Landscape Analysis and Business Model Assessment in Fecal Sludge Management: Extraction and Transportation Models in Africa

KENYA REPORT

FINAL REPORT

VOLUME I OF II

MAIN REPORT

DECEMBER 2011

BMGATES-REP-S2H0-17012012

Client
Bill & Melinda Gates Foundation
P.O. Box 450
Webster, NY 14580
USA

Consultant
Losai Management Limited
Milimani Flats, Block 4 – Suite 18
Off State House Road
P.O. Box 8584-00200 Nairobi, Kenya
Tel: +254.20.273.3334, +254.20.263.2996
Email: info@losaimanagement.com

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Main Report

Report disclaimer:
This report is based on research funded by the Bill & Melinda Gates Foundation. The findings and conclusions contained within are those of the authors and do not necessarily reflect positions or policies of the Bill & Melinda Gates Foundation.

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ABBREVIATIONS AND TERMINOLOGY

AFD	-	French Development Agency
BMGF	-	Bill and Melinda Gates Foundation
ESH	-	Environmental Sanitation and Hygiene
FS	-	Fecal Sludge – Human Bio-Waste
FSM	-	Fecal Sludge Management
FSTP	-	Fecal Sludge Treatment Plant
GOK	-	Government of Kenya
HH	-	Household - A person or a group of persons who reside in the same homestead/compound but necessarily the same dwelling unit, have the same cooking arrangement, same sanitary facilities
KIHBS	-	Kenya Integrated Household Budget Survey, 2005
KNBS	-	Kenya National Bureau of Statistics
KIWASCO	-	Kisumu Water and Sewerage Company
LGA	-	Local Government Authority
MOWASCO	-	Mombasa Water and Sewerage Company
MCK	-	Municipal Council of Kisumu
MDGs	-	Millennium Development Goals
NCWSC	-	Nairobi City Water and Sewerage Company
NCC	-	Nairobi City Council
NGO	-	Non-Governmental Organization
NWSS	-	National Water Services Strategy
OSS	-	On-Site Sanitation Systems
WASH	-	Water, Sanitation and Hygiene
WSB	-	Water Service Board
WSP	-	Water Service Provider
WSPA	-	Water Service Providers Association
WSS	-	Water and Sanitation Services

EXECUTIVE SUMMARY

E.1 Introduction

As part of Bill and Melinda Gates Foundation global initiative for the promotion of "Sanitation that Works for the Poor," Kenya (among other 4 countries in Africa), was selected to participate in the exploratory research to better understand the fecal sludge emptying as a service in the country's cities sanitation provision. The aim of the study is to inform the sanitation sector on the dynamics of the fecal sludge management (FSM) and linkages to future investments in the sector – by the governments, donors and other development partners.

The Kenya Study was carried out by Losai Management Ltd in collaboration with the Water Service Providers Association (WASPA). The output of the Study is this Report – which highlights the current FSM situation in Kenya and explores possibilities that exist for up-scaling the FS service provision "for the benefit of the low income segment of the participating cities population."

E.2 Kenyan Cities Selected for FSM Landscape Analysis

As per the BMGates criteria for selection of the 3 local case study sites (cities), the Kenya Study Team selected Nairobi – the capital and the largest city - in the center; Mombasa and the second largest city - at the coast, in the east; and Kisumu – the third largest city - by the lakeside, in the west. The 3 cities each have sludge treatment plants and official dumping sites.

E.3 Institutional and Legal Framework of FSM

The current main institutional context for the effective delivery of FSM in Kenya is outlined in the National Environmental Sanitation and Hygiene (ESH) Policy 2007. The document outlines the roles and responsibilities of all the ESH actors, including: Government Departments e.g.: the Ministry of Public Health and Sanitation (the lead agency); Ministry of Water; Ministry of Local Government – and the associated Municipal Councils; and the National Environment Management Authority (NEMA).

The ESH document also outlines the critical roles of Non-Governmental Organizations (NGOs), private sector, and above all the communities – in partnership with all the other actors: "to create and enhance an enabling environment in which Kenyans will be motivated to improve their hygiene behavior and environmental sanitation". The Report highlights some of the active NGOs in the sector – and a social enterprise firm also involved.

E.4 Methodology of the FSM Study

The Study used a combination of quantitative and qualitative methods to obtain the required data, on the various aspects of FSM situation in the 3 selected Study cities. These methods were:

- Literature review – or secondary data sources. This involved in-depth analysis of previous studies reports; official Government of Kenya documents; and operational documents of relevant agencies.
- Key Informant Interviews – with Key officials of agencies in the water and sanitation sector.
- Household Survey – involving 1,200 sample households in the 3 Study Cities.

A Questionnaire instrument was used – to generate primary data on the FSM situation in each of the cities.

E.5 Results and Analysis of Socio-Economic Aspect of Urban FSM Practice

From the secondary data sources and the Household Survey, the Study made the following findings (stated very briefly):

(a) Demographics

According to the latest (2009) National Census, Nairobi – the capital city had a population of 3,138,369; Mombasa 938,131 and Kisumu 409,928. The population sample studied indicated very high literacy levels in the 3 cities: with over two-thirds having attained secondary level education and above – and minimal (less than 1%) being non-literate.

The average number of people per household was about 5 across the cities, whilst majority of household heads were in self-employment occupations.

(b) Drinking Water Supply Coverage

From the Household Survey, 69% of Kisumu households may be said to have access to drinking water supply from **safe sources**: viz, individual connections, water kiosks and boreholes. For Mombasa, this is 80%, whilst in Nairobi it is 71% (although Nairobi has the highest rate of access to individual connections: 69%). This is much higher than the national average for urban areas: 52.6% - according to the 2009 National Census.

Both Kisumu and Mombasa are currently under a vigorous water supply improvement program – with funding from AFD: French Development Agency. Nairobi too is implementing a World

Bank funded improvement program. What this good news means for the 3 cities FSM initiative is that, the improved availability of water supply will significantly increase greater access by the residents to sewer connections.

(c) Sanitation Coverage

An encouraging 88% of households in Kisumu have access to sanitation facilities of one type or another, within their compound. In Mombasa, this is 91% whilst Nairobi has the lowest rate: 85%. Of this, 43% in Kisumu, an encouraging 62% in Mombasa and 56% in Nairobi – use facilities that may be categorized as consisting safe or hygienic management of human waste (VIP latrine, Septic tank, cess pool, and sewerage). The average number of users per toilet in Kisumu is 8, Mombasa 4 and Nairobi a high of 12.

For those without access to a sanitation facility at home, a worrying 40% in Kisumu and 50% in Mombasa and a lower 20% in Nairobi – dispose human waste in open spaces, drainage channels and other unsafe sites – this posing great danger to human health in the respective cities.

E.6 Fecal Sludge Management Services in Kenya

Fecal sludge management services are classified under two broad categories, which are manual and mechanical operations.

There are two main types of trucks available in Kenya, one, locally fabricated and two, second hand imports of specialized trucks.

FSM offers numerous forward and backward linkages. There are financial transaction opportunities to the FSM service providers in this case manual and mechanical emptiers. These transactions arise from the supply of goods and services including credit. Other opportunities arise from the payment for emptying services by service provider clients.

Many service providers in the FSM sub-sector are informal Small and Medium Sized Enterprises and micro sized enterprises. These have limited access to formal credit and alternative sources are likely to be expensive, including borrowing from microfinance institutions may be untenable. This is because interest rates in Kenya have remained well above 10% per annum for more than 20 years. High interest rates inhibit adequate lump sum borrowing which may the needed amount to assist in business transformation and take off.

The broad framework of emptiers in the 3 cities is identical. Trucks are licensed on a unit basis by the national environmental agency. Each city has 2 treatment plants, one conventional type and another stabilization pond type. Dumping in the 3 cities is centralized and as such there is only one designated tipping point in each of the 3 cities. There are more similarities than differences amongst the operators and in some instances some are branch outlets, therefore operating in more than one city. In addition, in all the cities the FSM sub sector policy framework is under developed and in urgent need of formulation. Mechanical emptying services are 100% provided by the private sector with the public sector playing varied regulatory and oversight role. The degree of oversight across the cities is generally licensing and less of enforcement**.**

In most instances, financial and business accounts were not accessible as operators were unwilling to share. Under these circumstances, financial data in the three towns was obtained through interviewing the operators. The estimates then received were validated through further interviews with employees of the operators and cross checked with data obtained from competitors.

