, 2008).

Table 1: Classification of sanitation facilities (WHO and UNICEF, 2008)

Improved sanitation facilities	Unimproved sanitation facilities
Flush or pour flush connected to piped sewer system, septic tank, pit latrine	Flush or pour flush to street, yard, plot, and open sewer,
Ventilated improved pit latrine	
Pit latrine with slab	Pit latrines without slab or open pit
Composting toilets	Hanging toilet/ latrines

Second, monitoring of the progress is on the basis of people who have access to the sanitation facilities. However, people may have access but not utilize the facilities. Thus, no health benefits may be derived from having access, if the facilities are not used. This is ironical because improving health is usually the objective of provision of the sanitation services. However, in this case improved health is not an indicator rather, it is the number of toilets available to the people. So, a situation may arise where an area may have a high coverage with the facilities but derive no health benefits. This is actually one of the problems in Kenya. Success of sanitation programs are based on the number of toilets put up while little effort goes to monitoring the health impacts. In my opinion, may be monitoring health impacts would result into more prioritizing of sanitation in the developing countries.

Third, classification of the facilities is on the basis of the technology. However, communally shared facilities are excluded from being improved on the basis of the management of the facilities. Maintaining the cleanliness of these facilities is assumed to be questionable. In my opinion, monitoring the cleanliness of these communal facilities would be better, rather than disqualifying the facilities in totality. Since, in the slum areas, communal facilities may be the only viable option. Thus, disqualifying the communal facilities may act as a disincentive for improving sanitation in slum areas.

It is also worth noting that shared facilities are recognized in the JMP sanitation ladder and falls in between the improved and unimproved facilities. However, based on the criteria used to classify the improved facilities implies that communal facilities cannot attain a class of being improved. This means it is neither improved nor unimproved.

2.2 Sanitation options

2.2.1. Conventional Sewerage system

Conventional sanitation systems utilise water for transporting the waste water. It includes systems of pipes for collection and transporting of waste water to the treatment plant (Langergraber and Muelleger, 2005).The system provides high convenience to the users. However, the system has four major disadvantages. First, the high cost involved in terms of capital, operation and maintenance costs. Second, the system use large quantities of water for transporting the waste. Third, the system mixes small quantity of waste with a lot of water thus magnifying the problem (Dellström Rosenquist, 2005). Finally, there is a high risk of polluting water bodies in case the system malfunction by the virtue of high quantities involved (Czemiel Berndtsson & Hyvönen, 2002); (Dellström Rosenquist, 2005). Owing to the high cost and the quantity of water required for the system to run effectively, Conventional sewerage are considered inappropriate for slum areas(Paterson et al. 2007). In addition, it is difficulty to lay conventional systems in the unplanned areas (Nawab *et a*l., 2006)

2.2.2 Simplified sewerage

Simplified sewerage is based on the same principle as the conventional system. The technology differs from the conventional system in the following aspects: First, it utilizes small diameter pipes laid at shallow depths. Second, less expensive materials like PVC pipes can be utilized instead of expensive concrete pipes. Third, simple pipe junctions clean out and inspection units are utilized rather than manholes. Third, the sewer laterals can be laid inside a housing block and below pavement instead of in the streets. Finally, the system functions with less water (Paterson et. al., 2007). Thus, simplified sewerage is cheaper as opposed to conventional system (Nance & Ortolano, 2007).

Another advantage of simplified sewerage is that the network is flexible and suits the irregular layout of the informal settlements. Paterson et al., 2007) argues that the technology is suitable for high density area. Moreover, it has been found to be cheaper than other onsite technology for high density area (D. Mara & Alabaster, 2006). In addition, the technology is based on the same design principle as the conventional sewerage. Thus, the engineers can easily design it.

2.2.3 Pit latrines

Pit latrine in essence is just a simple hole on the ground with a squatting hole and a shelter constructed around it (Paterson et al., 2007).The excreta drops in the hole. Pit latrines are common in the developing countries. They are based on the principle of “drop and store” (Langergraber & Muellegger, 2004). The liquid part of human excreta is dispersed in the soil whereas the solid part excreta stored indefinitely in a pit. The solids can also be removed after decomposition for use in agriculture (Langergraber and Muellegger, 2004; Paterson et al., 2007). The technology has four advantages: it is cheap to construct, requires no water for flushing and it is easy to operate and maintain. The disadvantage of the system includes: odour, can be a breeding ground for flies, contamination of ground water in areas with high water table, risk of collapsing in unstable soil and the distance from the house may reduce its use

especially at night. In addition, in densely populated areas there is limitation for digging new pits once the old ones are full due to lack of space (Langergraber and Muellegger, 2004). To mitigate this weakness, in urban settings the pit is lined to allow for emptying of the waste rather than digging a new hole.

2.2.4 Ventilated improved toilets

Basically consists of four components: a normal pit, concrete slab, a structure around it and a vent pipe with a fly screen. The VIP is designed to eliminate the problem of smell and insects experienced with the pit latrines. The vent pipe is meant for air circulation to eliminate odour and the flies' nuisance (Paterson et al., 2007). The foul smell from the pit is emitted through the vent pipe thus eliminating the odour problem. The flies are also trapped at the fly screen and ultimately die off. With exceptional of the odour and flies problems, the technology poses similar challenges like the pit latrine. The VIP toilets in urban settings are lined to allow for emptying due to unavailability of space.

2.2.5 Biogas toilets

Bio-toilet consists of a shallow pit, bio digester and a vent pipe equipped with a fly screen for control of control odour and flies. The excreta are deposited in the pit which is connected to the bio digester. Human waste both urine and faeces are collected in a concrete digester to produce methane gas. From the digester, the sludge is stored in a septic tank.

The operation of the system involves emptying the septic tank after a specified to avoid overloading the digester and disruption of production of gas with inert materials. In addition, the system may have a provision for adding organic matter from the kitchen and animal wastes (often cow dung) to the digester to boost up production of methane. The gas produced is used for various purposes mainly lighting, heating water or cooking (Avvannavar and Moni, 2008). The system advantages includes offering an opportunity to reuse waste and also reduced operation costs due to the reduced frequency of emptying in comparison to a lined VIP toilet.

2.2.6 Ecological sanitation

The eco-san paradigm is based on the closed loop approach to the material flows. In this approach, human excreta is treated as a resource and reused rather than being disposed of as a waste ((Dellström Rosenquist, 2005); Berndtsson and Hyvonen, 2002). In most cases, the different waste flows are collected and treated different in order to optimize reuse. Urine diverting toilets are the most commonly used, whereby urine and faeces are collected separately. Urine is collected using a bowl at the front while the faeces are collected at a rear bowl (Langergraber and Muellegger, 2004).

Urine and faeces contain nitrogen, phosphorus and potassium that can be used in agriculture. Urine contains the highest content of nitrogen, phosphorus and potassium while faeces contain high organic matter. Urine contains 80 % 0f nitrogen, and 55 % of phosphorus in the household waste (Berndtsson and Hyvonen, 2002)

Ecological sanitation applies different technologies ranges that range from simple compost toilets, natural waste water treatments, to complex, (Langergraber and Muellegger, 2004). Due to this flexibility ecological sanitation may allow for adoption in different local situations. Eco-san technology offers the following benefits: recovery of nutrients, prevent pollution of water bodies, conservation of water, improve health through use of nutrients in agriculture and by preventing pollution of water bodies (Berndtsson and Hyvonen, 2002)

Despite its many advantage it faces many challenges due to cultural barriers. At the same time for the technology to function effectively, it demands more effort from the users in comparison with most of the other technologies. Thus, it may be difficult for people to adopt it areas where handling faeces may not be in harmony with the existing culture (Nawab et al., 2008) Moreover, marketing of urine diverting toilets has focused on reuse of nutrients protecting, health and environment. In contrast, the current body of research shows that people are motivated to adopt sanitation facilities to achieve, privacy, cleanliness, dignity and security. Therefore, the health benefits and recycling of nutrients may not persuade users to use ecological sanitation

2.2.7. Pour flush toilet

Pour flush toilet has a pan with a water seal to prevent odour, flies and mosquitoes. The seal is a U shaped conduit partially filled with water. The excreta is flushed manually to the pit or to the sewer network by pouring water 1-3 litres of water in the pan. (Paterson et al., 2007)

2.2.8. Appropriate technology

“An appropriate technology is a technology that offers a socially and environmentally acceptable level of service with full health benefits and at least economic cost” (Loetsher, 1999). Thus, an appropriate technology is context dependant and is based on a combination of economic, technical, environmental and social criteria. On the technology criteria the following parameters are considered: housing density, soil conditions, water supply level among others Further, an appropriate technology should be affordable, institutionally appropriate, socially acceptable and ought to offer utmost health benefits (Loetscher, 1999).

2.2.9. Selection of an appropriate technology

Various approaches are applied in selecting the most appropriate sanitation technology for the community. One of the approaches entails enumerating all the feasible technologies, which is followed by elimination of some, on the basis of technical, health, social and cost. The community is then responsible for selecting the most appropriate technology that meets the community needs at an affordable cost. Another approach entails the use of a multi criteria analysis. In this approach, certain criteria are developed for assessing the different technologies. And each of the selected criterions is weighed numerically on a scale. The degree to which each technology satisfies each criterion is assigned a score on a numerical scale (Kalbermatten, Julius, & gunnerson, 1982). An overall weighed performance value is then calculated for each technology; the technologies are then ranked accordingly. The weighing of the criteria depends on the local situation and there is no universal formula.

2.3 Sanitation provision approach

To achieve the benefits of sanitation, it is important to ensure proper functioning and utilization of the facilities after implementation. Social cultural aspects of a community certainly play an important role in determining utilizing, operation and maintenance of sanitation system by the community. The social culture aspects of a community include religion, culture, belief, needs and preferences. Thus, taking into account these aspects during the planning stage is of capital importance in improving sustainability of sanitation programmes. Two common approaches in provision of sanitation services are described below.

2.3.1 Supply driven sanitation

This has been the traditional approach to sanitation provision in most developing countries. In this approach, the emphasis has been provision of infrastructure as sanitation problems are perceived to be technological problems requiring only engineering solutions. Often, social cultural factors that affect utilization of the facilities are ignored. This situation has been fuelled by the fact that most of the water and sanitation sector employs mainly engineers. So, often they result to offering engineering solutions only. The failure of this approach has been attributed to failure of sanitation programmes to meet the community needs.

In supply driven approach, often no community needs is undertaken. Rather, sanitation need is assumed to exist in the targeted community (Ibem, 2009). In doing so, the community preferences, practices and belief are not taken into account. Further, the technology choice is mostly based on the country policy of what should be implemented where or at times is usually a replication of successful technology carried out elsewhere. Since, there is no much communication between the users and the provider often there arise differences in perceived needs and preferred technology between the users and the providers. Moreover, what works in one place may not work in another place because community needs differ and community acceptability of sanitation systems is affected by social issues like culture and religion.

As a result of excluding the community during implementation of the projects, sustainability of the facilities can be affected, particularly in terms of functioning, use and community acceptance(Nijman, 2008). In addition to operation and maintenance of the facilities in particular, where the community is responsible for the operation and maintenance of the facilities. This is because people have desires that need to be met by the selected technology such as cleanliness, privacy and convenience (Jenkins and Curtis, 2005). In addition their culture and beliefs may affect their choice of technology. Hence, if the technology does not meet their desires and fails to be compatible with their culture, the community may reject it (Nawab et al., 2006). Thus, due to lack of community participation, the projects are prone to high risk of failure in terms of utilization and operation by the people. Reasons for failure includes: the technology not meeting the peoples desire, so the community continue with their old practices or prefer their traditional alternatives. Second, sanitation may not be a felt need in the community or even facilities being located in the wrong place. As a result, the facilities may end up being underutilized, misused or not used at all (Bahadar et al, 2006).The failure of this approach points on the need to take into account social cultural issues.

2.3.2 Demand driven approach

Demand driven is an alternative approach which is increasingly being advocated to overcome the shortcomings of supply driven approach. The rationale for this new paradigm is the recognition of importance of taking into account the users needs and preferences in order to increase success rate of sanitation programmes.

In this approach, the emphasis is on community participation in making decisions during the entire process of the implementation process. In doing so, the social issues that affect utilization and maintenance of facilities like needs, preferences, culture and religion are taken into account. Numerous studies indicate that sanitation systems are more likely to be sustainable in terms of utilization and maintenance if they meet the community needs (Jenkins and Curtis, 2005). In addition, involvement of community is becoming more prominent in developing countries as the government is increasingly delegating responsibility of management of the systems to the community due to the limited finances. Thus, it has become even more critical to involve the community to ensure proper use, operation and maintenance (Nijman, 2008; Ibem, 2009).

In this approach, the targeted community partner with the provider in the entire process of implementation. During the planning stage, the community is expected to identify their needs and the technology that fits their needs and compatible with their culture (Langergraber and Muellegger, 2004; Mara 2003). This enhances acceptability and sustainability of the facilities. The provider is expected to offer advice with regard to different applicable technologies and is also responsible for community training to enhance informed decision making. In addition during the planning stage the requirements for operation and maintenance for the various technologies are identified as often the community is responsible for operation and maintenance of the system.

To incorporate wide community needs often men and women needs are identified separately in small groups to enhance participation. This is because sanitation needs for women and men are differs (Mara 2003; Nawab et al., 2006). For example, research shows that women need for privacy is greater than for men

Usually, during the construction of the facilities, the provider offers technical advice while the community offers skilled and unskilled labour. On completion of the project, the community operates and maintains the system by charging for use of the facilities.

Community participation under demand approach allows for continued use and functioning of the facilities. This is because social issues that affect operation and use are taken into account during implementation. Second, communication between users and providers helps to close the gap between users and providers with regard to perceived needs for the community. Finally, the communities choose the desired technology that matches their needs, expectation and cultural habits (Dellström Rosenquist, 2005; Jenkins & Curtis, 2005).Though the process of involving the community may be long and costly, and the approach is justified on the grounds of increased sustainability of the projects

2.3.2.1. Social issues and sanitation

Community culture, beliefs and religion affects community approach to sanitation since people view sanitation from a cultural aspect. This lead to people accepting certain technology and rejecting others that are not in harmony with their culture. Therefore, involving the community can help in developing feasible strategies that meet the community needs. In addition to

ensuring proper use and operation of the systems. Social issues affecting use of sanitation facilities are discussed below:

a) Religion

Religion influence people approach to sanitation. For example, Muslims religion demands human excreta disposal systems that use water. A case in point is a study done in a rural area inhabited by Muslims in Pakistan. Results indicated that all household wanted a toilet with water for anal cleaning. This implies that promoting dry sanitation technologies, in such an area may not be accepted since the religion demands people to clean after defecation. In addition, the community also had a requirement for positioning of the toilet to avoid facing Mecca as dictated by the religion. This stresses the need for community involvement during implementation of sanitation system. This implies that, any technology implemented in any community needs to meet the requirements of the religion for sustainability purposes

b) Culture and beliefs

In some community open defecation is culturally accepted and installing toilets in the houses is perceived unacceptable(Banda, et al., 2007); Jenkins and Curtis, 2005). In other culture the need for toilets is culturally demanded. For example, the Kikuyu community in Kenya culture stresses the need for a toilet. Often construction of the toilet precedes house construction (WSP, 2004) In other culture, for example, people believe that one can be bewitched if witchcraft gets hold of ones faeces. As a result, such belief dictates the system the community may accept.

c) Personal desires

People acceptance of the sanitation systems is affected by the desire for privacy, convenience, cleanliness, safety and status symbol. Use of the facilities may be limited if implemented technology does not measure up to the people expectation.