The analysis of the results obtained indicates operating consistency between the operators operating in the three cities surveyed; and there are no noticeable outlier estimates. For the case of Kisumu and Mombasa, only one operator was interviewed for each category of trucks owned and operated. In Nairobi 16 operators were interviewed. However, for purposes of the analysis, the best performing operator in Nairobi was selected and marked against comparable operators in Kisumu and Mombasa in the corresponding category of number of trucks owned. When depreciation is included in the financial estimates, most of the operators are found to be unprofitable. However on a cash basis most of the mechanical operators remain profitable

Under these circumstances, the existing business models may on a short term basis be self-sustaining but they may not be self-sustaining in the medium and long term. Periodic cash surpluses are consumed by intermittent but high cost of repairs as shown by the impact of depreciation on the bottom line. Alternatively, probably all businesses are profitable, but the reported number of trips per truck is understated to give the impression of low profitability.

E.7 FS Production and Market Size Calculation Method

Market size calculation is based on Household Survey results and population data provided from reliable sources. The population data is obtained from the national population census report conducted by the national institution responsible for the same task.

The population data provides for the census estimates for the city. The Household Survey offers the variables necessary for inference which include distribution of sanitation services- pit latrines, septic tanks, sewer connections- the frequencies of emptying for onsite sanitation and others. The variables estimated through the survey are used as inputs to estimate the parameters of the units under study. It is the combination of both Household survey variable estimates and population census that forms the input to the computation of the market size.

There are 74 trucks operating in the 3 cities while there are 43 registered operators. Unlike in Kisumu and Nairobi there are more operators in Mombasa than the number of trucks. This is because some of the operators are “brokers” who hire the trucks periodically from the mainstream operators-truck owners- to service clients.

Across the three cities the capacity of trucks varies from 6,000 litres to 22,000 litres. The drum combination trucks found in Mombasa have a lower capacity of 5,600 litres and 7,200 litres. However, all trucks across the cities charge on a per trip basis and sometimes the fee is higher depending on the distance to the dumping site. The longest distance is in Nairobi which is 50 km comprising of from client to dumpsite to parking bay, while the shortest distance is in Mombasa which is 4 kilometers. Most trips have an average distance of 8 km in Kisumu and Mombasa

Across the cities the number of trips per day varies. In the case of Nairobi there are at least 4 trips for every three days, which translates to 8 trips for a week of six days and in Mombasa 3 trips for every three days, that is 6 trips per week and at least one trip per day for the operators in Kisumu where two of the 3 operators reported at least 1 trip per day every day on a 22 working day cycle while the other reported a trip every two days. There are reports of manual emptying taking place and illegal dumping and connection of septic tanks to the storm drain in Nairobi and Mombasa. The operators using drum-trucks-in Mombasa work closely with manual emptiers. Manual emptiers in Mombasa reported that only 50% of their emptying is transported by trucks. The total dumping by drum trucks in a year is estimated at 180. This

means that every 2 days there is manual emptying taking place in Mombasa with the FS being either dumped into the storm drain or being buried into the ground.

In Nairobi the annual demand for FS management services is estimated at 4,604,701 m^3 and the mechanical supply for those services is estimated to cater for only 299,520 m^3 at present representing 10% service delivery rate. On the other hand, the manual supply has an annual demand of approximately 1,808,010 m^3 which represents about 35% service delivery rate. The capacity to cater for more demand exists in the current operating environment both for mechanical and manual operators, however due to the hazardous nature of manual FS extraction; mechanical extraction if well developed as a service may experience the needed growth to meet the excess demand.

In Mombasa the annual demand for FS management services is estimated at 853,341 m^3 and the mechanical supply for those services is estimated to cater for 28,142 m^3 representing 3% service delivery rate and 261,766 m^3 in manual extraction supply, representing 30% service delivery rate. From the study it was established that a substantial number of households do not use the mechanical services but opt for manual services. These households was estimated to produce a total of 50,930 m^3 annually in FS, however the mechanical supply was estimated at 28,142 $m^{3,}$. This implies that the operators operated with underemployed capacity and in some cases had to make trips to the dumping site with half-filled tanks. On the other hand, the manual supply has an annual demand of approximately 802,411 m^3 and a corresponding 261,766 m^3 annual supply from manual operators which represents about 33% service delivery rate.

Kisumu has three mechanical operators operating a total of four trucks among them. It has an estimated annual demand for FS management services of 691,903 m^3 and the mechanical supply for those services is estimated to cater for only 6,240 m^3 at present representing a 1% service delivery rate. On the other hand, the manual supply has an annual demand of approximately 508,431 m^3 and a corresponding 266,549 m^3 annual supply from manual operators which represents about 35% service delivery rate. The capacity to cater for more demand exists in the current operating environment both for mechanical and manual operators.

The trucks in use have an average age of 25 years meaning they are inefficient and use old technology which is expensive. Some operators have trucks with smaller capacity and they have

better chance of increasing their revenues especially when they are dealing with large institutions since they can make numerous trips and billings is made against trips as opposed to truck capacity.

The truck owner in many cases has no way of validating the number of trips made since clients are not issued with receipts. The dumping sites are not properly controlled and largely truck drivers do not record the trips they make. The truck owners incur more cost trying to monitor the business.

For both Mombasa and Kisumu one truck operators, their businesses have negative contribution margins which imply that they are making losses. In each case, to break even, operators have two options; they can either increase the number of trips one makes per year to 396 from 288 or increase the tariff charge per trip to $ 70.77 for the same number of trips they make per year. While for the second operator in Mombasa, he needs to increase his number of trips to 395 per year from 142 he makes currently or double the tariff charge per trip to USD 345 for the same number of trips. The price variance in order to break even and become profitable is 37% and 178% respectively. Due to the price sensitivity nature of this kind of business and the high level of competition increasing the tariff may be difficult due to clientele flight to cheaper service providers. It is also very likely that the number of trips reported is far below the actual trips by the operators.

In the case of two truck operators only Mombasa operator yields a negative contribution margin. For this operator to break even he needs to increase the number of trips per truck to 161 per year from the current 129 trips or increase the charges to USD 134 from 108 charged currently.

For the four truck operators only found in Nairobi and Mombasa there is a consistency on the capacities of their trucks-large capacities, both are profitable on a cash basis and even after charging depreciation. The four truck operators enjoy a mix of size and tariff that has resultant economies of scale in the operations of mechanical emptying services.

Access to finance is limited and remains a big challenge on three fronts.

Rate of Interest: The rates of interest on lending have remained very high in the economy over the last 20 years. This has deterred borrowing as the business would experience challenges in making payments.

Credit limits: Access to credit at micro finance institutions falls well below what is required to acquire the key asset in mechanical emptying services, namely the truck. MFI would have to raise their credit limit but even then the MFI's would have to lend at lower interest rates than they have been in the past.

Lack of Lease finance financial services for the sector: Lease finance tends to be at lower rates of interest; however, since there is not equipment supplier in Kenya for specialized mechanical emptying trucks, this has not developed. Thus whereas a new truck chassis would be lease financed, the value for money of the locally fabricated mechanical emptying truck falls below the value for money of an imported specialized reconditioned emptying truck. As a consequence it may be more beneficial to offer lease finance for services for reconditioned imported trucks.

Across the three cities FSM policy is generally lacking and as a consequence, the present framework of guiding private sector stakeholders does not lend itself to developing a sustainable industry. A number of areas are in need of public policy intervention

i. Regulation : This has to be centralized and formulated
ii. Licensing: This is not coherent, the licensing regime and the whole system lacks structure
iii. Industry Incentives: These are non-existent and therefore private sector operators have to pay to provide public infrastructure. For example the lack of sufficient tipping points causes long distance travel, which reduces the overall service rate of the industry.
iv. Taxation: Fiscal incentives lack for this industry even which may be deserved since the service often qualifies as an essential service

Three business models proposed which would improve the value chain in the industry. These are

i. Bio-centers as social enterprises: On the whole the Bio-centers have proven to be self-sustaining once capitalized and have demonstrated positive health externalities particularly at the low income household levels.
ii. Microfinance targeted at Sanitation services: A microfinance model and fund targeted at sanitation services would enhance the access to credit to the sub-sector.
iii. Treatment plants enhancement for product drying, packaging and distribution. Treated FS is more affordable that commercial fertilizers. The acceptability of treated FS re-use

would be raised by increased public education, though already there is FR-re-use acceptability. Investing in modernizing FSTP to rely less on weather for the drying process would increase annual output. Kenya has wet conditions for 8 months of the year. In addition, because of the bulky nature of treated FS packaging would ease transportation and distribution to market. The large share of agriculture in the economy at 24% of GDP would offer a market for the use of treated FS.

The immediate business opportunity in FSM identified during this study is investing in Bio-centres. The bio-centre service has been noted to be self sustaining entities able to achieve cost recovery and payback the initial capital outlay.

CHAPTER 1. THE KENYA COUNTRY FSM BACKGROUND

1.1 Introduction

The International FSM Study Initiative

Kenya – like many other developing countries elsewhere in the world, is currently faced with the twin challenges of urban poverty and inadequate sanitation infrastructure in urban slums and other low income areas. Globally, the WHO/UNICEF Joint Monitoring Program on line data base indicates that in Developing Countries, over 1 billion urban dwellers lack provision arrangements for the collection, emptying, haulage, safe disposal and treatment of fecal sludge (FS) produced by on-site sanitation infrastructure – in their "latrine based cities."

The Bill and Melinda Gates Foundation (BMGF) of USA, which is spearheading initiatives for the promotion of "Sanitation that Works for the Poor," observes that, in most of low income areas of cities in the Developing Countries, the main method of emptying latrines when full is manual based. And most worrying of such practices is that, sludge from latrines is usually "deposited into nearby lanes, drains or open spaces." Such unhygienic modes of fecal sludge disposal obviously represent a significant risk to public health and more particularly, to the vulnerable populations.

Notwithstanding the pervasiveness of this worrying situation in the "latrine based cities" of the Developing Countries, BMGF notes that, "very limited or little research has been carried out to understand the fecal sludge emptying as a service, and its effectiveness as a component, or an integrated part of the cities' sanitation provision."

Accordingly, BMGF has rolled out an initiative for conducting exploratory research in 5 African countries (and others in Asia) including Kenya and Ethiopia in East Africa, Senegal, Burkina Faso and Nigeria in West Africa. This exploratory research initiative is aimed at informing the sanitation sector on the dynamics of FSM and linkages to future investments in the sector by governments, donors and other development partners.

This Report highlights the current FSM situation in Kenya and explores possibilities that exist for up scaling the FS service provision "for the benefit of the low income segment of the participating cities population."

1.2 The Context of the FSM Study Initiative in Kenya

According to the recent (2009) national census, Kenya had a total population of 38.6 million – occupying an area of 581,313 km^2. This gives it an average density of only 66 persons per square kilometre.

Kenya's population has been rapidly growing over the past few decades: 3% between 1999-2009; 2.9% 1989-1999; 3.4% 1979-1989; 3.8% 1969-79 (2009 National Census)

Alongside the general rapid population growth, Kenya has equally witnessed a fairly high rate of urban population growth. The 2009 Census indicated, of the country's total population, nearly a third (32.3%) lived in cities and towns. This was up by 8% in the previous census. *The Kenya Vision 2030 (2007)* forecasts that, if this trend continues unchecked, Kenya's urban population is expected to rise to 60% by the year 2030.

Of the total Kenyan urban population, 25% live in Nairobi alone, whilst in combination with Mombasa and Kisumu – the 3 largest towns, between them they account for 36% of the total urban population.

The rapid urbanization in Kenya has brought into its wake serious social and economic problems, including: increased overcrowding; unemployment; environmental degradation; poor infrastructure services, and above all, the pervasive proliferation of informal settlements – characterized by extremely poor living conditions.

The earlier cited poor management of fecal sludge in Kenya's urban areas therefore falls neatly under these challenges, and it is in this context that, this situation will be appropriately analyzed in this Report.

1.3 Water Supply and Sanitation (WSS) Coverage in Kenya

1.3.1 Water Supply

The Government of Kenya (GOK) has put a lot of effort in the recent past, to support the development of sources of clean and safe water supplies to its citizens, in both the urban and rural areas. In 2007, the National Water Services Strategy (NWSS) Paper reported that sustainable access to safe water was estimated at 60% in urban areas and only 40% in rural areas. The current situation – as derived from the 2009 Census shows that while 38.4% of urban

households in Kenya have access to piped water only 14.2% have access to piped water supplies in their dwellings as shown in Table 1-1.

Table 1-1 : Percentage Households by Main Source of Water – Kenya

	Water Source	% Urban	% Rural
1.	Piped	38.4	13.4
2.	Piped into Dwelling	14.2	2.2
3.	Water Vendor	13.2	2.3
4.	Spring /Well /Borehole	24.2	42.6
5.	Rain Harvesting	0.7	1.3

Source: 2009 Kenya Population Census

Access to piped water in dwelling is a significant indicator, in that, piped water determines usage of water borne sanitation facilities, and conversely, that the bulk of the others will perforce resort to on-site modes of sanitation – with implications on FSM initiatives.

1.3.2 Sanitation

The National Water Services Strategy (2007) estimates that improved sanitation coverage in Kenya in 2006 was 55% in urban areas and 45% in the countryside. The main modes of human waste disposal according to the 2007 national census are Main Sewer, Septic Tank, Cess Pool, VIP Pit Latrine and Pit Latrine (Table 1-2). **Septic tanks** refer to waterproof chambers (usually rectangular) installed below ground to receive sewage. Septic tanks separate solid components (sludge) and liquid components. After separation, the liquid components leave the septic tank and are filtered through soakage pits or drainage fields and discharged to the soil. The solid components remain in the septic tank where anaerobic decomposing and fermentation processes reduce the sludge volume. The residual sludge has to be emptied at regular intervals depending on the size of the tank. **A Cesspool** is a below ground chamber/pit to receive sewage. The walls of the chamber/pit are lined with stone/concrete blocks or other materials while the bottom of the chamber is not. Sewage solids settle to the bottom, floating grease and

scum collect at the top and liquid seeps into the ground, initially through the bottom and most of the time through the side of the cesspool.

Table 1-2 : % of HH by Main Mode of Fecal Waste Disposal – Kenya

	Mode of disposal	% Urban	% Rural
1.	Main Sewer	19.5	0.2
2.	Septic Tank	8.0	0.5
3.	Cess Pool	0.7	0.1
4.	VIP Pit Latrine	5.9	4.3
5.	Pit Latrine (Covered/Uncovered	62.5	74.1

Source: 2009 Kenya Population Census

Significantly, only 19.5% of Kenyan households are connected to the sewerage system in all the cities and towns in the country. The remainder uses on-site sanitation facilities – with the simple pit latrine accounting for whopping 74.1% in the rural areas and 62.5% in towns. A point to note here however, is that the construction and usage of the simple (or ordinary) pit latrine varies considerably from place to place and in varied socio-economic situations – in regard to safety, hygiene and privacy parameters, this variation is so much so that, some could not qualify to be regarded as being "safe and hygienic mode of excreta disposal."

The National Water Services Strategy aims at improving access to these two basic services by 2015, by attaining 80% access to safe and reliable water for urban areas and 75% for rural areas. For sanitation, the aim is to increase access to 70% and 65% for urban and rural households, respectively. And with regard to sewerage, the aim is to attain 40% and 10% access for urban and rural areas, respectively.

1.4 Institutional and Legal Framework – At the National Level

The main institutional context for the effective delivery of the FSM in Kenya is outlined in the National Environmental Sanitation and Hygiene (ESH) Policy, 2007 – which still provides the primary policy framework for the Sector. To a limited extent, the NWSS Paper does provide

institutional responsibilities – **but only within the Ministry of Water context** – "for the provision of water and sanitation services."