2.3.2.2 Ghana

The research was undertaken to establish household demand for improved sanitation. The methodological approach taken was interviewing heads of families who had not installed sanitation facilities in their homes. The results indicated that satisfaction of users was significantly related with the cleanliness and safety of the facilities or the defecation sites. Most people valued convenience and cleanliness of the facilities or defecation sites. The most detested aspects were smell and dirt.

From the study, respondents were dissatisfied with facilities or defecation sites for the following reasons: Smell 27.1%, dirty 26.6%, distance to the facilities 8.3%, lack of comfort 7%, paying to use 6% and sharing facilities 5.8%. Respondents who gave positive attributes for the facility or defecation site enumerated: convenient 26.6% and clean 17.8 % (Jenkins and Scott, 2007)

The motivation for putting up sanitation facilities was mainly for convenience (51%), easy to keep clean (43.1%), good health (41.9%) and general cleanliness (27.8%).

The study shows the expressed needs of the people with regard to sanitation. Thus, for people to be satisfied, the preferred technology needs to satisfy the expressed needs for cleanliness, convenience and safety.

2.3.2.3 Benin

A study was undertaken in Benin rural area to investigate what was motivating the people to invest in toilets, and yet there was no subsidy. To undertake the study, family members with and without toilets were interviewed. The study revealed the main motivators were mainly prestige, increased comfort, privacy, safety and elevation of social status (Jenkins and Curtis,2005; WSP, 2004)

This underscore the need for community participation to ensure their needs are taken into account, during the implementation program. This is important because often promotion of improved sanitation is based on the need of improving community health. On the contrary, this research shows that the need to improve health is often not a priority for the community. This clearly shows that the promoters of sanitation are ignorant of household desires for improved sanitation. Similarly, the users are ignorant of scientific findings on the relationship health and sanitation. As a result, often the users are not motivated to use improved sanitation system they fail to identify with reasons given by the promoters.

This case clearly demonstrates that there exist discrepancy on perception of community needs between the providers of sanitation and the community. The providers look at technologies in terms of achieving health benefits whereas users are motivated by desire for cleanliness, privacy, safety and prestige. Hence, users are looking for the facilities that meet their expressed needs. If the facilities do not meet their needs, health benefits are not likely to motivate the users to use the facilities. This highlights the importance of engaging users in choosing the preferred technology (Jenkins and Curtis, 2005; Rosenquist, 2005; Nawab et al., 2006)

2.3.2.4 Pakistan

A research was undertaken in a rural Muslim dominated area in Pakistan. The aim was to investigate cultural preferences in designing the ecological sanitation systems for the community. To identify the community needs, preferences and desires, data was collected through participant observation and interviewing household members, key informants, women and men focus groups. The conventional and ecological sanitation systems with the possibilities of being tailored to the culture and local context were proposed to the community. However, the community did not adopt either of the two but preferred to pick from the two systems and adapt it to their culture and environment.

The community preferred installing flush toilets with a sewer system and natural waste water treatment (constructed wetlands). The community rejected urine diverting toilets on cultural and religion grounds. For instance, the community viewed urine diverting toilet as an ancient technology symbolising poverty and underdevelopment. It was also challenging to incorporate anal cleansing in the system. Moreover, due to religion concerns of faeces being impure, villagers were resistant to use composted faeces for fertilizing their farms. To stress this

one farmer said "We prefer dying than eating our own faeces." However, the community was willing to use waste water after treatment for agriculture after discussing the potential of the treatment plant in combination with religious documentation (Waste Water Use Decree of Council of leading Islamic Scholars)(Nawab et al., 2006).

These findings clearly show the importance of engaging the community in designing sanitation system. By actively engaging the community, the community changed their perceptions of waste water reuse. Even better, the ecological sanitation principle was adopted to fit in the local conditions. This underscores the need for technologies to be flexible and the need to tailor solutions to fit the local context. In this case, urine diverting toilets were not accepted but the underlying principle was accepted and applied. "People don't have to fit in the existing sanitation systems but rather, the sanitation systems need to suit the requirements of people" (Dellström Rosenquist, 2005)).

2.3.2.5. Mumbai

Supply driven Approach

To provide sanitation facilities in slum areas within Mumbai area, Brinham Mumbai Municipal Corporation (BMC) had adopted the supply driven approach up to the year1995. BMC used to construct and maintain the facilities in the slum. Communities were not consulted to identify their preferences and needs rather, the BMC opted to offer standardised public toilets in all slums within Mumbai. A survey done in the year 2001 indicated that over a half of the total informal population had been provided with the public blocks. The survey estimated that 1/3 of the toilets malfunctioned within 6 months of construction. This was as a result of overuse and lack of water supply.

The same survey indicated only 39% of the blocks had electricity, 14% had water supply and only 31% were connected to sewer while the rest were either connected to septic tanks or aqua-privy system. The latter two systems were prone to frequent blockage.

The blocks were also reported to have additional four problems. First, the blocks were poorly constructed. Second, the blocks offered no privacy as men and women toilets were within the same corridor. Third, some of the blocks that required emptying were located in unreachable places. Finally, the maintenance of the blocks by BMC was poor. As a result, majority of the slum residents preferred open defecation rather than use the dirty toilets (McFarlane, 2007).

Demand driven approach

To mitigate the shortcomings of the supply driven approach, the demand driven approach was adopted to create a sense of ownership by the residents, under the slum Sanitation program. In this approach, the community was involved from the planning stage and is responsible for operation and maintenance of the community blocks. Under this program, community members form Community Based Organization and pay some upfront maintenance fund for the community toilets. BMC provides finances for construction, land, pay for electricity, water connection and where applicable sewer connection. The NGOs and private contractors construct the facilities.

As a result of community involvement the current communal facilities differ from the previous constructed by BMC in several ways. First, all the blocks have separate toilets for men, women and children. Second, the blocks have a room for a caretaker, who is responsible for cleaning of the toilet. Third, all the blocks have storage tank for storing water for hand washing and cleaning while the BMC one lacked reliable water supply. Finally, the blocks designs are different depending on the size of the plot and local preference; some facilities have social gathering place. In addition, on construction, the CBOs operate and maintain the blocks through charging the residents a monthly user fee (Nitti and Sarkar, 2003; Burra et al., 2003; McFarlane, 2007). Though the program is ongoing, it shows noteworthy success. For instance, most of the CBOs collect enough funds for maintenance of the facility. Second, the sanitation situation has improved compared to the previous supply driven approach (McFarlane, 2007).

The case shows the importance of involving the community in designing of sanitation systems. It shows that since the community was involved from the planning stage, the maintenance is even better than when under the BMC. It is noteworthy to a large extent that all community blocks are designed differently, though the same technology was applied under supply driven approach. Thus, the communities were still able to incorporate their desire in the community block layout. For example, all blocks are reported to have separate place for men, women and children. In addition, all blocks have a caretaker room and because he lives within the block, this could motivate him to keep it clean.

2.4 Conclusion

It is not in doubt that provision of sanitation is important for protecting health and environment. However, recent research shows that the community desire for improved sanitation is to achieve privacy, cleanliness and elevation of social status. In fact, improved health rarely motivates community to use sanitation facilities. Thus, the community may reject sanitation facilities that fail to meet their desires. Therefore, to achieve sustainable use and maintenance of the facilities, it is important to involve the community to identify their preferences and desires.

Supply driven approach has been the traditional approach in the provision of sanitation services in most developing countries. The approach has resulted

failed to offer sustainable solution due to the failure to take into account the users' need. Thus, there has been a shift to demand driven approach.

Demand driven approach in provision of sanitation increases the chances for proper use, operation and maintenance of facilities. This is because users' needs in terms of preferred technology, desires like cleanliness, comfort and convenience are taken into account. In addition Culture, religion and beliefs influence peoples' choice of sanitation systems. Research done in a Muslim dominated area is a good evidence of the need to involve people in designing sanitation systems.

Residents in this area rejected urine diverting toilets due to their religion teachings. However, the principle behind it was tailored to suit the local context, which enabled the people to accept an ecological approach to sanitation. In addition research done in Benin and Ghana showed users motivation to use sanitation system is to gain privacy, cleanliness and prestige and not health as promoted by advocators of sanitation. Thus, for facilities to be used these expressed desires need to be met.

Urbanisation in the developing countries is expected to continue. The increase in population will mostly be absorbed in the slums and peri urban areas. In fact, in Africa slum growth rate is almost equal to the urban growth rates at 4% and 4.6%. This means that the situation can only get worse if nothing is done to address the sanitation situation.

3 Analytical framework and methodology

This chapter details the strategy employed and the methodology used to collect the data for the research project. The chapter begins with the description of the research design followed by the analytical framework employed and the research methodology. The research methodology describes the different methods that were employed to collect data namely: semi structured interviews, questionnaires, observation, photographs, literature review and document review. The chapter winds up with the description of how the data was stored and analyzed.

3.1 Design of the research

The research started with review of literature to get theories and concepts to guide the research, choice of research strategy and methods. The second phase involved developing an analytical framework to guide the research. This was followed by field data collection from the providers and the users. The data collected was then analysed and a report compiled. The field research was undertaken in Kibera slum in Kenya from November 2008 to January 2009.

3.2 Analytical Framework

Analytical framework shown in figure 1 was developed to guide my research. The framework was employed to collect the users' and the providers' views with regard to communal sanitation facilities.

In this research, the focus was the communally managed toilets. The unit of analysis was the communal sanitation facilities, where I focused on four different technologies namely biogas toilets, pour flush, VIP and water cistern toilets.

3.3 Research methodology

The research design for the study was a case study of Kibera slum.
To get the providers' views, data was collected from Non Governmental Organizations (NGOs), Community Based Organization (CBOS) and government water and sanitation bodies (AWSB and NWSC). Similarly, to get the users' views, data was gathered from the users of the various facilities. The study was undertaken in the selected facilities located in 7 villages within the Kibera slum.

Analytical framework

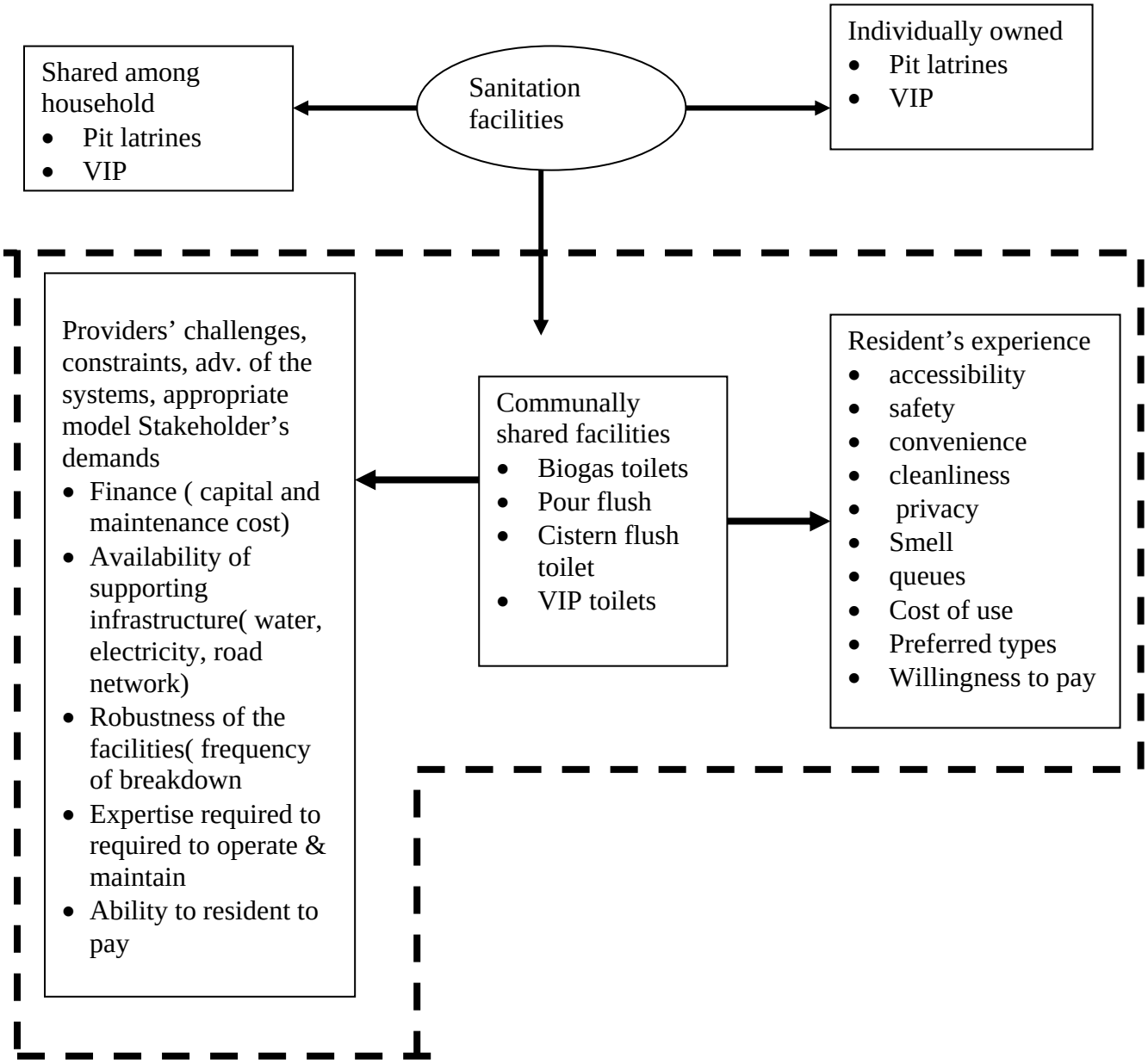

Figure 1: Analytical Framework

The data was collected using a combination of methods namely:

- Literature review
- semi structured interviews with key informants
- Users questionnaire
- Direct observation
- review of documents
- Photography
- Review of the secondary data

A total of 16 interviews were conducted for the providers while for users a total of 76 questionnaires were administered.

3.3.1 Semi structured Interviews

Semi structured interviews were employed to collect data from the providers namely: CBOs, NGOs, AWSB and NWSC. To obtain the providers' views on communal sanitation facilities, providers were asked questions on sanitation situation in Kibera, partnership with the various stakeholders, challenges faced, roles in sanitation provision, technology selection, performance of the facilities, affordability, appropriateness of the technologies, operation and maintenance of the facilities. A total of 16 interviews were conducted. Table 2 shows the distribution of the interviews conducted.

Table 2: Stakeholders interviewed

Stakeholders	No of interviews
NGOS	7
NWSC	1
AWSB	2
CBOS	6

In addition, before commencing the research, preliminary semi structured interviews were conducted with the NGOS, CBOs and government agencies. The aim was to familiarise myself with the study area, fine tuning the plans and strategies for data collection prior to conducting the users' survey.