The ESH document outlines the policies and strategies which could be implemented by the Government of Kenya: "to create and enhance an enabling environment in which Kenyans will be motivated to improve their hygiene behavior and environmental sanitation."

More relevantly here, the ESH Policy outlines the roles and responsibilities of all the ESH actors. Table 1-3 below shows a simplified framework for the institutional relationships in the ESH network at the national level.

Table 1-3 : Institutional Framework for ESH – at the National Level

No.	Name of Document	Executing Agency	Parent Ministry	Institutional Role
1.	Public Health Act, Cap 242	Division of Environmental Health	Ministry of Public Health and Sanitation (MPHS)	Ensuring conformity to national norms and standards, and making regulatory interventions to improve compliance
2.	Local Government Act, Cap 265	Local Government Authorities (LGAs): City/Municipal Councils	Ministry of Local Government (MOLG)	Oversight responsibility over LGAs for ensuring compliance with the provisions of the Public Health Act and protection of the environment from pollution
3.	Environment Management Coordination Act, 1999	National Environment Management Authority (NEMA)	Ministry of Environment and Mineral Resources (MEMR)	Enforcement of the law for the protection and conservation of the environment, and gazettement of regulations to control operations regarding various environmental protection concerns
4.	Water Act, 2002	Water Service Boards (WSBs) Water Service Providers (WSPs)	Ministry of Water and Irrigation (MOWI)	Responsible for developing water and sewer facilities, and provision of water and sanitation services – to complement ESH activities
5.	Non-Governmental Organizations Coordination Act, 1990	Non-Governmental Organizations (NGOs)	Various Line Ministries	To be encouraged by GoK to participate in ESH activities – with their own funds, or as agents for others, to scale up the ESH target achievement
6.	Relevant Companies Acts	Various Private Sector Actors	Various Line Ministries	To be encouraged by GoK, to invest in ESH services and to provide consulting services
7.	Relevant Laws	Households and Communities	Relevant Service Providers	Responsible for improving ESH services in their properties – including proper use and care of the installed facilities

NB: The Ministry of Housing, which is currently implementing the Kenya Informal Settlements Improvement Project (with World Bank financing) in various towns in Kenya – including Nairobi, Mombasa and Kisumu, is also a significant stakeholder in the FSM issues.

1.5 The Objectives and Scope of the FSM Study

As part of its global initiative in the broad area of Water, Sanitation and Hygiene (WASH) sector, BMGF has commissioned Losai Management Ltd of Nairobi, to conduct an exploratory research on the FSM situation in 3 selected Kenyan cities. In doing so, Losai is working in collaboration with the Kenya Water Service Providers Association (WASPA) – a lobby group for all the water and sewerage providers in the country.

The main objectives of the Study are to understand fecal sludge emptying/transportation in the country and to identify opportunities for business model and product innovation. More specifically the Study has the following fivefold objectives, viz:

a. To assess the current situation as regards the level of and practices related to, the sludge extraction and transportation business – including that of the existing products and technologies used.
b. To carry out market analysis on the current and potential size and scope of fecal sludge extraction and transportation operations, including outlining the roles of public sector actors in the sector.
c. To review the current service delivery models for pit/septic tank emptying and transportation in the selected cities.
d. To carry out business model analysis – to quantitatively determine the cost and revenue levels and barriers to profitability of the extraction and transportation supply chain models.
e. To make appropriate recommendations for the improvement of the quality and sustainability of urban sanitation chain – on issues of institutional, governance, financing models, product technology and business models – at both the local and global levels.

BMGF criteria for the selection of the local case study sites in each participating country are that:

- 3 cities should be covered – in order to understand the full spectrum of urban sanitation delivery models for the country.

- The selected cities should include the capital city, a secondary large city and a mid-sized city.
- All the 3 cities selected must be ones which have sludge treatment plants and official dumping sites.

The Kenya Study Team selected the 3 largest cities in the country which meet all the above criteria as follows (in order of their relative importance and size): Nairobi (the capital), in the center; Mombasa – the port city in the east – at the coast; and Kisumu in the west – by the lakeside. Evident here is that, the 3 cities are geographically dispersed; have varying climatic and topographical characteristics; and represent diverse cultures and socio-economic mix.

1.6 Brief Profiles of the Selected Study Cities

Kenya is bordered by Somalia to the northeast, Ethiopia to the north, South Sudan to the northwest, Uganda to the west, Tanzania to the south and Indian Ocean to its southeast. The scope of work requires the research to be carried out in three cities in order to better understand the full spectrum of urban sanitation service delivery models in the country. The research for the Kenyan component was undertaken in Nairobi, Mombasa and Kisumu (Figure 1-1).

Figure 1-1 : Location of selected Cities: Nairobi, Mombasa and Kisumu

Nairobi

Nairobi is the capital and largest city of Kenya. The city and its surrounding area also form the Nairobi County. Founded in 1899 as a simple rail depot on the railway linking Mombasa to Uganda, the town quickly grew to become the capital of British East Africa in 1907 and eventually the capital of the independent Kenyan republic in 1963. The city lies on the Nairobi River and has an elevation of 1795 m above sea-level. According to the 2009 Census, Nairobi is the most populous city in East Africa with 3,138,295 inhabitants living within 696 km^2. It is estimated that Nairobi's population will reach 5 million in 2015. There is a wide variety of standards of living in Nairobi. Most wealthy Kenyans live in Nairobi but the majority of Nairobians are average and poor. Half of the population has been estimated to live in slums which cover approximately 5% of the city area. Kibera is one of the largest slums in Africa, and is situated to the west of Nairobi. The slums cover approximately two square kilometres and are on government land. Other notable slums include Mathare and Korogocho. Altogether, 66 areas are categorized as slums within Nairobi. The Nairobi City Council manages the affairs of the City of Nairobi.

Mombasa

Mombasa is the second-largest city in Kenya. Lying next to the Indian Ocean, it has a major port and an international airport. The city also serves as the centre of the coastal tourism industry. The town is also the headquarters of Mombasa District.

The city has a population of 939,370, as per the 2009 census, and is located on Mombasa Island, which is separated from the mainland by two creeks: Tudor Creek and Kilindini Harbour. The island is connected to the mainland to the north by the Nyali Bridge, to the south by the Likoni Ferry and to the west by the Makupa Causeway, alongside which runs the Kenya-Uganda Railway. The port serves both Kenya and countries of the interior, linking them to the Ocean.

Being a coastal town, Mombasa is characterized by a flat topography. The town of Mombasa is centered on Mombasa Island, but extends to the mainland. Mombasa has a warm, tropical climate. The amount of rainfall depends essentially on season. The rainiest months are April and May, while in January to February the rainfall is minimal.

Mombasa is managed by a municipal authority, the Mombasa Municipal Council. Mombasa is the main city in the Coast Province, and one of such administrative regions in Kenya. The district boundaries are coterminous with those of the municipal authority.

An estimate from the Kenya Integrated Household and Budget Survey (2005/6) shows that 37.6% of Mombasa's Households fall below the poverty line hardly an improvement over the 38.2% recorded in the Welfare monitoring survey of 1997. Virtually all the urban poor, well over a third of Mombasa's total population, live in more than 55 slums across the City. The poor face stark living conditions in these settlements, paying exorbitant prices for water, over 58% using pit latrines and 54% dumping rubbish in open areas and drains.

Although there is diversity of land ownership patterns in slum areas, tenure is often insecure, leaving residents with little incentives to invest in their dwellings.

Kisumu

Kisumu is the third largest city in Kenya with an estimated population of 409,928. It is situated in the West of Kenya and is bordered by Lake Victoria to the southwest, and the sugar belt and Kano irrigation scheme to the east. It has an area of 417 km^2 (157 km^2 of water and 260 km^2 of land). Kisumu has an elevation of 1131 m above sea level.

The city lacks adequate shelter, with approximately 60 percent of the urban population that reside in the peri-urban and informal settlements lacking basic services. Approximately 75 percent of peri-urban inhabitants live in temporary and semi-permanent structures.

According to a UN-Habitat study (2004) the city experiences a high unemployment rate of about 30%, and the bulk of the population, particularly in the informal and slum settlements, works in the informal sector: 52% of the working population is engaged in informal activities. Low income and job insecurity are the biggest challenges that the poor of Kisumu face. 48% of the urban population lives within the absolute poverty bracket.

Kisumu experiences the highest average urban poverty levels at 48% against a national average of 29%.

CHAPTER 2. METHODOLOGY OF THE FSM STUDY

2.1 Literature Review

The data used in the preparation of this report were collected in the month of August 2011 from a variety of sources. Information on water and sanitation was obtained mainly from secondary sources – especially GOK policy, strategy and planning documents and reports. These secondary sources supplemented the main primary data stocks which were derived from 3 collection processes, viz (a) the household survey, (b) in depth interviews with the key stakeholders and (c) Observation of FSM phenomena. The data collection instruments used in this regard are included as Appendix A and also in Volume II of II of this report.

In order to fully understand and internalize the full range and dynamics relating to the FSM activities in the country and elsewhere in the developing countries, the Study Team delved into the various sources of relevant secondary information, including: past studies ; official policy and planning documents and websites; and reports of the relevant GOK line agencies. Such sources are listed in the references section of the report and the main ones are reviewed here below – highlighting how they relate to the FSM issues.

1. **Bill and Melinda Gates Foundation, 2011: Water, Sanitation and Hygiene: Grand Challenges Exploration**

   This has already been quoted earlier in Section 1.1 of this report.

   The document has references to the global fecal sludge situation, including: the magnitude of the problem and the glaring lack of knowledge on the non-piped sanitation services in the developing countries. The document cites such authorities as WHO – UNICEF Joint Monitoring on-line database, to powerfully drive home the message of the huge challenges confronting FS management in particular and sanitation services in general.

2. **Straus M. et al, 2000, 2003: On-Site Sanitation: When the Pits are Full: Planning for Resource Protection in Fecal Sludge Management**

   Observes the predominance of on-site sanitation systems (OSS) over sewered sanitation in developing countries. He notes that in Sub-Sahara Africa, “more than 75% of householders in large cities and up to 100% in towns are served by on-site sanitation facilities.” He therefore proposes that governments should put in place adequate

measurers to address this challenge, including carrying out far reaching institutional, regulatory, financial economic and technological reforms.

3. EAWAG-SANDEC, 2006: Urban Excreta Management: Situation, Challenge and Promising Solutions

The problems associated with extraction, transportation and disposal of fecal sludge in developing countries cited in literature resonate well with the situation in Kenya. These problems include low priority on authorities' agenda, inadequate legal and regulatory framework, lack of cooperation between fecal sludge stakeholders, lack of incentive/sanctioning procedures, difficulty in securing suitably located sites, inadequate recognition, definition and legal framework of private entrepreneurs, non-affordability of emptying fees, difficulty of accessing on-site sanitation facilities, and infrequent emptying of on-site facilities. These challenges result in indiscriminate dumping and reuse of untreated fecal sludge leading to environmental contamination, high risks of disease infections and increased mortality and morbidity. These causes, problems and effects of fecal sludge management are captured well in the presentation slide from Global Video Conference Series on Sanitation & Hygiene: Session 2. 22 of January, 2008 reproduced in Figure 2-1 below.

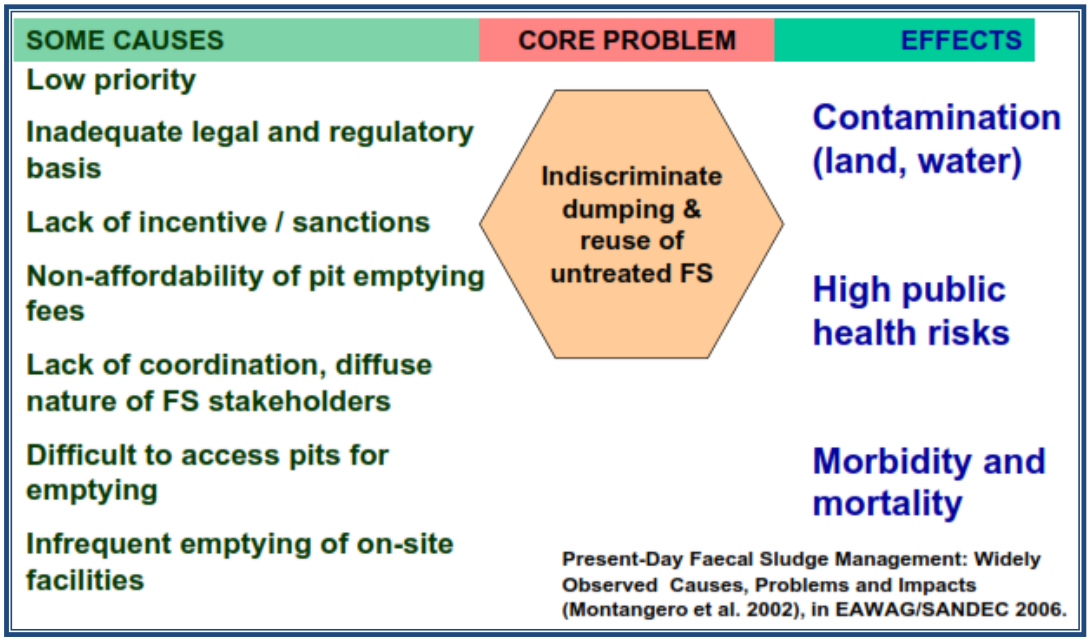


Figure 2-1 : FSM: Widely Observed Causes, Problems and Impacts

4. **Water and Sanitation Program (2011): Economic impacts of poor sanitation in Africa**

   Notes that the current sanitation investment in Kenya is much lower that the recommended minimum of 0.5% of GDP. The publication further observes that, "increased investments in sanitation and hygiene promotion are required not only to realize health and welfare benefits, but also **to avert large economic losses**.

5. **Water and Sanitation Program (2004): Sanitation is a Business, Approaches for demand-oriented policies**

   Prepared for the Swiss Agency for Development and Cooperation the publication prescribes how governments should be seriously involved in FSM by: initiating and implementing effective sector plans; building FS disposal sites; treating sludge adequately; licensing of private entrepreneurs; guaranteeing competition between service providers; creating incentives; and applying sanctions to offenders.

6. **Rose Osinde, 2006: Fecal Sludge Management and On-Site Sanitation in Lunga Lunga and Korogocho Informal Settlements in Nairobi**

   The study on Fecal Sludge Management & Sanitation in Informal Settlements (Rose Osinde, 2006) provides data on fecal sludge management in two informal settlements in Nairobi: Lunga Lunga and Korogocho. The objective of the study was to identify institutional policy gaps, develop strategies for addressing community-level constraints for better sanitation service provision, facilitate coordination and partnership between stakeholders (including conflict management) and identify areas of assistance from external support agencies. The study identified 15 toilets in the settlement, majority either connected to the sewerage system or discharging directly to Ngong River. In Korogocho, the study identified manual exhausters who use 200 litre drums, transport in handcarts and discharge into the polluted Nairobi River at a cost of Kshs 300 (USD 4.15) per load. The study also identified concerns/issues affecting fecal sludge management at the national, utility/Regulator, SSIP, Community and Donor/Development agencies levels. The identified concerns/issues are summarized in Table 2-1.