3.3.2 Users Questionnaire

a) Sampling plan

Villages within Kibera slum were purposively selected to include only villages with the identified sanitation facilities. 7 villages were identified where four different technologies have been implemented namely: Ventilated Improved toilets, pour flush, water cistern toilets and bio gas toilets.

b) Questionnaire design

Questionnaire was first developed through reviewing literature. On discussing with 2 NGO social workers, the questionnaire was modified to enhance data collection. This was followed by pretesting with the users of the facilities. The questionnaires were refined following pretesting before the administering for the survey.

The questionnaires were administered onsite on the users of the selected communal facilities. Administration of questionnaires was in Kiswahili language since most of the users were comfortable speaking the language. A total of 76 questionnaires were administered. Table 3 shows the distribution of questionnaires for the different facilities under the study.

Table 3: Distribution of questionnaire per technology

Type	No of facilities	No of questionnaire
Biogas toilets	2	20
VIP toilets	2	20
pour flush	2	24
WC toilet	1	12

User's questionnaires were administered to gather information on the users views on the different sanitation facilities. Respondents were asked to rate performance of the facilities in terms of cleanliness, privacy, convenience, safety and accessibility on a 5-tier scale (very poor, poor, neutral, good and very good). Additional questions addressed the issue of smell, users satisfaction, improvements desired, preferred sanitation facilities and affordability

The questionnaires were administered with the assistance of 5 research assistants, who have experience in conducting research in similar settlements.

3.4 Field observation

The method was employed to collect data on the types of facilities, the current status of the facilities, operation procedures, and the general surrounding conditions and for triangulation purposes.

3.5 Photographs

Photos were taken to document the condition of the facilities, the surrounding, general sanitation situation, and general outlook of the settlement and for visual presentation in the research report.

3.6 Documents review

The method was employed to collect background information of the study area. Secondary data was collected from the Government agency (AWSB), NGOS and WSP reports.

3.7 Data storage and validation

Data collected from the providers was validated by discussing the data with the providers whereas for the users, open ended questions were used to check the consistency of the data. Data collected through questionnaires was stored in an excel sheet in form of tables while interview data was recorded in a daily sheet in a word document. Similarly, where applicable, data collected through observation was stored in a daily sheet in a word document.

3.8 Data Analysis

Data collected was analyzed using various methods; description, narratives, descriptive statistics and comparing statistically. Data collected on cleanliness, privacy, convenience, safety, accessibility and satisfaction was first transformed

linearly on a scale of 0-100.The results were then analysed by conducting a pooled t test.

3.9 Limitation of the study

The affordability of the users' charges is based on their responses, no effort was made to determine the economic status of the users.

3.10 Conclusion

An analytical framework was used to guide the data collection to assist in identifying the type of information to collect, source of information and method of data collection. To conduct the study, a case study of Kibera slum was undertaken. Data for the study was collected using interviews, questionnaire, observation and photography. Semi structured interviews were used to collect the providers' views where as a structured questionnaire was employed to collect users' views.

4 Communal Sanitation facilities in Kibera Slum

This chapter presents the types of facilities studied and the stakeholders involved in provision of the facilities. It begins by describing the study area, then moves on to describe the facilities and the role played by the various stakeholders, during the implementation and the operation of the facilities. Finally the chapter concludes with a summary.

4.1 Description of Study area

Kibera is an informal settlement, located 7 kilometres south west of Nairobi, the capital city of Kenya. The settlement covers an area of 250 hectares with an approximate population of 500,000 people; the population density translates to 2000 people per hectare. The settlement annual growth rate is estimated at 12 %(WSP, 2000). Figure 2 shows the map Nairobi showing the location of Kibera. Table 4 shows the estimated population of residents in Kibera.

Kibera lies on a flood plain and like other slums; it is characterized by high population densities, lack of basic infrastructure and services like water, sanitation services, solid waste management, roads, and electricity. Other problems that characterize Kibera include a haphazard layout and high poverty incidences. Figure 3 to 4.2d shows the sanitation situation in the study area.

The settlement is an informal settlement since the residents have settled illegally on the government land. The slum is composed of 12 villages namely: Kianda, Mashimoni, Silanga, Gatwekera, Kianda, Lindi, Line Saba, Soweto East, Soweto West, Kisumu ndogo, Lindi and Raila.

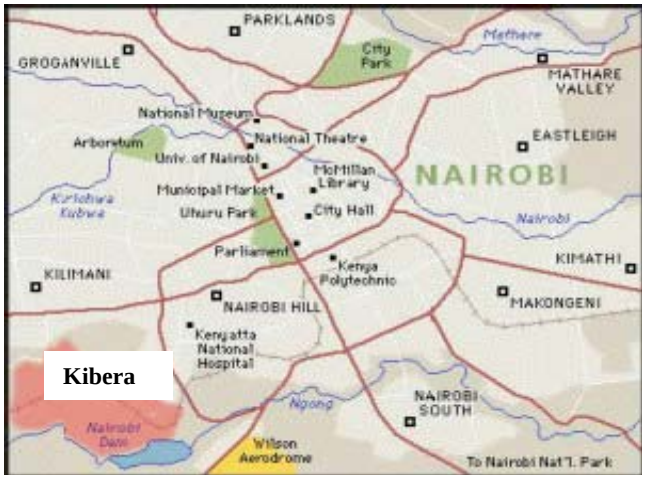

Figure 2: A map of Nairobi showing the location of Kibera
Source (www.hassconsult.co.ke)

Table 4: Population of villages in Kibera

Village	Population estimates(2003)
Makina	69,225
Mashimoni	22,625
Silanga	43,250
Gatwekera	55,425
Kianda	33,600
Lindi	45,450
Kambi Muru	10,600
Soweto East	53,725
Soweto West	15,530
Line Saba	53,250
Kisumu Ndogo	27,625
Raila	22,850
Total	453,175

Source: Pre investment study for ADB bank: Managing water for African cities UNHABITAT (2008)

Figure 3: Unplanned Kibera
(Photo taken by author)

Figure 4: Hanging toilet discharging the content to the drainage channel
(Photo taken by author)

Figure 5: Drainage channel full of solid waste
(Photo taken by author)

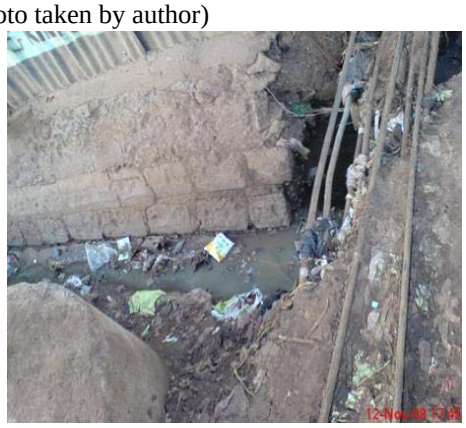

Figure 6: Potable water pipes lay close to grey water channel
(Photo taken by author)

4.2 Type of Sanitation facilities

Seven communal sanitation facilities were identified for the study, through a discussion with the NGOs involved in the implementation of the facilities. The facilities are of four different types of sanitation technologies namely: Ventilated improved toilets, pour flush toilets, water cistern toilets and biogas toilets. Figure 7 to 10 shows the schematic drawings of VIP, biogas toilet, pour flush and WC toilets. Table 5 gives an overview description of the facilities under the study. Unfortunately, it was not possible to get an estimated construction cost of Makina pour flush and Soweto VIP. This is because the people who were involved had left the NGOs to work in other places.

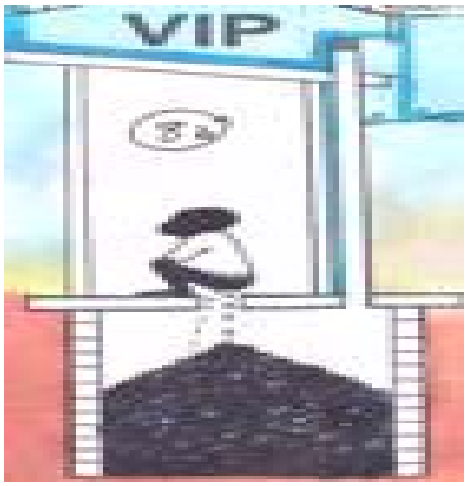

Figure 7: Drawing of the VIP toilet
Source: Oleja, 2008

Figure 8: Drawing of the biogas toilet
Source: Oleja, 2008

Figure 9: Drawing of the pour flush toilet
Source: Oleja, 2008

Figure 10: WC system
(Photo taken by author)

Table 5: Overview description of facilities

Type	location (village)	construction cost(estimate)	Construction (year)	Operation (year)	Users (day)	Emptying Frequency and cost (monthly)	
VIP	Soweto	N/A	2003	2004	500	After 2-3 months	€160
VIP	Line Saba	€15000	2004		600	Every 5-10 days	€300
Biogas toilet	Line Saba	€18000	2003	2003	350-550	N/A	N/A
Biogas toilet	Gatwekera	€ 26000	2006	2007	500-650	Every 4 months	€100
pour flush	Makina	N/A	2006	2006	450-800	N/A	N/A
pour flush	Kianda	€ 9000	2003	2003	100-120	Every 2 weeks	€ 80
WC	Silanga	€13000	2008	2008	50	N/A	N/A

4.3 Description of the facilities/ Roles of the stakeholders

Of the chosen 7 facilities, 6 were financed by different NGOS while Makina pour flush was financed by the UNDP. All the facilities have a water connection, bathrooms and are managed by the various CBOs. The water is billed at a flat rate of an equivalent of €0.01 for $10m^{3.}$ This is in strong contrast to formal estates, which are charged on an increasing block tariff ranging from € 0.12-0.20 per $10m^{3.}$ Table 6 shows the various stakeholders involved in provision of sanitation facilities.

Table 6: Stakeholders involved in sanitation provision

Governmental agency	NGOS	CBOS
AWSB	Maji an Ufanisi	Ushirika wa Usafi Line Saba
NWSC	KWAHO	Soweto Usafi Group
	Umande Trust	TOSHA
	Practical Action	Al-Swaafa youth Organization
		Ushirika wa Maisha Kianda
		Silanga Development CBO

The current communal facilities are: VIPs, pour flush toilets, water cistern toilets and biogas toilets. The stakeholders involved in the provision of these facilities are CBOs, NGOs, NWSC, AWSB and the Users.

The NGOS finances the construction of the facilities, initiate the projects, organize and build the community capacity in operation of facilities. The CBOs are involved in operation and maintenance of the facilities. NWSC authorizes all the water connection and is currently financing the extension of the sewer line in Kibera while AWSB is concerned with the policy direction.

4.3.1 Soweto VIP

Figure 11: The selected Soweto VIP toilet
(Photo by the author)

Construction of the facility was financed by Maji na Ufanisi. After construction, the facility was handed over for management to Soweto Usafi group CBO. The facility has been in operation for four years and is comprised of 4 toilets, 2 bathrooms and 2 water storage tanks. The toilets and bathrooms for men and women are clearly marked. However, in practise, they are shared without consideration of gender.

Overall, the toilet seems to be well constructed, well maintained and strategically located near the road. The surrounding area seems to be clean, with no human waste from the toilet.

4.3.2 Line Saba VIP

Figure 12: The selected Soweto VIP toilet
(Photo by the author)

Construction of the facility was financed by Maji na Ufanisi. On completion, the facility was handed over for management to Ushirika wa Usafi Line Saba CBO. The facility has been in operation for 4 years and is comprised of 5 toilets, 5 bathrooms and 3 water storage tanks. The toilets and bathrooms are clearly marked for men and women though in practice, they are shared without

consideration of gender. At the time of visiting, only 2 toilets were in operation while the other 3 were full. The lack of money for emptying was attributed a case the CBO had pending in court over vandalization of their water system. The CBO reported to have spent approximately €1000 on the case.

The toilet seems to be well constructed and strategically located near the road. The surrounding area is clean, with no human waste from the toilet. Overall, the facility seemed not to be well maintained.

4.3.3 Line Saba biogas toilet

Figure 13: Line Saba Bio gas toilet
(Photo taken by author)

Figure 14: The multi purpose hall
(Photo taken by author)

Figure 15: A bio digester
(Photo taken by author)

Figure 16: Line Saba rental houses
(Photo taken by author)

Construction of the facility was financed by Maji na Ufanisi. After construction, the facility was handed over for management to Ushirika wa Usafi line Saba CBO. The facility has been in operation for 5 years and is comprised of 6 bathrooms and 8 toilets, a caretaker office and a water storage tank. The toilets and bathrooms for men and women are clearly marked though in practice, they are shared without consideration of gender. In the same compound, there is a multi purposes hall: week days, it is usually a nursery school and over the weekends, it is occasionally hired for meetings. In addition, there are 3 rental houses owned and managed by the same CBO. Biogas produced in the toilet is utilized for cooking in the nursery school and for warming water for bathing.

Overall, the toilet seems to be well constructed, well maintained and located near the road with drainage systems around the facility. The surrounding area is clean, with no human waste from the toilet.

4.3.4 Gatwekera biogas toilet

Figure 17: Gatwekera biogas toilet
(Photo taken by author)

Figure 18: Biogas cooker
(Photo taken by author)

Construction of the two storey building was financed by Umande Trust. After construction, the facility was handed over for management to TOSHA CBO. The facility has been in operation for two years. The CBO has rent out the first floor: one room is currently a restaurant, the other one is an office for a local football club. The second floor is a hall which is hired out on request and also a meeting place for the CBO members. The CBO operates the toilets and bathrooms located on the ground floor. There are 5 bathrooms and 9 toilets, a caretaker office and a water storage tank. The toilets and bathrooms for men and women are separate and have separate entrances. The biogas produced is utilized for cooking in the restaurant and for warming water for bathing. The owner of the hotel pays for use of biogas and the room at a cost of 3500 shillings per month (an equivalent of 35 Euro).

The toilet seems to be well constructed, well maintained and strategically located near the road with drainage systems around the facility. The surrounding area is clean, with no human waste from the toilet.

4.3.5 Makina pour flush toilet

Figure 19: Makina pour Flush toilet
(Photo taken by author)

Figure 20: inside of the toilet
(Photo taken by author)

Construction of the facilities was financed by KWAHO. After construction, the facility was handed over for management to Al Swaafa youth welfare organization CBO. The facility has been operation for 2 years and is comprised of 4 toilets and 4 bathrooms. The facility is connected to a sewer line. Toilets and bathroom for men and women toilets are separate. The facility is located within a local mosque compound. The water for use in the facility is fetched from the mosque borehole at a cost of 200 shillings per day. Overall, the facility seems to be well constructed, well located and accessible to the users.

4.3.6 Kianda pour flush toilet

Figure 21: The selected Kianda pour flush toilet
(Photo taken by author)

Construction of the facilities was financed by the UNDP. On construction, the facility was handed over for management to Ushirika Wa Usafi Kianda CBO. The facility has been in operation for 5 years and is comprised of 6 toilets, 4 bathrooms and a care taker office. The toilets for men and women are separate. The toilet is connected to a septic tank.

Overall, the toilet seems to be well constructed, well maintained and located near the main tarmac road quite close to a bus stop. The drainage system around the facility carries very filthy water from the settlements and could be the source of the smell experienced by the users. Surprisingly, despite being close to the bus stop, it seemed to have a few users per day.