Table 2-1 : FSM Concerns/Issues: Lunga Lunga & Korogocho Settlements

National Level: • *Inadequate investment and budget allocation for sanitation sector.* • *Practical and sustainable delivery mechanisms for sanitation services in informal settlements not yet developed.* • *Inter-sectoral coordination and collaboration lacking*	***Utility/Regulator level:*** • *Lack of institutional and innovative technological know- how on the best practices for sanitation services in the informal settlements.* • *Un-defined link between utility/regulator and the SSIPs – roles and responsibilities not regularized & no existing governance structure.* • *Lack of systematic ground-level coordination and collaboration with other interventions* • *No control over activities of existing SSIPs*
SSIP Level: • *Lack of proper emptying facilities – health and security risks* • *No designated desludging points – no access to Municipal sewers, even where available* • *Lack of formal recognition of service – affects time of work; social stigma* • *Unregulated tariffs – lack of accountability.* • *Lack of emphasis on link with SSIPs for water* • *Lack of governance structure/regulatory framework*	***Community Level:*** • *No consumer voice – exploitation by SSIPs - no accountability – unregulated tariffs* • *Compromised water quality (through cross- contamination)* • *Communities pay for sanitation on water bills but don't receive services* • *Security issues for women and children* • *Lack of focus on hygiene promotion* • *Impracticality of individual basic sanitation facilities* • *space limitation and tenure issues*
Donor & development agencies Level: • *Uncoordinated interventions – too many interventions with little overall impact* • *Differing approaches for urban/rural/peri-urban* • *Linkages between sanitation interventions & Land/Shelter policy*	

Source: Rose Osinde, 2006: Fecal Sludge Management and On-Site Sanitation in Lunga Lunga and Korogocho Informal Settlements in Nairobi

7. Water and Sanitation Program & Maji na Ufanisi: 2004: Understanding Small Scale Providers of Sanitation Services: A Case Study of Kibera (Nairobi)

Limited data is available on fecal sludge management in the Kibera informal settlements from field surveys carried in 2005 by World Banks Water and Sanitation program and Maji na Ufanisi, a local Non-Governmental Organization. The study interviewed 51 service providers (manual pit emptiers, truck emptier employees, public toilet employees etc.) and other stakeholders. The purpose of the study was to provide a better understanding of who the Small Scale Providers of Sanitation Services (SSPSS) are, and the range of services they offer, with a view to identifying and recommending improvements to the environment, within which they operate, and the quality and efficiency of the services they offer. The services offered by these providers included latrine management; latrine construction; and latrine emptying.

The study found that sludge emptying was a key activity for SSPSS since pits needed to be emptied every 10 months. The findings are represented in the Table 2-2 and Figure 2-2.

Table 2-2 Key Findings on Small Scale Providers of Sanitation Services in Kibera

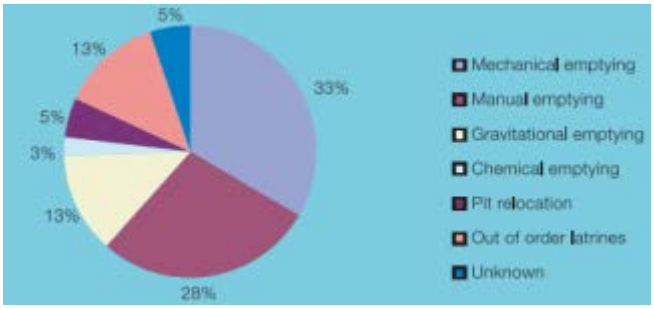


Figure 2-2 : Household Options in Kibera when Pit Larine Fills up

A summary of the key findings from this study are as follows:

- *The three main emptying techniques employed in Kibera are manual, mechanical, and gravitational.*
- *Few manual emptiers can afford basic protective gear such as gloves and boots for their work.*
- *Manual emptiers are ignored by public authorities, despite the role they play in the domestic pit emptying market.*
- *Manual emptying will remain as a necessary method for exhausting pit latrines for as long as vehicle access is limited in Kibera.*
- *Heavy sludge and solid waste in the pit and accessibility hampers mechanical emptying*
- *Accessibility is the greatest deterrent to real competition in mechanical emptying in Kibera.*
- *The average pit capacity is 2-3 m^3*
- *Gravitational emptying is generally only possible when the pit is next to a river or a drain as the contents flow directly into the water.*
- *Investment for manual emptying equipment is from personal savings*
- *The SSPs are poorly organized, have no formal service associations and very little contact with other stakeholders. Better coordination would increase their bargaining power. Coordination through formal associations would help transform them into real partners in the sanitation sector. Regulating mechanisms need to be developed to avoid the formation of cartels.*
- *There is need to improve the working environment of SSPs, the most critical of which is to enable better use of existing sewers for sludge disposal.*
- *There is need to promote dialogue between various stakeholders to clarify issues and obstacles, to better articulate activities of the various actors, and to make better use of the skills and know-how of the local private sector.*
- *Create an enabling framework for SSPSS Start discussion between public sanitation authorities and SSPSS to develop agreements, and good professional practices especially with regard to sludge disposal. This framework should not restrain SSPSS, but rather take advantage of their flexibility.*
- *There is need to develop and implement a sludge disposal policy.*

Source: Water and Sanitation Program & Maji na Ufanisi: 2004: Understanding Small Scale Providers of Sanitation Services: A Case Study of Kibera (Nairobi)

8. Ministry of Health, Kenya, 2007: The National Environmental Sanitation and Hygiene (ESH) Policy

This was briefly alluded to earlier in Section 1.4. The document analyses the general ESH situation in the country in general and identifies the main challenges that must be addressed in the short and long term; proposes practical approaches for effective hygiene promotion and sanitation marketing; choice of appropriate technologies; and financing mechanisms for ESH interventions.

Specifically with regard to FSM, the ESH policy identifies 2 main concerns:

a. That although in cities and towns water-borne sanitation is the desired mode of human waste disposal; the installed treatment plants are often non-functional due to poor operation and maintenance. This has resulted in discharge of raw sewage into the watercourses – posing grave danger to public health.

b. That due to inadequate basic sanitation services, residents of urban slums discharge fecal sludge in streams running through the settlements – this again posing serious danger to those residents health and to that of the downstream e.g. "population".

9. Ministry of Water and Irrigation, Kenya, 2007: The National Water Services Strategy (NWSS): 2007 to 2015

Like the ESH policy, the NWSS (also cited earlier in sections 1.3 and 1.4), equally: identifies the main challenges encountered in the provision of adequate water and sewerage services and proposes workable strategies to address such challenges.

In sections specifically focusing on FSM issues, NWSS equally notes that "on-site sanitation facilities in urban slums dispose their sludge at nearby streams – thus contaminating ground and surface water." The document further observes that funds for rehabilitation, upgrading and expansion of existing dilapidated facilities. "are insufficient to meet the huge demand for sustainable access". To address these challenges - in line with its set goals, NWSS proposes to substantially increase access to waterborne sewage collection, treatment and disposal, both in the urban and rural areas of the country. (See also section 1.3).

10. Government of the Republic of Kenya, 2007: Kenya Vision 2030 A Globally Competitive and Prosperous Kenya

This document constitutes the blueprint for the country's current development policy within the framework of the country's long term development strategy.

Vision 2030 aims at accelerating growth in GDP up to 10% p.a, so as to transform Kenya into a middle income country by 2030. The Vision is based on 3 pillars: economic, social and political development, which will depend on micro economic stability, increased investments in transport and energy infrastructure, education and governance reforms. It is envisaged that the implementation of these strategies will in the short and long term, enhance equity and wealth creation opportunities for the poor and enable the country to achieve the Millennium Development Goals (MDGs) and reduce poverty to minimum levels.

The goals of the ESH policy and NWSS are firmly factored into the Vision 2030's Social Pillar: "to ensure water and improved sanitation availability and access to all Kenyans." To achieve this, Vision 2030 emphasizes, "Water and sewerage infrastructure will have to rise in order to meet the standards associated with middle income countries."

2.2 Situational Analysis Methodology

2.2.1 Household Survey Design

National Sample Size

As provided for in the Scope of Work for the Study, a total of at least 1000 households for the country were sampled. This was distributed in the 3 Study cities as follows: Nairobi – 400; Mombasa – 400; Kisumu – 400. The main instrument used was the Household Survey Questionnaire (Annex 1) – which had already been pre-designed by BMGF. However, the Study Team made a few modifications (without altering the substance and format), to ensure nestedness in the Kenyan context.