4.3.7 Silanga WC toilets

Figure 22: Silanga WC toilet
(Photo taken by author)

Construction of the facilities was financed by Practical Action. After construction, the facility was handed over for management to Silanga development CBO. The facility is connected to a sewer line. The facility has been operation for 3 months and is comprised of 4 toilets, 4 bathrooms, a laundry place, a storage tank and a caretaker office. The toilets and bathrooms for men and women are separate.

Overall, the facility seems to be well built but did not seem to be well located. Accessibility may be poor particularly, during the wet seasons because the area lacks storm water drainage system. In addition the paths to the facilities are very narrow.

4.4 Tariff for different facilities

Users pay to use the facilities. Different tariffs are applied for different sanitation systems. The fee is either per visit or an upfront monthly family charge. "Pay and use" mode of payment is applied in Line Saba biogas toilet, Kianda pour flush, Line Saba and Soweto VIP toilets whereas both family monthly subscription and " pay and use" are applied for Makina pour flush, Gatwekera biogas toilet and Silanga WC toilet.

It seems for the facilities requiring emptying, only pay as you use charges are applicable. This is possibly because the monthly charges are cheaper than the pay as you use. And faced with high cost of emptying, the CBO opt to charge per visit. Table 7 shows charges applicable for various facilities. It is worth noting that the monthly subscription only applies for toilet access by the family members. In all facilities, use of bathrooms are charged per visit. From the table, the cheapest toilets are Soweto VIP, Silanga and Gatwekera where members pay an equivalent of 0.02 euro per visit. The charge is 2.5 times cheaper than the highest tariff charged by Makina and Kianda pour flush toilet. Generally, the monthly tariff is cheaper than the pay per visit as two residents put it.

"This monthly charge is affordable because we pay only once per month and is cheaper than paying per visit."

"I prefer monthly charges because at times we may not have the 2 shilling when we need to use the toilet"

Table 7: Tariffs applicable per facility

Facilities	Toilet charges per visit (€)	Bathroom charges per visit in (€)	Monthly family subscription(€)
Soweto VIP	0.02	0.03	N/A
Line Saba VIP	0.03	0.05	N/A
Gatwekera biogas toilet	0.02	0.05-0.10	0.8
Line Saba biogas toilet	0.03	0.05	N/A
Makina pour flush	0.05	0.05	1-3
Kianda pour flush	0.05	0.05	N/A
Silanga WC	0.02	0.04	1-3

4.5 Record keeping in different facilities

Attendants keep track of the numbers of users per day and the daily revenue collection. Each tissue paper is cut into predetermined pieces, which ranges from 28 - 50 pieces. Each user is given one piece per visit. Buying receipt books was perceived to be costly, thus the CBOs opted to save on cost by counting the number of tissues used per day. The receipt book cost on average 6.5 euro and lasts for an average of 10 days. However, in Silanga the number of users is monitored through receipts issued.

4.6 Stakeholders roles

Various stakeholders play different complementary roles in provision of sanitation facilities in the area. The NGOs finances the projects, mobilize the communities, build CBO capacity and offer support during operations of the projects. The CBOs help in mobilising the community in addition to managing the facilities. NWSC authorizes water connections and AWSB is concerned with the policy development.

In addition, in Silanga and Soweto toilets, the NWSC extended the sewer lines to the two facilities while AWSB partly financed the construction of Silanga toilets. Table 8 shows the various stakeholders that were involved in specific projects.

Table 8: Stakeholders involved

Managers(CBO)	Village/Facilities	Financiers	Government Agency
Soweto Usafi group	Soweto VIP	Maji na Ufanisi	NWSC
Ushirika wa usafi line Saba	Line Saba biogas toilets and VIPs	Maji na Ufanisi	NWSC
Tosha	Gatwekera biogas toilets	Umande Trust	NWSC
Al Swaafa youth welfare organization	Makina pour flush toilets	KWAHO	NWSC
Ushirika Wa Usafi Kianda	Kianda pour flush	UNDP	NWSC
Silanga	Silanga flush toilets	Practical Action and AWSB	NWSC and AWSB

4.7 Demand and supply roles

Demand side refers to the community while the supply side refers to the providers of the facilities.

4.7.1 Initiators and Community mobilisation

Supply side initiated all the sanitation facilities. Community mobilisation for the different facilities were undertaken differently by the various NGOs involved. Kianda pour flush toilets were initiated by the UNDP while the rest of the facilities were initiated by the NGOs.

For Soweto VIP toilets, the community members was mobilised by Maji na Ufanisi through community leaders. The communities formed CBOs that later merged to form an umbrella CBO by the name of Soweto Usafi group.

For Gatwekera biogas toilet, the community members were mobilised by Umande trust through the local residents. For Line Saba, community members, were mobilised by APCOME (African network, prevention and protection against Child abuse).However; the NGO lacked technical expertise on water and toilet provision and therefore referred the community to Maji na Ufanisi

CBOs members managing Silanga flush toilets, Makina pour flush and Kianda pour flush were approached by Practical action, KWAHO and UNDP respectively. The three CBOs were in existence and were undertaking clean ups activities in their respective areas.

4.7 2 Planning

Planning stage entails identification of the community needs, technology selection and community training to enhance informed decision making. CBOs were involved in different ways during the planning stage. According to the NGOS involved, In Soweto VIP, Line Saba VIP, Gatwekera bio-toilet, Silanga, and Line Saba biogas toilet CBO members participated in the need assessment, prioritization and technology selection. However, CBO members for line Saba and Gatwekera biogas toilets indicated the technology was chosen by the financier. This makes sense since the users may not have a choice when

financiers opt to promote a specific technology. During the selection stage, the technology may have been given more emphasis than the other applicable technologies. For Makina pour flush toilets, CBO members were not involved in the need assessment. CBO members were requested to choose the preferred technology. In contrast, Kianda pour flush community members were not involved in planning stage at all. Rather the UNDP contracted Practical Action to undertake construction of the facilities.

4.7.3 Site selection

For all the facilities, site selection was undertaken by the demand side. Community members searched for space for all the facilities and did the processing of the legal documents. The legal document entails signing a memorandum of understanding between the landlords and the CBO. This is important to avoid landlords reclaiming ownership of the space after the implementation of the programmes. For Soweto and Line Saba VIP, initially the site had pit latrines owned by 'landlords". The "landlords" forfeited the space for free because they were CBO members. For Gatwekera, the "landlord" was compensated by being allocated one toilet and a bathroom for his personal use.

In Line Saba biogas toilet the owner was paid 300,000 shillings (equivalent of 3000 Euros) for the space. This amount is substantial but the space is equally large: it hosts the CBO meeting hall, rental houses and the toilets. For Makina pour flush toilets, the space was given for free by a local mosque. In Kianda and Silanga the location was serving as undesignated dumping sites, thus no compensation was necessary.

The two VIPs, biogas toilets and Kianda pour flush are located near the road to allow for accessibility particularly, for emptying purposes. Makina pour flush is located in an accessible place but not near the road. For silanga, accessibility may be restricted during the wet seasons because the area lacks storm water drainage system. In addition the paths to the facilities are too narrow. It is worth noting that Makina and Silanga toilets are sewered. Thus, a site close to the roads may not have been a major consideration.

4.7.4 Construction

In 6 of the facilities community members were involved during the construction of the facilities while in one of the facility the community was not involved. Community members offered skilled and non skilled labour during the construction. Construction was undertaken by the community members with the supervision and technical advice of the NGOs for the following facilities: Soweto VIP, Gatwekera biogas toilet, Silanga, Makina pour flush, Line Saba VIP and bio gas toilet. However, for Kianda pour flush the locals were not involved during the construction. Rather, the financier contracted Practical Action to undertake the construction.

4.7.5 Management and Operation

Apart from Kianda pour flush the NGO provide capacity building on financial management, operation, maintenance and also offer technical support.

All the sanitation facilities are managed by an elected committee in charge of day to day operations. To maintain the facilities, the community members pay for use of the facilities. The committee employs an attendant to collect a fee from the users and clean the facility. For Soweto VIP, Kianda pour flush, Line Saba VIP and biogas toilet, the attendants are usually members' children's or relatives and are swapped every month. However, in Makina the members take turns in charging users and keeping the facility clean. In Silanga and Gatwekera, the attendants are engaged from the neighbourhood of the toilet. The attendants are paid about 70-100 shillings per day (equivalent of 0.7 to 1 euro). All the facilities operate from 0600 to 20.00 hours.

4.8 Conclusion

Kibera is a large slum covering an area of 250 hectares with an estimated population of 500,000 residents. The slum is growing at an estimated rate of 12 % annually. Different institutions are providing the residents with communal sanitation facilities to address the poor sanitation situation in the slum. For this study, we selected a few of the communal facilities. The facilities studied are the VIPs, pour flush, biogas and WC toilets.

5 Results and Discussion: Providers perception

This chapter describes the providers' views with regard to various aspects of sanitation provision. To get the views and the perspectives of the various stakeholders, several questions were posed and the responses are documented in this chapter. First, the various providers interviewed are listed followed by their views on sanitation situation in the study area. Issues in the rest of the chapter are discussed in this order: sanitation situation in the study area, technology selection, challenges faced during the implementation of the facilities, performance, appropriateness, affordability, financing, partnership and finally a conclusion of the chapter.

The providers identified were 6 CBOS, 4 NGOS and two government agencies namely AWSB and NWSC.
To get the perspective of the various stakeholders, several questions were posed to the various providers.

5.1 Sanitation situation

Question: How is the sanitation situation and how easy is it to improve it? A summary of the responses received are presented below.

All the providers perceive the sanitation situation in Kibera to be poor. This is because majority of the residents use pit latrines. These pit latrines are overused since in some areas up to 200 people share a single pit latrine. Moreover, majority of these facilities are poorly constructed, unhygienic and discharge the waste to the storm water drains due to the inaccessibility and the high cost of emptying. Hence, most of the pit latrines are equivalent to "improved" designated open defecation sites and thus contribute in degradation the immediate environment. Figure 23 and figure 24 show the poor condition of most of the pit latrines in Kibera. Figure 23 shows a traditional poorly constructed toilet. Figure 24 shows a toilet designed to discharge the content directly to the storm water drainage channel.

Figure 23: A poorly constructed toilet
(Photo taken by author)

Figure 24: A hanging toilet
(Photo taken by author)

Improving the sanitation situation is perceived to be difficult for varying reasons. Maji na ufanisi perceive it to be difficult due to the many years of neglect. This has resulted to many people lacking access to sanitation facilities, in addition to lack of space for putting up the facilities. Thus, any attempt to improve the sanitation situation often demands destroying the houses to create space for putting up the infrastructure. The NGO respondent said, “Any effort geared towards improving the sanitation situation, often results to stepping on many people’s toes”. Likewise, Umande Trust perceives it equally difficult since the only appropriate sanitation facilities are communal facilities. The NGO perceives these facilities to have a major limitation in improving the situation, since they can only be used daytime. Moreover, the insecurity in the area, further limit their use. Similarly, Practical Action and NWSC perceive it to be difficult since on one hand, the finances are limited and on the other hand, the demand for the facilities is high. In contrast, KWAHO perceive improving the sanitation to be easy on condition that the locals are involved and the right technology chosen.

5.2 Technology selection criteria

The Question was: What factors do you consider when putting up sanitation facilities? The responses I got are as below:

The perception of the providers is that limited infrastructure in the slums, limits the technologies options availed to the community. For instance, limited sewer line and unreliability of water in the area, forces most of the NGOs to implement technologies requiring emptying. This translates to high operation cost for the CBOs.

Umande and Maji na Ufanisi perceive biogas toilets to be the best technology for areas with unreliable water supply and lacking a sewer line. This is because the only other alternative is VIP technology. Biogas toilets are perceived to have less emptying cost due to less frequency of emptying in comparison with the VIPs. Further, the biogas from the toilet can be utilized by the community. This translates to less operation cost for the CBOs.

On the contrary, Practical Action perceives the biogas toilets to be inappropriate as it entails biological processes that are sensitive. Hence, the technology demands proper operation to avoid failure or disruption of the biological process. To prove that the technology is not appropriate, the NGO argues that they piloted one biogas toilet in Kibera but failed due to poor operation. The biogas toilet was later converted to a pour flush toilet. On the basis of this , the NGO argues that the best technology in the areas with no sewer line is a pour flush toilet connected to a septic tank.

All the NGOs perceive a sewered toilet (WC or pour flush) to be appropriate in areas with a sewer line .This is because of low cost of operation as no emptying cost is incurred. In addition, the water is sold at a subsidised rate.
Thus, It seems the selection of the appropriate technology is based on the availability of infrastructure and operation cost. Capital cost and people preferences seem not to be major criteria.

5.3 Challenges

The question was: what challenges do you face during the implementation of the facilities? The responses were as follows:

Different stakeholders face different challenges during the implementation of sanitation facilities. The haphazard layout of the settlement is perceived to be the major challenge by all the NGOS. This has three major impacts. First, it results to unavailability of leeway for laying the infrastructure and space for putting up the facilities. Second, it leads to lack of roads. This particularly, increases the cost of transporting construction materials to the site. In addition, it renders some of the villages inaccessible. For example, most water storage tanks are transported by rolling over the house roofs.

Maji na Ufanisi identified an additional challenge to be the donor dependence mentality of the residents. As a result, most residents tend to participate in projects only if they are paid. On the other hand, bringing together people from different cultural backgrounds is perceived to be a major challenge by Umande trust.

KWAHO perceives the poor soil formation to be the major challenge. It translates to high cost of installing facilities to avoid collapsing, especially for VIP toilets. On the other hand, NWSC perceives the major challenges to be financing, political interference, low prioritization of sanitation by some of community members and lack of a coordinated approach among the stakeholders and interventions implemented.

High cost of emptying is perceived to be the major challenge for CBOS operating systems demanding emptying. For example, for Soweto VIP, emptying of the pit is done after every 2-3 months at a cost of Ksh 16000(equivalent of €160). This cost is double the CBO's other monthly cost.

For Line Saba VIP the frequency of emptying is also perceived as an additional challenge. Exhausting the pits cost the CBO 10,000 shillings (equivalent of €100) after every 5-10 days. As a result, the Line Saba VIP at times closes down due to lack of money for emptying. The high frequency of emptying is possibly due to the hardening of the sludge at the bottom of the pit. Thus, the emptying is not efficiently done due to the hardening of the sludge at the bottom. Figure 25 shows how emptying is done manually.

For CBOs operating biogas toilets, the sensitivity of the system is perceived to be the major challenge. This is because the biogas toilets involve biological processes, which can be easily, be disrupted by pouring detergents and water into the system during the normal cleaning. Besides, the users at times throw polythene bags into the pit which have potential of blocking the bio digester.

Figure 25: Scavengers emptying Line Saba VIP toilet
(Photo taken by author)

For Makina pour flush toilet the main challenge is frequent power interruption. This interrupts the operation of the facility as the CBO relies on electricity to pump water for use at the facility. The CBOS also face additional challenges of misappropriation of revenue by the toilet committee members. In addition, water cartels in the slum vandalize CBOs water connection. This is because the CBOs sell water at a much cheaper cost than the cartels.

5.4 Performance of the facilities

The question was: How would you rate the performance of the facilities?
The responses are as follows:

Different providers have varied views on the performance of the facilities. All the four NGOs perceive the sanitation facilities successful. On the other hand, CBOS rate the performance of the facilities to range from low to high depending on the operation costs incurred.

Maji na Ufanisi views the biogas toilet in line Saba, VIP facilities in Soweto and Line Saba to be successful. The success is evidenced by the fact that the CBOs, meet the maintenance costs and maintain an acceptable level of the cleanliness. Other reasons given are the CBOs have acquired meeting halls from the revenue generated from the toilets. Moreover, some of the CBOs members, have started small scale businesses, courtesy of entrepreneurial training offered by the NGO. Figure 26 shows a business operated by one of the CBO member

The NGO attribute these successes to participation by community members, demand for sanitation facilities, low maintenance cost, capacity building of CBOs members continuous support from the NGO and ownership of the facilities by the community members.

On the other hand, Soweto Usafi group CBO members perceive the performance of the VIP to be average due to the high cost of emptying. For instance, at times all the revenue collected is used to finance the emptying

costs. The other reason is the infighting among committee members. This at times derails decision making and creates mistrust among the committee members. The CBO attributes the success achieved so far, to the commitment of the CBO members and the continuous support from NGO.

Figure 26: A shop owned by one of the CBO member
(Photo taken by the author)

The CBO for Line Saba, perceive biogas toilets successful due to low operation cost. On the contrary, the performance of the VIP toilet is perceived to be low, due to the high cost of emptying the facility. The CBO attribute the success achieved so far, to awareness of importance of sanitation and the financial benefits derived by the members.

Umande Trust, perceive Gatwekera biogas toilet to be successful. Since it serves many users, generate revenue from the biogas and due to low cost of emptying. On the other hand, the CBO rate the performance to be average, mainly due to the unreliability of water and constant infighting among the members. The unreliability of water forces the CBO to buy water from the vendors. Thus, increasing the expenses incurred. However, the CBO attributes success achieved so far to constant support from the NGO and also the commitment of the members.

KWAHO perceives the Makina pour flush to be successful due to the ownership demonstrated by the CBO, capacity building and continuous support from the NGO. Similarly, the CBO perceives it to be successful since it has reduced the use of flying toilets in the area. The CBO attribute the success to maintaining good communication with the users.

Practical Action perceives Kianda pour flush to be successful because the CBO members are able to: maintain the cleanliness, to meet expenses and continued willingness of the users to pay. In addition, the facility serves many people. On the contrary, the CBO performance to be low, due to high cost of emptying incurred.

Thus, it seems the NGOs rate all the facilities to be successful because the CBOs are able to maintain the cleanliness, pay workers and pay running cost. However, the CBOs seems to rate the performance of the facilities depending on the operation costs. The CBOs incurring high costs in particular for emptying,

gauge the performance to range from low to average. Thus, there seems to be a discrepancy on the indicators of success between CBOs and NGOs. The NGOs seems to gauge the success depending on the continuous running of the system while the CBOs gauge the success based on the operation cost of the system.

5.5 Appropriateness

The question was: how appropriate are the facilities?
The answers are given are as below:

Communal facilities are perceived to be the only feasible solution in the area. Individual facilities are perceived to be inappropriate due to lack of space in the area. The NGOs financing the biogas toilets perceive the technology to be appropriate for areas with unreliable water and lacking a sewer line. This is because the technology uses very little water. In addition to reduced frequency of emptying in comparison with the VIP toilets. Similarly, line Saba CBO shares the same opinion. On the contrary, TOSHA CBO perceives the biogas toilet inappropriate due to the strong odour emitted by the toilet. The operation efficiency is perceived to be lower than the standard. This is attributed to the poor designing of the facility.

All the providers perceive pour flush toilet or WC toilets to be appropriate for areas with a sewer line. This is because of reduced operation costs due to subsidised water charges in the slums. Concerning the VIP toilets, all the providers perceive them to be inappropriate due to high cost of emptying the facilities. Thus, it seems the major criteria for selecting an appropriate technology, is the availability of the infrastructure and the operation cost

5.6 Affordability

The question was: Are the charges affordable
The answers are as below:
The providers perceive the charges for use of the facilities affordable. The charges are either per visit or upfront monthly family charges. The monthly charges are applied in a few of the facilities and are cheaper than per visit charges.

5.7 Financing

The question was: How are the sanitation facilities financed?
The answers are as below:

The NGOS perceive involvement of the community as a way of reducing cost of putting up the infrastructure. The community is expected to offer skilled and unskilled labour during the implementation of the projects. In addition, the community is expected to manage and finance the maintenance of the systems.

Maji na Ufanisi and Umande Trust perceive the capital costs for the biogas toilets to be higher than for the VIP toilets. However, the operation costs for VIP

are far much higher than the biogas toilet due to the high frequency of emptying the VIP toilets.

Maji na Ufanisi perceives lack of consistent funding to undermine the NGOs ability to make major impacts in improving the sanitation situation. Maji na Ufanisi argues that the donors rarely fund projects for a long period of time. In addition, some of the funders only finance the infrastructure costs but not the administration and the training component of the projects. This presents a major challenge for the NGOs since, failure to train the community may affect the sustainability of the project.

KWAHO argues that donor funds rarely cater for monitoring the performance of the facilities after the implementation of the projects. As a result, lessons from previous projects rarely inform the new projects. Practical Action argues that donors set conditions, which NGOs have to stick to during the implementation. This forces the NGOs to look for ways of saving costs. All the operation and maintenance cost are financed through revenue collected, through charging the users.

5.8 Partnership

The question was: Why do you opt to work in partnership with other stakeholders?
The answers are as below:
Partnership is perceived by the stakeholders as an effective way of overcoming challenges associated with sanitation provision in the area. Challenges are overcome by exploiting the strengths of the various stakeholders involved.

The stakeholders involved are NGOs, CBOs, NWSC and AWSB. The NGOs, NWCS and AWSB argue that the community involvement helps in identifying community needs, creates ownership and ensuring sustainability of projects. Government involvement is important for fund mobilisation.

Similarly, NWSC and AWSB perceive the role of the NGOs vital in mobilizing the people and organizing for operation and maintenance of the projects. Similarly, the CBOs feel the NGOs play a great role in sensitizing them on the need for sanitation, capacity building and also in creating employment during the implementation of the projects. This provide evidence to support the theory that partnership can be an effective way of addressing sanitation problems in the slums (Otiso, 2003)

The partnership seems to be working. For example, in Silanga, the CBO members convinced community members to give way for extending a sewer line to Silanga WC toilets. NWSC laid the sewer line while Practical Action mobilized the residents.

Indeed, all the partners are benefitting; poor residents are beginning to use “modern facilities” sewered toilets, the NGOs are getting contracts from the water board to build facilities and mobilize the residents. Similarly, the government agencies (NWSC and AWSB) are achieving one of the key

government requirements, to improve water and sanitation in the slum areas as stipulated in the performance contract.

5.9 Conclusion

All the providers perceive the sanitation situation in Kibera to be poor. This is because majority of the residents use the pit latrines. Majority of these pit latrines are poorly constructed and inaccessible. As a result, majority of the pit latrines discharge the human waste to the drainage channels. Thus, these facilities do not improve the sanitation situation because the waste still end degrading the environment. Indeed, most of the pit latrines are equivalent to ”improved” designated open defecation sites.

The providers perceive lack of planning in Kibera slum, the major challenge in improving sanitation in the area. This is because it has two major impacts. First, it leads to some villages being inaccessible. This increases the cost of putting up the facilities since the materials are transported manually to the site. Second, it leads to lack of space and leeway for putting up the infrastructure. The other challenges include, the high cost of emptying VIP toilets and vandalisation of the CBO water systems.

The criteria for selecting an appropriate technology is the availability of the infrastructure and the operation costs of the technologies. Capital costs and people’s preference are not a major consideration. For example, VIP is considered inappropriate due to the high cost of emptying.

With regard to the performance of the facilities the NGOs perceive all the facilities to be successful. The performances indicator is the CBOs ability to maintain an acceptable level of cleanliness, pay workers and utility bills. On the other hand, the CBOs rate the performance of the facilities to range from low to average, depending on the operation costs particularly, with regard to the emptying cost. Thus, NGOs and CBOs seem to use different criteria to judge success or lack of it. Developing standardised criteria for gauging performance is thus important.
The users’ charges are perceived to be affordable. Regarding the financing of the facilities, community involvement is seen as a way of reducing cost of implementing the sanitation projects. Indeed, the community may not afford the capital cost but are they are meeting operation and maintenance cost.

On partnership, the stakeholders perceived as an effective way of overcoming the challenges involved in provision of sanitation in the area. This is achieved through utilizing the partners’ strengths. For instance, the community identify their needs and preferences while the NGOs, mobilize and organize the community for operation and maintenance of the facilities. The government agencies inject part of the needed capital.

6 Result and Discussion: Users perspective

This chapter presents the users experience with the facilities. The chapter start with discussing users' satisfaction with the different facilities then moves on to discuss issues of: cleanliness, privacy, convenience, safety, and accessibility, problem of smell, desired improvement, affordability and finally a conclusion of the chapter.

6.1 Users experience

Using a combination of open ended questions and closed ended questions, users were asked to rate the performance of the various sanitation facilities in terms of: satisfaction, cleanliness, privacy, convenience, safety and accessibility, affordability, problem of smell, improvements
The research was undertaken to include 2 VIP, 1 WC, 2 pour flush and 2 biogas toilets. For statistical analysis the 95% confidence level was used.

6.2 Satisfaction

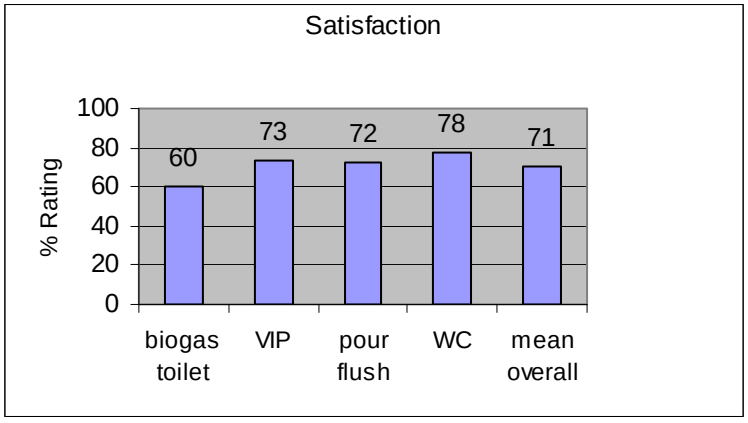

Figure 27: Users satisfaction for the various technologies

Figure 27 shows that generally in terms of satisfaction, all the technologies scored relatively high. The mean overall rating for satisfaction was found to be 71±8%. The relatively high level of satisfaction can be attributed to the relatively high level of cleanliness in all the facilities.

Figure 27 shows that overall, the level of satisfaction among the respondents interviewed per technology, was found to be the highest for the WC with a rating of 78%. This could be attributed to the flushing away of the waste from the site and even better, in a convenient mechanical way. On the other hand, satisfaction with the biogas toilets was found to be significantly lower than the satisfaction with the other technologies. This is possibly due to two reasons. First, due to the smell associated with the technology. Second, the human waste is deposited quite close to the squatting hole. The site of the human excreta could be disgusting to the users.

Some of there responses from the users regarding the facilities:

'I am fully satisfied with these toilets. I just wish it is my house. I can even eat food inside the toilet."

"This facility is fine, it is even better than our houses, can't you see that?"

Further, the research sought to establish the reasons for the users' satisfaction, with the different technologies. To do this, the users were asked an open ended question. The survey results from the responses received, indicated that nearly half of the respondents were satisfied with the facilities due to the level of the cleanliness. Figure 28 shows that 47% of the respondents were satisfied due to the facilities cleanliness. The results provide evidence to support the existing theory that cleanliness is one of the major factor that that contribute to the users satisfaction with the sanitation facilities (Jenkins and Curtis, 2005)

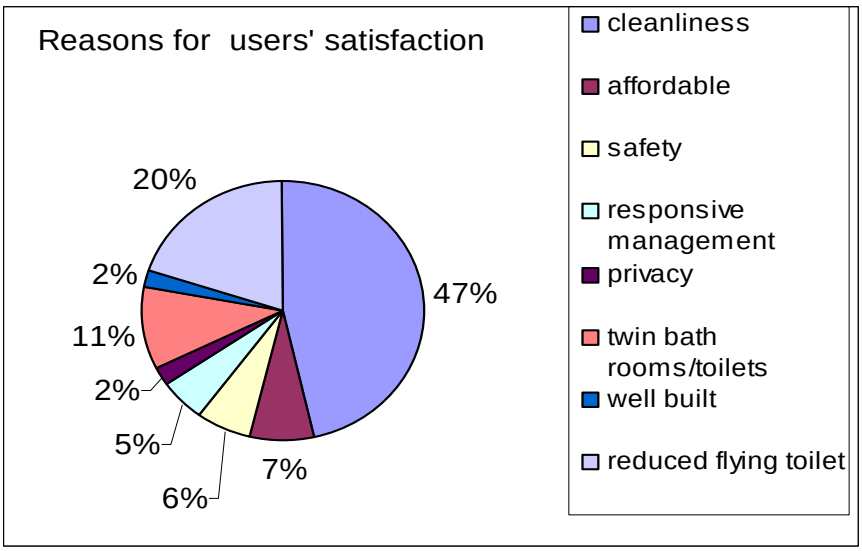

Figure 28: Reasons for the users' satisfaction

6.2.1 Cleanliness

Figure 29 shows that generally in terms of the cleanliness, all the technologies scored relatively high. The mean overall rating for the cleanliness was found to be 81 ±10%.

Figure 29 shows that overall, the level of the cleanliness among the respondents interviewed per technology, was found to be the highest for the WC with a rating of 92%.The reasons are as discussed in the section 6.2. With a rating of 69% the biogas toilets were rated significantly dirty than the other technologies. The reasons are as discussed in section 6.2

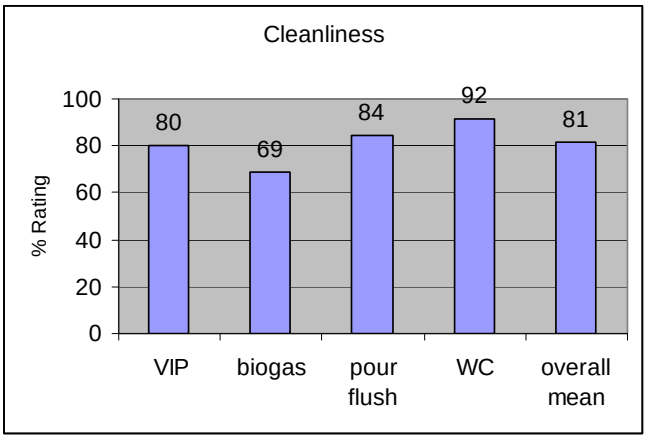

Figure 29: Cleanliness rating

It was also worth noting that as shown in figure 30, for the VIP technology, the Line Saba toilets scored quite high(88%) than the Soweto (73%). This is attributed to the higher water storage capacity for Line Saba. The facility has 3 tanks while Soweto has only one. Similarly, for the pour flush technology, Kianda was rated quite high with 94% as compared to Kianda with 75%.This is attributed to the reliability of water at Makina. The facility relies on a borehole which is more reliable than tap water used at Kianda.