Population and Sampling

The survey targeted residents of Kisumu City, Mombasa City and Nairobi City. The standard sampling procedures for the household survey were used – where the sampling points, i.e. the lowest unit of data analysis was the lowest Kenyan administrative unit: the sub-location. The main criterion for the selection of where the household survey could be conducted within the

sub-location was that, that particular area was not sewered. Another consideration for selection of a sub-location for the survey was its relative socio-economic standing in the city – falling under each of the following categories: high income (HI), middle income (MI) and low income (LI) areas.

Based on the above criteria, a sample of 400 households per city was used in the survey. The sample size for each sampled sub-location was proportionately allocated depending on the number of households in the sub-location based on figures obtained from the 2009 National Population Census. Although the survey was essentially urban core focused, special consideration was given to the relatively large peri-urban settlements in the city, which were accordingly allocated a few households from the sample frame to participate in the survey. This was aimed at enabling the Study Team "get a feel" of the FSM situation in areas of the city outside the core urban zone.

In determining the sample size, the following statistical formula was applied.

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

Where: n is Sample Size

N is Total Population

e is the precision level (taken as 5% at 95% confidence level)

A detailed methodology of the survey including breakdown of the distribution of the sample sizes to the various locations is presented in Volume II of II of this report.

Training to Conduct Household Survey

In July 2011, a team of 4 supervisors were extensively trained – to in turn be the trainers of enumerators, in the approaches, methods and procedures, of conducting the household survey. The supervisors were centrally trained in Nairobi, who then proceeded to train the Enumerators for the respective cities.

Fieldwork

Field work constituted the most substantive phase of the survey, which involved interviewing household respondents – using the Questionnaire instrument, to collect primary data on FSM in the 3 cities. Household interviews were conducted in each city during the following times:

Nairobi 4th – 10th August 2011, Kisumu: 9th - 12th August, 2011 and 27th – 29th September 2011; Mombasa: 16th – 19th August 2011.

2.2.2 FSM Practices

Fecal sludge management services are classified under two broad emptying categories: manual and mechanical operations.

Manual Emptiers

Operations of manual emptiers in emptying:

- Use buckets/bowls hung by rope into the pit latrine and drawn by hand.
- Emptying bowl is then transferred to buckets (20 liters) which are often then transferred into drums

Drums are:

- either transported manually to transfer points or
- transported by trucks to FSTP or
- dumped at a nearby hole for burying or dumped to a storm-drain, garden etc.

As part of the emptying service, manual emptiers also channel out FS from pits, septic tanks, and cess pools to storm-drains by way of discrete connecting canals, this is common in densely populated housing units such as multi-floor flat complexes.

Owing to lack of adherence to safety /public health procedures, manual emptying is the main cause of hygienic related illnesses among manual emptiers and it was reported that people in the industry have died in Nairobi and Mombasa from related diseases.

Emptiers generally do not own their tools, but hire these from known industry equipment suppliers. These tools comprise of a specialized hand cart, buckets, scooper and shovel.

Regulator tolerance for manual emptiers is ambivalent, in the public domain, the practice is illegal, but enforcement units are forced to accommodate manual emptiers under a complex framework of gate keeping, subcontractors and security informants.

Mechanical Emptiers

Mechanical emptying often refers to the use of a pump to convey the FS into a large tank rested on a vehicle/automobile to transport the same to a dumping site. The pump and vehicle

mechanism are generally standard but capacities of tanks differ and therefore the load capacity of trucks varies from 6 cubic metres to as high as 22 cubic metres.

In mechanical empting the vehicle is positioned next to the FS reservoir which may be a septic tank, cesspool or a pit latrine. The pump hose is then directed at the pool and pumping begins with emptying taking place. The key determinant of amount to be emptied is the size of the transportation tank. A number of local names are used to describe the ME trucks including – "exhauster truck, honey sucker truck or simply exhauster".

There are two main types of trucks available in Kenya, one, locally fabricated and two, second hand imports of specialized trucks. The fabrication service is available in the country and was the main mode of mechanical truck production. In this model, the vehicle chassis is obtained separately and the fabricator builds the tank and installs the pump.

In the case of the second hand (used) imported trucks these come as complete units and there is no local customization to the vehicle. The second hand imported trucks are now more preferred over the fabricated units. This is due to a number of reasons which include:

1. New or reliable truck chassis are expensive
2. The cost of a second hand imported truck –in its complete form- is lower than the cost of a new chassis and installation of devices
3. Installation and fabrication work takes a much longer time to complete, than the entire process of importing a truck
4. There is no down time with an imported truck and therefore these have an early cash flow incidence than the fabricated units.

2.2.3 Methods to Validate Financial Data

There are three sources of financial data.

1. Financial accounts prepared for purposes of tax returns where applicable. These can only be given voluntarily to third parties by the tax payer. For operators with books of accounts they were unwilling to give their financial reports.
2. Financial and business accounts prepared for stakeholders such as board of directors, lenders and other shareholders. These may be obtained from the stakeholders except that commercial banks would not be in a position

to share such confidential information. None of the operators asked was willing to share such documents.

3. Financial estimates obtained from operators based on oral interviews. This was the method used to obtain financial records. It was validated by way of interviews of stakeholders such as employees of the operator and by reviewing data maintained at the tipping point. Moreover, financial information released by the finance department of the utility correlated the frequency of dumping by operators at the tipping point.

In the three cities of Kisumu, Mombasa and Nairobi under study operators can be classified as formal and informal. The informal have no office premises and largely have no full time employees. The formal operators on the other hand have office premises and full time employees. In both instances however, financial and business accounts were not accessible as operators were unwilling to share formal financial reports. The formal operators maintain books of accounts given that they have corporate tax registration, established offices, have full time employees and their operations have been corporatized. For the informal operators these businesses do not keep any accounting information applicable for tax purposes and this may be explained by (a) they are sole proprietorships and as such the tax accounts would not differentiate the income from the business with income for the same individual from other sources. (b) the business income is not subject to any other tax outside of income tax and therefore records are not necessary. For instance, since the sanitation services are –sales tax or VAT tax exempt- there is no compliance requirement for record keeping. (c) the business owners maintain a sole proprietorship status because the same is not obliged under local laws to undertake financial accounting on an annual basis.

Under these circumstances, for the three cities, financial data was obtained through interviewing the operators. The estimates then received were validated through further interviews with employees of the operators and cross checked with data obtained from competition. Printed financial data is difficult to obtain especially from informal businesses. This presents challenges not only to tax policy but also to financiers who are unable to estimate the financial health of these organizations.

2.2.4 Treatment Plant/Dumping Sites Model

One of the earliest Wastewater Treatment Plants (WTP) in Kenya is found in Mombasa. The Kipevu WST was first commissioned in 1952 and last expanded in 2003. It is located in west Mainland of Mombasa and is a conventional type of treatment plant. Mombasa has a second Wastewater Treatment Plant (WTP) Kizingo Wastewater Treatment Works which was commissioned in 1962. This plant is designed for preliminary treatment (screening and grit removal) and primary treatment (sedimentation).

Across the three cities two broad types of treatment plants/dumping sites are known to exist, one-conventional type and two stabilization pond type. The conventional type includes Kariobangi Treatment Plant, Kisumu Central Wastewater Treatment District (CWTD), while the stabilization pond include Nyalenda stabilization pond in Kisumu and Dandora estate sewerage treatment plant which is located at Ruai, 30 Km east of the Nairobi city centre along Kangundo Road. It uses stabilization ponds and has a dry weather capacity of 80,000 m^3/d. Both industrial and domestic sewage are discharged at the plant.

The stabilization pond model tends to only have a filtration tank and drying beds. It employs the use of ultra violets rays from sunlight to kill micro organisms in the fecal sludge.

In the conventional type, there is use of mechanical aeration, filtration and discharge in treatment of fecal sludge. At the inlet the fecal sludge is filtered for solids and metals before being released into a tank where it is stirred for effective concentration. The fecal sludge is then moved to filtration tank and then to sedimentation tank which has a filter of rocks and sands for separation of solid and liquid. Wastewater treatment standards are included in the design such as a BOD of 560 mg/l or a design of BOD/SS effluent standard of 20/30. The processed fecal sludge which is transforming to organic fertilizer is left to dry naturally in the drying beds.