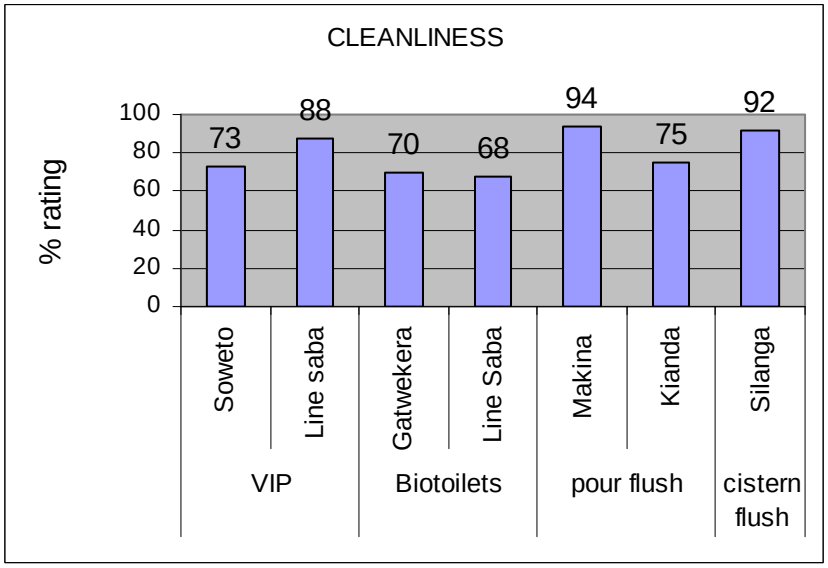

Figure 30: Cleanliness rating for the individual facilities

Some of the users comments with regard to the cleanliness of the facilities:

"What matters in a toilet is the cleanliness of the facility, if it is not clean, I won't use the facility."

"What matters in a toilet is the cleanliness; a slight smell will always be there for the entire toilet."

Some of the responses with reference to biogas toilets

” I will rate the level of the cleanliness to be neutral because of the smell emitted by the toilet.”

“I will rate the level of the cleanliness to be neutral because it cannot be as clean as flush toilet found in towns”

6.2.2 Privacy

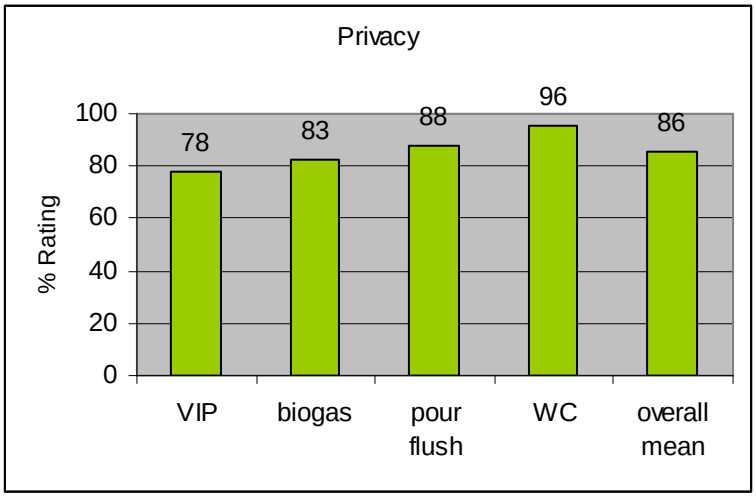

Figure 31: Privacy rating for individual technology

Figure 31 shows that generally, the ratings for all facilities were relatively high. The overall mean rating was found to be 86±8%.This is possibly because all the facilities seemed to be well built and with lockable doors. To stress the value of the privacy enjoyed by the residents, one respondent said “Look at this pit latrine, it is full of open spaces on the walls, people can see somebody as they pass by.”
Figure 31 shows that overall, the level of privacy among respondents interviewed per technology, was found to be the highest for the WC with a rating of 96%. On the other hand, VIP toilets were rated to be the lowest with 78%.

The VIPs were rated to offer significantly less privacy than the other technologies. This can be attributed to the design of the facilities. The two VIPs are designed in a way that the passerby can see users going to the toilet. The rest of the facilities, users get inside the building to access the toilets. So, they are not easily seen by the passerby.

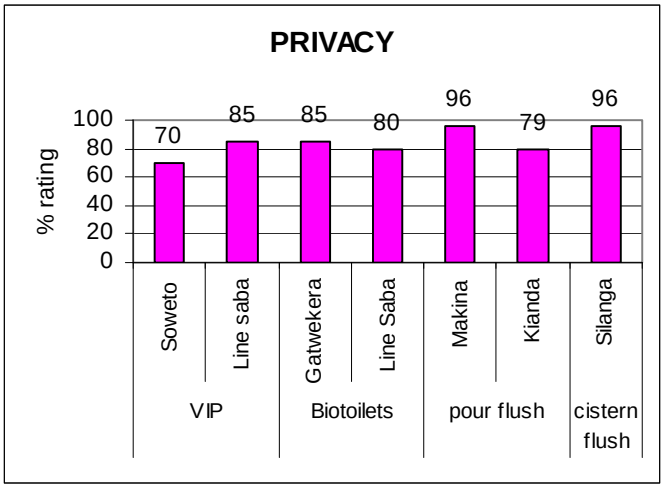

Figure 32: Privacy rating for individual facilities

It is worthwhile noting that as shown in figure 32 for pour flush technology, Makina was rated highly with 96% compared to Kianda with 79%.This is attributed to Makina being located in a fenced compound.

6.2.3 Convenience

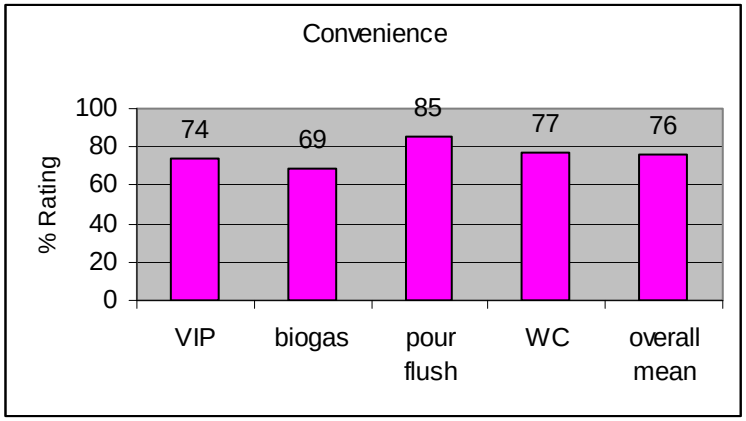

Figure 33: Convenience rating for individual technology

Figure 33 shows that generally, the rating for all facilities was relatively high. The overall mean rating was found to be 77±7%. Overall, the level of convenience among the respondents interviewed per technology was found to be the highest for the pour flush toilets with a rating of 85%.

Biogas toilets were rated to be significantly less convenient than the other technologies. This is attributed to the fact that the excreta is deposited quite close to the platform. The site of the excreta could be disgusting to the users.

6.2.4 Safety

Figure 34 shows that generally in terms of safety, all the technologies scored relatively high. The mean rating overall was found to be 85±8.0%. The relatively high level of security for all facilities can be attributed to the fact that the facilities are open during the day and closes at night. The security is usually relatively fine during the day. Overall, the level of safety among respondents interviewed per technology was found to be the highest for the VIP with a rating of 94%.

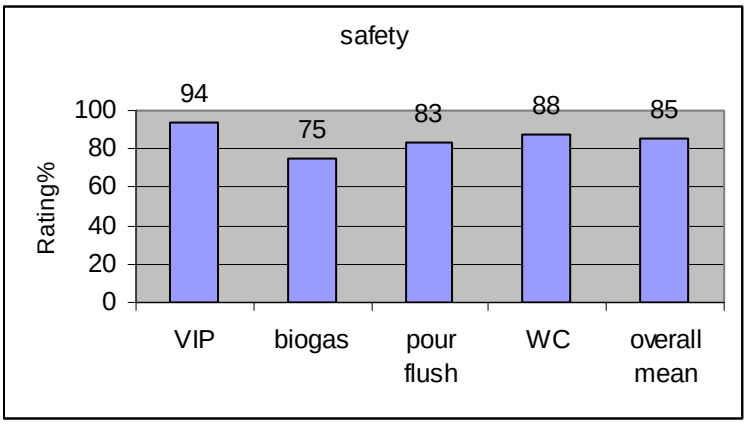

Figure 34: Safety rating for individual technology

Biogas toilets were rated to be significantly less safe compared to the other technologies. This is possibly due to the general insecurity within the location of the facilities. Users in particular for Line Saba biogas facility, expressed concerns of frequent burglary incidences in the area.

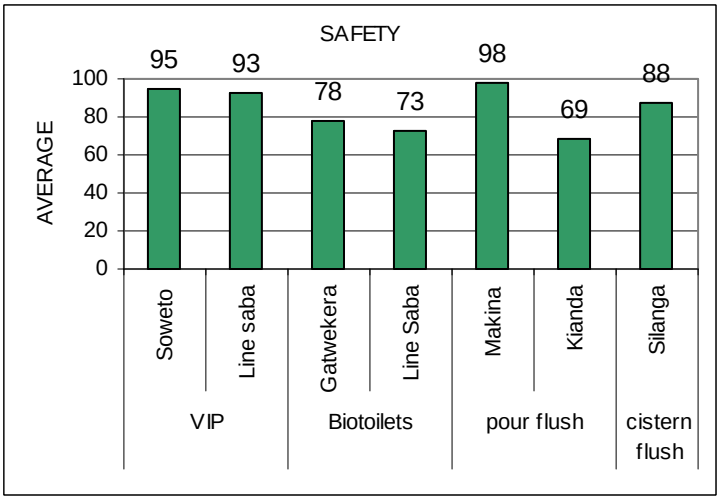

Figure 35: Safety rating for individual facilities

It was also interesting to note that for pour flush toilets, as shown in figure 35 Makina scored quite high, as compared to Kianda with ratings of 98 and 69 respectively. This can be attributed to the location of the facility and the longer operating hours. Makina is located in a well lit fenced compound and remain open to the users up to 2100 hours.

6.2.5 Accessibility

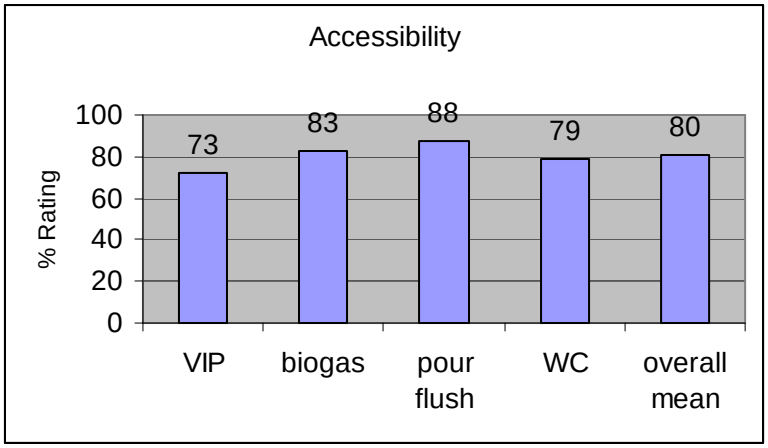

Figure 36: Accessibility rating for individual technology

Figure 36 shows that the accessibility was quite high for all the facilities. The mean rating was 80 ±6%. This could be attributed to the location of the facilities, most of the facilities are located quite near the road. Overall, the level of accessibility among the respondent interviewed per technology, was found to be the highest for the pour flush with a rating of 88%

The VIPs were rated significantly less accessible than the other technologies. This can be attributed to the intermittent closing down of Line Saba VIP

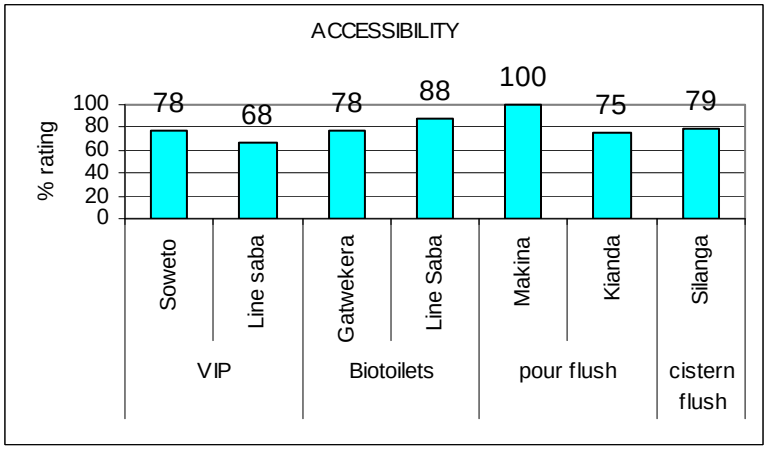

Figure 37: Accessibility rating for individual facility

It is worth noting that for pour flush technology, as shown in figure 37 Makina was rated quite highly than Kianda with a rating of 100 and 75 % respectively. This can be attributed to the longer operating hours in Makina. The facility remains open to the users up to 2100 hours, since it is located within a well lit mosque compound.

Further, users were also asked to rate the performance of the facilities with regard to smell.

6.2.6 Smell

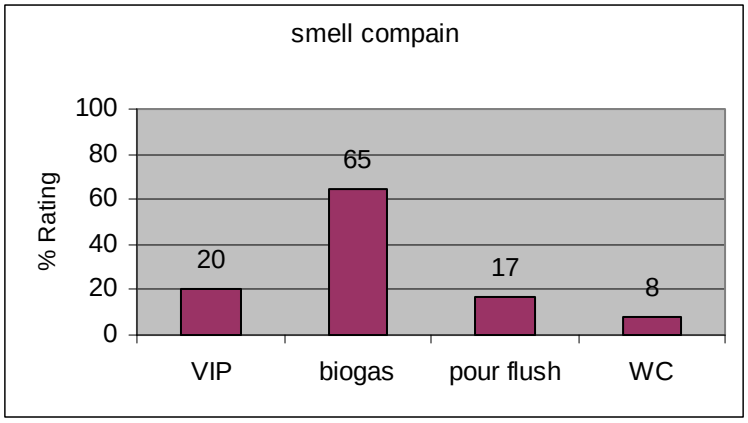

Figure 38: Complains of smell

Figure 38 shows that majority of respondents for the biogas technology (65%) indicated that the biogas technology emits a bad smell. This can be attributed to the design, operation and maintenance of the biogas toilet. The technology is designed in a way that the human excreta is deposited in a shallow hole which then feeds the bio digester. The flow rate of the faeces from the hole to the digester is relatively low. On the other hand, the facilities are used by many people. As a result, the pit fills so fast that the excreta is often deposited quite close to the squatting platform. Figure 39 shows a biogas toilet with faeces quite close to the surface.

Figure 39: A biogas toilet with faeces close to platform

Ordinarily the other technologies are expected to have minimal smell. The reason for the smell reported by the respondents can be attributed to the unreliability of water and fouling of the squatting platform by the users. Figure 40 shows a warning sign against fouling in one of the facility.

Figure 40: Shows warning against fouling

Further, an open question was posed to users to find out the areas they felt needed an improvement.

For the VIP toilets users, the desired improvements were: improving water reliability, lighting the facility, increasing the number of toilets and improving the level of cleanliness. However, these priorities expressed varied in the two places that is Soweto and Line Saba. Figure 41 and 42 shows the desired improvements for each of the facility.

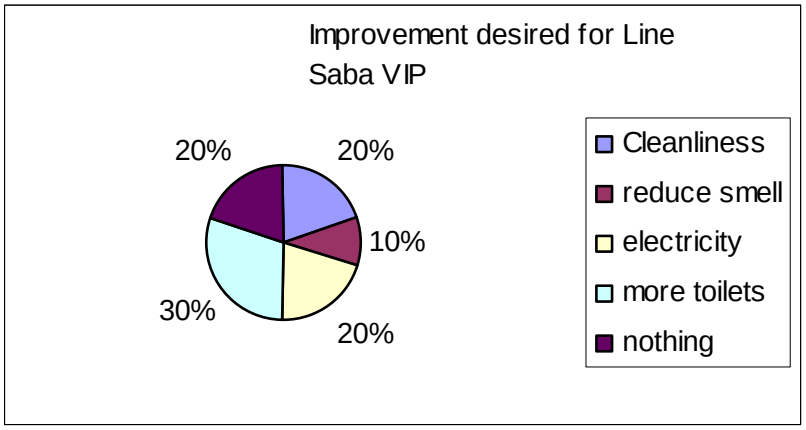

Figure 41: Improvement desired (Line Saba VIP)

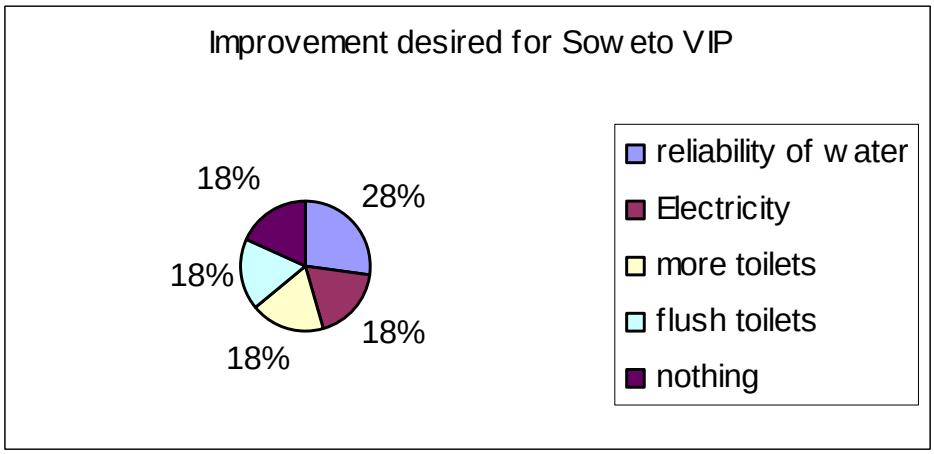

Figure 42: Improvement desired (Soweto VIP)

For biogas technology, the need to reduce the smell was quite clear. At least half of the responses for each of the two facilities received, indicated the need for addressing the smell problem. Figure 43 and 44 shows in Gatwekera and Line Saba biogas toilets 50% and 54% of the respondents respectively, expressed the need to address the smell problem.

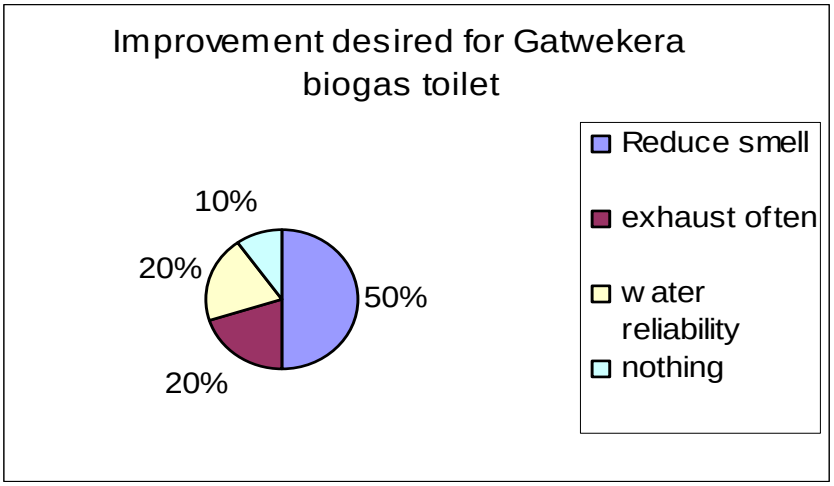

Figure 43: Improvement desired (Gatwekera biogas toilet)

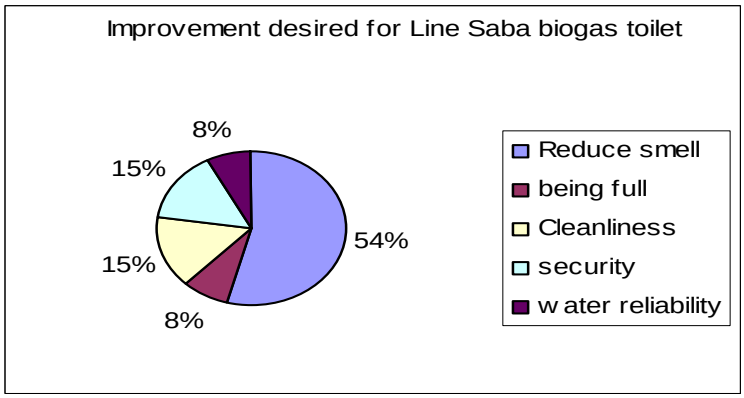

Figure 44: Improvement desired (Gatwekera biogas toilet)

For pour flush toilets the improvements desired were: increasing the number of toilets, converting the toilets to WC, increasing the level of cleanliness, lighting the facility, and reducing the smell. However, these priorities expressed varied in the two places. Figure 45 and 46 shows that most of the people were indifferent for the desired improvement Makina (33%) while for Kianda most people felt the need to reduce the smell. The smell experienced by the users at Kianda pour flush toilet, could be attributed to the filthy water stagnating in the drainage channel, close to the vicinity of the facility.

For the WC Figure 47 shows that the majority (62%) of the users expressed the need for storm water drainage, to improve the facility accessibility.

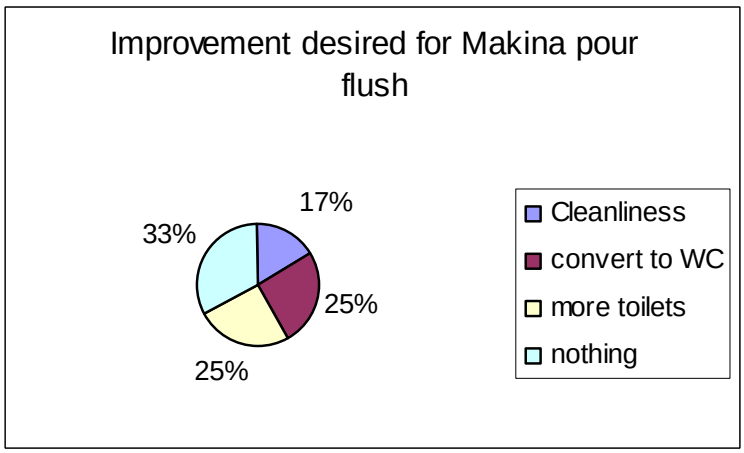

Figure 45: Improvement desired (Makina pour flush)

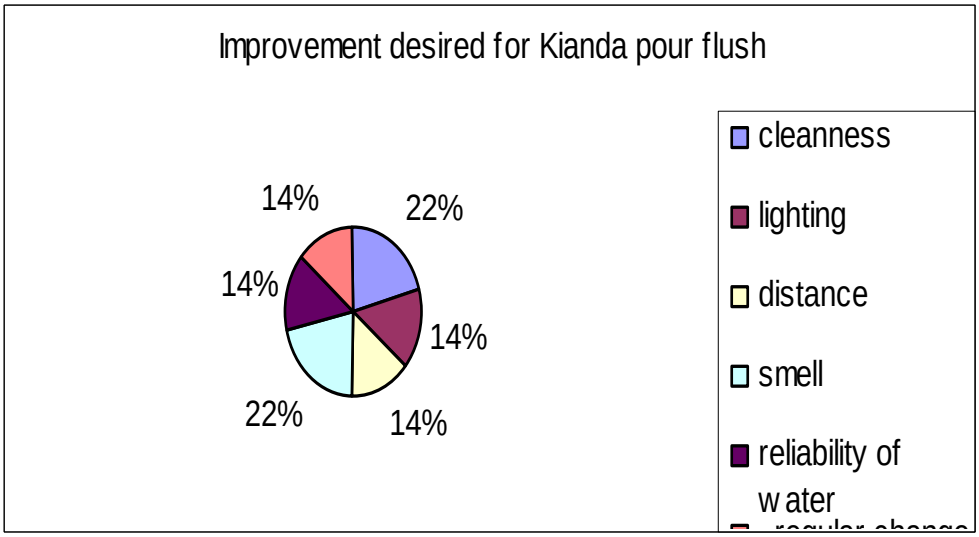

Figure 46: Improvement desired (Kianda pour flush)

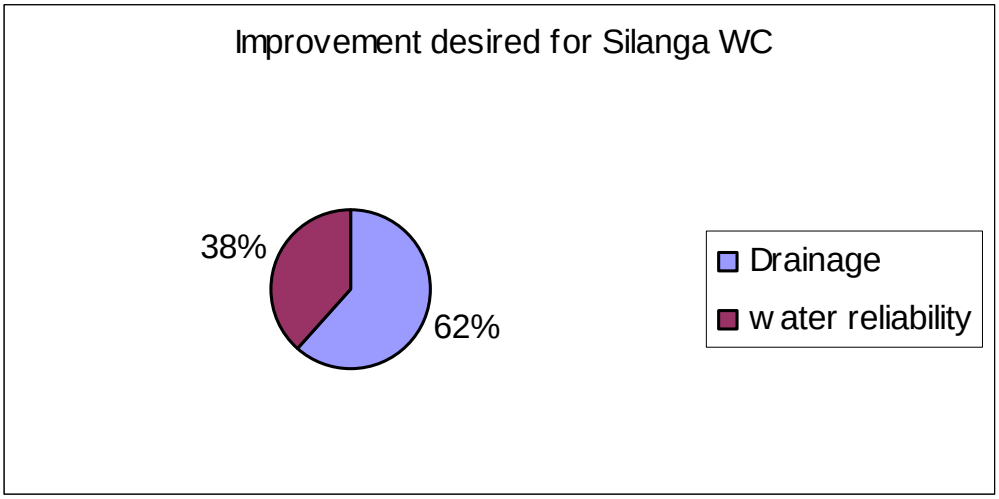

Figure 47: Improvement desired (Silanga)

In addition users were asked their opinion with regard to queuing and the affordability of the charges.

6.3 Queuing

Queuing was found to be common mainly early in the mornings, evenings and the weekends. It was reported to last between 5 – 10 minutes.

6.4 Affordability

Most residents perceive the charges to be affordable. Actually, 97% indicated the charges are affordable.

"The management of the facilities minds our welfare because they don't charge us highly like in towns"
"The charges are fair given the cost of living is quite high."

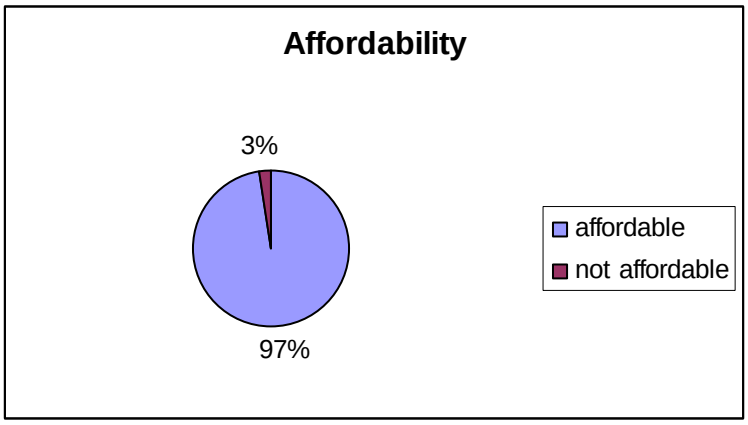

Figure 48: Affordability of the charges

6.5 Conclusion

There is a strong relationship between the user's satisfaction and the facilities level of cleanliness. A similar trend was observed in responses regarding cleanliness and level of satisfaction with the various technologies. The analysis shows that users were less satisfied with biogas technology in comparison with the other technologies Biogas toilets were rated to be significantly lower than the other technologies, in terms of the level of cleanliness, convenience and satisfaction. This is attributed to the unpleasant smell associated with the technology and the fact that human waste drop quite close to the squatting platform. The smell and the site of the human waste could be disgusting to the users. In addition, the users seemed to relate smell to the cleanliness or lack of it.

The relatively high level of privacy rating for all the facilities can be attributed to the facilities being well built with lockable doors whereas, the high level rating of security for all the facilities is attributed to the fact that the facilities are used only day time. Day time security is usually relatively fine. Similarly, the high rating of accessibility is attributed to the location of the facilities. Most of the facilities are located quite close to the road. Finally, the users charge is considered affordable.

7 Synthesis and conclusion

7.1 Synthesis of provider's and user's perspectives

There is a strong relationship between user's satisfaction and the facilities level of cleanliness. A similar trend was observed in responses regarding the cleanliness and the level of satisfaction with the various technologies. With regard to the cleanliness, the users place a high premium on the cleanliness of the facilities. Indeed, users are willing to pay to access clean facilities. Thus, operation and maintenance requirements for the facilities need to be considered during the planning stage.

Some of the users' comments were as follows:

"For the facilities to be kept clean, we need to pay."
"If we do not pay the level of the cleanliness will go down."

Similarly, the providers perceive the cleanliness of the facilities to be very important. This is evidenced by the fact that the providers consider maintenance of cleanliness by the CBOs, an indicator of the performance of the facilities.

Both the providers and the users perceive the users charge to be affordable. Actually, 97% of respondents indicated the charge to be affordable. However, with regard to appropriateness, users seems to consider appropriateness based on the level of cleanliness, lack of unpleasant smell and appealing facilities while the providers seems to consider the availability of infrastructure and operation costs. Thus, it seems the users and the providers are using different criteria to judge what is appropriate or not.

Users seem to agree with the provider on the appropriateness of the WC and pour flush toilets. This is probably because they are meeting the users demands of being clean, offering privacy, convenient and probably with minimal smell. Similarly, for providers it seems to meet the criteria of being less costly. However, with regard to the biogas technology, the users seem not to prefer it, probably due to the smell characterizing the technology. On the other hand, the NGOs promoting the technology perceive it to be appropriate due to the low cost of emptying. For VIPs, the users seem to consider it appropriate but the providers perceive in appropriate, due to the high cost of emptying. This shows that the users and the providers are considering different things with regard to the appropriateness of the facilities. Providers seem to consider the cost of operation while the users seems to consider the issue of smell and the level of cleanliness. This support research done elsewhere showing the users perceive cleanliness and lack of smell to be important. In addition, it emphasises the need for involving both the providers and users in identifying an appropriate technology. (Dellström Rosenquist, 2005; Jenkins & Scott, 2007)

Users seemed not to prefer biogas toilet based on their responses on cleanliness and satisfaction. The respondent gauged the level of the cleanliness, convenience and satisfaction with the technology significantly less than the

other technologies. However, among the other technologies WC, VIP and pour flush toilets there seemed to be no clear preference. The relatively less satisfaction with biogas toilets in comparison with the other technology can be attributed to the smell characterizing the technology. Actually, 65% of the respondents of the biogas technology perceived the technology to have a problem of smell. Thus, addressing the smell problem is likely to increase the level of satisfaction with the technology. In contrast, the providers promoting biogas toilets perceive biogas toilets appropriate for the area with no sewer line due to low cost of emptying.

7.2 Differences between users and providers

Providers' major criteria for selecting an appropriate technology are the availability of infrastructure and the operation costs. On the other hand, the users are gauging appropriateness by considering the level of cleanliness, convenience, and smell. Thus, majority of providers think that biogas toilets are appropriate because of tapping biogas. On the contrary users seem to consider it inappropriate because of the smell. For VIP, the users perceive it to be appropriate probably because it is meeting their needs on cleanliness with minimal smell whereas; the providers perceive it inappropriate due to the high cost of operation.

On the appropriateness of the facilities, the users and the providers seems to be motivated by different things. This stresses the need for involving the users and the providers during the technology selection to ensure it meets the users' needs

7.3 Differences among the Users

Biogas technology was rated differently from the other technologies in three aspects. Users rated satisfaction with the technology to be significantly lower than the other technologies. They were also rated to be significantly dirty, and less convenient than the other technologies. This can be attributed to the smell and the fact that faeces are dropped close to the squatting hole.

Difference in rating among the different technologies on privacy, security and accessibility were associated with the location and design of the facilities rather than the technologies.

7.4 Conclusion

This chapter concludes the findings of this research and recommends areas of further studies.

- Satisfaction with the facilities is related to facilities level of cleanliness
-
- Cost of emptying is a major criteria in selecting an appropriate technology.
- Capital costs of the infrastructure and the users' preference are not major consideration in selecting the technology.

- Addressing the smell problem characterizing the biogas toilets would enhance the users' satisfaction.
- The charges are affordable

7.5 Recommendation

Based on the results of this study I recommend the following:

- For the policy makers, they should be aware of the importance of the infrastructure and regulation of emptying.
- For the providers, they should be aware users value cleanliness and make arrangements for maintaining the cleanliness
- Users should arrange for maintaining the cleanliness
- For the scholars, there is need to address the problem of smell associated with the biogas toilets. This is likely to improve the satisfaction of the users
- A similar case study with a similar approach to be conducted elsewhere to compare the results.

- In conducting a similar study, it is important to incorporate open ended questions in the users' questionnaires. Indeed, it was found very helpful in exploring issues raised in the closed questions and for checking the consistency of the respondents.

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Appendices

1. Survey questions for resident using communal sanitation blocks.

1) What kind of toilet do you use?

VIP

Biotoilet

Flush sanitation blocks

Pit latrines

Others (specify)

2) How much does it cost per visit?

3) Is it affordable?

4) How would you describe the condition of the toilet your use in terms:

Cleanliness---------- very poor / poor / neutral / good/ very good

Privacy---------- very poor / poor / neutral/good / very good

Convenience---------- very poor / poor / neutral / good / very good

Safety---------- very poor / poor /neutral /good / very good

Accessibility----------very poor/ poor / neutral / good / very good

7) How long do you stay in the queue?

8) How satisfied are you with the facility?

Very satisfied

Satisfied

Not satisfied

9) What make you not satisfied with the facility?

10) What do you like most about the facility?

11) What don't you like about the facility?

12) Who manages the facility?

13) How would you rate the performance of the management and why?

Good/ fair/ poor

14) What do you think should be improved for the sanitation facility?

15) If not satisfied with the facility what type would you prefer and why?

2. NGOS/ Government Agencies

1) How is the sanitation situation in Kibera slum?
2) What activities are you involved in provision of sanitation in Kibera?
3) How do you go about in identification of sanitation facilities to install, location of projects and model for implementation
4) What factors do you consider when putting a sanitation facility?
5) What type of facilities have you put in Kibera why did you opt for it?
6) Did you consider other options?
7) How would you rate it in terms performance(success or failure)
8) Why would you consider it as success or failure?
9) Is it appropriate for such a setting and why?
10) In which way did it fail and why and what would have been done to avoid that?
11) What is the shortcoming of the facility and how can it be mitigated?
12) How easy is it to improve sanitation in this area and why?

13) How is the community involved?

14) What challenges and obstacles do you face when implementing sanitation projects and how do you overcome them?
15) What sanitation facilities do you think are appropriate for the area and why?
16) What are the roles played by the relevant government agency, private providers and CBOs?
17) How are these sanitation facilities managed?
18) What is the cost of construction?

3. CBOS

1) How is the sanitation situation in Kibera slum?
2) What activities are you involved in provision of sanitation in Kibera?
3) How do you go about in identification of sanitation facilities to install, location of projects and model for implementation
4) How do you manage the sanitation facilities?
5) What problems do you face in operating and maintaining the system
6) What is the cost of operation and maintenance?
7) How much do you charge for the services?
8) Is it difficult to collect money from the residents?
9) Do you think the facility is appropriate for residents and if so why or why not?
10) What challenges do you face in provision of sanitation facilities running and maintenance?
11) How can those challenges be overcome?
12) How would you rate it in terms performance(success or failure)
13) Is it appropriate for such a setting and why?
14) Why do you think is a success or fail?
15) What is the shortcoming of the facility and how can it be mitigated?
16) How easy is to improve sanitation in this area and why?
17) How would you rate it in terms of

    Cleanliness----------very poor / poor /neutral / good / very good

    Privacy----------very poor / poor /neutral / good / very good

    Convenience----------very poor / poor /neutral /good / very good

    Safety----------very poor / poor / neutral / good / very good

    Accessibility----------very poor / poor / neutral / good / very good

20) How is the community involved?
21) What challenges and obstacles do you face when implementing sanitation projects and how do you overcome them?
22) What sanitation facilities do you think are appropriate for the area and why?
23) What are the roles played by the relevant government agency, private providers and CBOs?

4. Users' perception of various sanitation facilities

Pooled t test

	Cleanliness		
N(10)	mean	N(10)	
Gatwekera biotoilet	70.0	Soweto VIP	72.5
Line Saba biotoilet	67.5	Line Saba VIP	87.5
mean	**68.8**	Cleanliness mean	**80.0**
SD	**1.8**	**SD**	**10.6**
variance	**3.1**	**variance**	**112.5**

s^2_w	57.8
sw	7.6
t_{test}	3.3

t from table is 2.101
p<0.05

Biotoilet and pour flush

	N=10	N=12	
Gatwekera biotoilet	70.0	Makina pour flush	93.8
Line Saba biotoilet	67.5	Kianda pour flush	75.0
mean	68.8	mean	84.4
SD	**1.8**	**SD**	**13.3**
Variance	**3.1**	**variance**	**175.8**

s^2_w	98.1
s_w	9.9
t_{test}	3.7

p<0.05 t from the table=2.074

Pour flush and VIP

Cleanliness	N=12	N=10	
Makina pour flush	93.8	Soweto VIP	72.5
Kianda pour flush	75.0	Line Saba VIP	87.5
mean	**84.4**	**mean**	**80.0**
SD	13.3	**SD**	10.6
Variance	175.8	**Variance**	112.5

s^2_w	101.5
s_w	10.1
t_{test}	1.0
t from the table	2.1

p>0.05
Not significant

continued

Privacy

VIP		Biotoilet	
Soweto	70.0	Gatwekera	85.0
Line Saba	85.0	Line Saba	80.0
mean	**77.5**	**mean**	**82.5**
SD	10.6	SD	3.5
Variance	**112.5**	**variance**	**12.5**
n	**10.0**	n	**10.0**
s^2_w	62.5		
s_w	7.9		
t test	1.4		
t from the table	2.1		
p>0.05			

Biotoilet		pour flush	
Gatwekera	85.0	Makina	95.8
Line Saba	80.0	kianda	79.2
mean	**82.5**	**mean**	**87.5**
SD	3.5	SD	11.7
Variance	12.5	**Variance**	137.8
n	10.0	n	12.0
s^2_w	81.4		
s_w	9.0		
t_{test}	1.3		
t from the table	2.1		
p>0.05			

VIP		pour flush	
Soweto	70.0	Makina	95.8
Line Saba	85.0	kianda	79.2
mean	**77.5**	**mean**	**87.5**
SD	10.6	SD	11.7
variance	**112.5**	**variance**	**137.8**
n	10.0	n	12.0
s^2_w	126.4		
sw	11.2		
t test	2.1		
t test from tables	2.1		
p<0.05			

Continued

Convenience

VIP		Biotoilets	
Soweto VIP	82.5	Gatwekera biotoilet	62.5
Line Saba VIP	65.0	Line Saba biotoilet	65.0

Cleanliness mean	**73.8**	Cleanliness mean	**63.8**
SD	12.4	**SD**	1.8
variance	**153.1**	**variance**	**3.1**
n	10.0	n	10.0
s^2_w	78.1		
sw	8.8		
t_{test}	2.5		
ttable	2.1		
Biotoilets		pour flush	
Gatwekera biotoilet	62.5	Makina	97.9
Line Saba biotoilet	65.0	kianda	72.9
mean	**63.8**	**mean**	**85.4**
SD	1.8	SD	17.7
Variance	**3.1**	**Variance**	**312.5**
n	10.0		12.0
s^2_w	173.3		
sw	13.2		
t_{test}	3.9		
t table	2.1		
Pour flush		VIP	
Makina	97.9	Soweto VIP	82.5
kianda	72.9	Line Saba VIP	65.0
mean	**85.4**	**mean**	**73.8**
SD	17.7		12.4
variance	**312.5**		**153.1**
n	12.0	n	10.0
s^2_w	240.8		
sw	15.5		
t_{test}	1.8		
t test	2.1		

p>0.05

Continued

Safety

VIP		Biotoilets	
		Gatwekera	
Soweto VIP	95.0	biotoilet	77.5
		Line Saba	
Line Saba VIP	92.5	biotoilet	72.5
mean	**93.8**	**mean**	**75.0**
SD	1.8	SD	3.5
Variance	**3.1**	**Variance**	**12.5**
n	**10.0**	**n**	**10.0**

Continued

s^2_w 7.8

sw	2.8
t_{test}	15.0
T from the tables	2.1
p< 0.05	

VIP		pour flush	
Soweto VIP	95.0	kianda	68.8
Line Saba VIP	92.5	Makina	97.9
mean	**93.8**	**mean**	**83.4**
SD	1.8	SD	20.6
Variance	**3.1**	**Variance**	**423.4**
n	10.0	n	12.0

s^2_w	234.3
sw	15.3
t test	1.6
t table	2.1
p> 0.05	

pour flush		Biotoilets	
kianda	68.8	Gatwekera biotoilet	77.5
Makina	97.9	Line Saba biotoilet	72.5
mean	**83.4**	**mean**	**75.0**
SD	20.6	SD	3.5
Variance	**423.4**	**Variance**	**12.5**
n	12.0	n	10.0

s^2_w	238.5
sw	15.4
ttest	1.3
t from the table	2.1
p>0.05	

Accessibility

VIP		Biotoilets	
Soweto	77.5	Gatwekera	77.5
Line Saba	67.5	Line Saba	87.5
mean	72.5	**mean**	82.5
SD	7.1	SD	7.1
Variance	**50.0**		**50.0**

s^2_w	50.0
sw	7.1
t_{test}	3.2
ttable	2.1
p<0.05	

VIP		pour flush	
Soweto	77.5	Makina	100.0
Line Saba	67.5	Kianda	75.0
mean	**72.5**	**mean**	**87.5**
SD	7.1	SD	17.7
Variance	**50.0**	**Variance**	**312.5**
n	10.0	n	12.0
s^2_w	194.4		
s_w	13.9		
t_{test}	2.5		
t table	2.1		
p<0.05			

pour flush		Biotoilets	
Makina	100.0	Gatwekera	77.5
Kianda	75.0	Line Saba	87.5
mean	**87.5**	**mean**	**82.5**
SD	17.7	SD	7.1
variance	312.5	Variance	50.0
n	12.0	n	10.0
s^2_w	194.4		
s_w	13.9		
t_{test}	0.8		
t table	2.1		

Continued

Satisfaction

pour flush		VIP	rating
makina	77.8	Line Saba	66.7
kianda	66.7	Soweto	80.0
mean	72.2	mean	73.3
SD	7.9	SD	9.4
variance	61.7	variance	88.8
n	12.0		10.0
s2w	73.9		
sw	8.6		
t test	0.3		
t table	2.1		
p> 0.05			

satisfaction

Continued

	biogas	pour flush	
gatwekera	60.0	makina	77.8
line Saba	60.0	kianda	66.7
mean	60.0	mean	72.2
SD	0.0	SD	7.9
variance	0.0	variance	61.7
n	10.0	n	12.0
s2w	33.9		
sw	5.8		
t test	4.9		
t from table	2.1		
p<0.05			

satisfaction

biogas	rating	VIP	rating
gatwekera	60.0	Line Saba	66.7
line Saba	60.0	Soweto	80.0
mean	60.0	mean	73.3
SD	0.0	SD	9.4
Variance	0.0	Variance	88.8
n	10.0		10.0
s2w	44.4		
sw	6.7		
t test	4.5		
t testtable	2.1		
p<0.05			

5. Research methods

Research Questions	Specific objective	variables	Research methods
1. Which are the current communal facilities available?	To identify the current communal facilities and types.	• Type of sanitation facilities available	Survey reports, review of reports, observation
2. Who are the current stakeholders involved in provision and management of currently communally shared facilities and their roles?	To identify the current stakeholders involved in provision and management of currently communally shared facilities and their roles.	Service providers/ roles • Actors(CBO, NGO, government agencies) • What services they offer and at what cost?	Semi structured interviews for NGO/ CBOs, Government Agencies
3. What are the views and opinions of residents on the different communally shared sanitation facilities?	To establish the views and opinions of residents on the different communally shared sanitation facilities?	Appropriateness of the shared facilities in terms of • accessibility • safety • convenience • cleanliness • privacy • Smell • Long queues • Cost of use • Preferred types • Willingness to pay	Household questionnaires/ record of use, literature review Observation
4. What are the stakeholders' opinion and views with regard to different types of communally shared facilities?	To establish the views and opinions of stakeholders with regard to different types of communally shared facilities	• Constraints encountered • Challenges and obstacles • Appropriate types • Advantages of the various technologies • Finances required(capital cost, running cost e.g. desludging cost) • Prone to vandalism • Availability of supporting infrastructure like sewer networks, availability of water, road network for accessibility by desludging trucks, • Robustness of the facilities(frequency of breakdown) • Expertise required to operate and maintain • Availability of labour/ local material, • ability of resident to pay, • awareness raising required	Semi structured interviews / reports, literature review, record of use