FS sludge collected by emptiers whether mechanically or manually is disposed to the dumping site via a tipping point. Tipping points are characteristically man-holes located at a point on the trunk sewer line and designated by the Utility operator as the disposal point. In all the three cities there is a single designated operational tipping point serving all emptiers.

In order to understand the treatment plant processes, visits will be made to these facilities and technical staff working at these locations will be interviewed. The actual visits and discussions will entail full descriptions of the treatment process from delivery of FS to post treatment.

2.3 Determination of Financial Flows and Key Stakeholders

There are 6 key stakeholders in Fecal Sludge Management:

1. Fecal Sludge (FS) extraction operators (private entities and public entities where they exist)
2. Utility companies who issue permits for use of the dumping sites
3. Fecal Sludge Treatment Plants (FSTP) who manage the disposal of the sludge
4. Local authorities who issue business permits
5. Environmental authorities who vet the equipment used for these services
6. Customers who form the demand component of the service

Each of these stakeholders has an economic incentive under the present framework to support the proper functioning of FS management services.

The flow of funds (Figure 2-3) begins with clients and should terminate with the end user of the fecal sludge (product/byproduct).

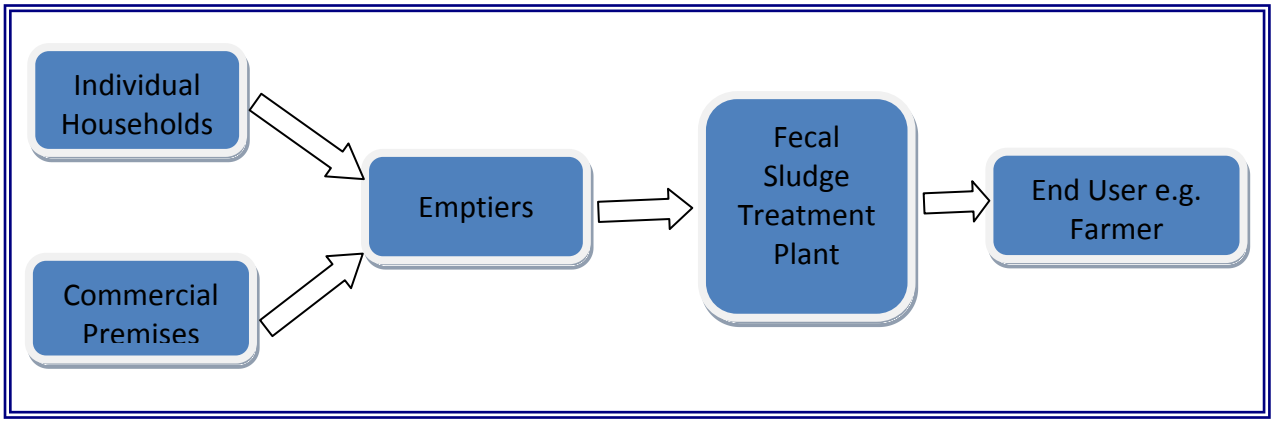


Figure 2-3 : FSM Flow of Funds Expected Financial Flows in FSM Operations

Emptiers earn an income from the clients. There is therefore a strong business case for emptiers to offer competitively priced services. Pricing is important because of the general income levels of households and the substitution effect noted when prices are out of reach of households.

FSTP and Utility companies earn an income from the emptiers in the form of licensing fees. The FSTP also earns an income from the sale of treated FS.

Utility companies generally obtain investment capital from 3 sources. (a) the national exchequer through the national budget or devolved funding under the various fiscal programs of the state. (b) from donors as financial assistance-aid or grants and (c) from Multilateral and bilateral lenders such as the World bank, African Development Bank, French Agency for Development under guarantee programme of the national exchequer. Funding to the FSTP also even when specific is directed through the utility company. The utility company does earn revenues from water services and sanitation services from those households it supplies water and those connected to its sewerage infrastructure.

Local authorities earn from FS through business licensing fees. The same applies to the environmental authorities. However, the local authorities do not require a FS specific business license. On the other hand, the environmental services have a specific fee for FS equipment in particular applicable to the FS extraction trucks. This fee is on a truck basis, is not transferable and works as a certification of fitness for use for the truck. Each and every truck providing FS extraction is classified broadly as a sanitation truck and is required to meet design and fitting requirements.

2.4 Market Size Calculation Method

Market size calculation is based on Household Survey results and population data provided from reliable sources. The population data is obtained from the national population census report conducted by the national institution responsible for the same task.

The population data provides for the census estimates for the city. The Household Survey offers the variables necessary for inference which include distribution of sanitation services- pit latrines, septic tanks, sewer connections- the frequencies of emptying for onsite sanitation and others. The variables estimated through the survey are used as inputs to estimate the parameters under study. It is the combination of both Household survey variable estimates and population census that forms the input to the computation of the market size.

For purposes of computation of market size, the following is used.

P1	**Market Size =**	**Total VOLUME of sludge TO BE emptied / year in m^3**	**(A x PV) + (B x SV) +(C x CV)**	**m^3**	This is the FS produced in the city **based on ACTUAL survey data**
P2	**Theoretical Market Size =**	**Total VOLUME of sludge TO BE emptied / year in m^3**	**(PITS x Number of users x (0.3 to 0.6) + (ST x number of users x (0.7 to 1.0)**	**m^3**	This is the **THEORETICAL FS** produced in the city

Where A, B and C in P1 (market size are defined as outputs of estimation)
A= **TOTAL Pits TO BE emptied per year**
B= **TOTAL Septic tanks To BE emptied/ year**
C= **TOTAL cesspools To BE emptied/ year**
PV =Average Volume of Pit
SV= Average Volume of Septic Tank
CV= Average Volume of Cess Pool
Where in P2 (theoretical market size)
PITS= assumed to be equal to the number of HH with PITS
ST = assumed to be equal to the number of HH with septic tanks
Number of users is assumed to be the household size
The ratios on P2 are based on assumptions that dry pits get 0.3 liters per day per person and multi chamber septic tanks get up to 1.0 liter per day per person.

2.4.1 FS Production and Collection Computation

The computation for FS market size is identical to the estimate for FS produced within a city. Therefore FS production is identical to the estimate to be derived from the formula set out in the calculation of FS Market size.

The FS collection computation is based on the distribution of usage of Mechanical emptiers and Manual emptiers as derived from the household survey and inferred from the population data obtained from the national census. The inference uses the following computational formulations (Table 2-3).

Table 2-3 : Methodology of FS Collection Computation

FS Collection Calculations	Source
Number of households in the city	**National Census Data**
% of the city HH with On-site sanitation	**National Census Data**
Number of the city HH with On-site sanitation	**National Census Data**
% of the HH with on-site sanitation having pits in the city	**HH survey**
% of the HH with on-site sanitation having septic tanks in the city	**HH Survey**

FS Collection Calculations	Source
% of the HH with on-site sanitation having OTHER (i.e. cesspools, holding tanks) in the city	**HH survey**
Number of the HH with on-site sanitation having pits in the city	**HH survey**
Number of the HH with on-site sanitation having septic tanks in the city	**HH Survey**
Number of the HH with on-site sanitation having Cess pools in the city	**HH survey**
% of the HH with on-site sanitation having pits in the city using Mec. Emp	**HH survey**
% of the HH with on-site sanitation having septic tanks in the city using Mech. Emp	**HH Survey**
% of the HH with on-site sanitation having OTHER (i.e. cesspools, holding tanks) in the city using Mec. Emp	**HH survey**
% of the HH with on-site sanitation having pits in the city using Man Emp	**HH survey**
% of the HH with on-site sanitation having septic tanks in the city using Man. Emp	**HH Survey**
% of the HH with on-site sanitation having OTHER (i.e. cesspools, holding tanks) in the city using Man. Emp	**HH survey**
% of households with On-site sanitation using mechanical emptying	
% of households with On-site sanitation using manual emptying	
Number of the HH with on-site sanitation having pits in the city using Mec. Emp	**HH survey**
Number of the HH with on-site sanitation having septic tanks in the city Using Mec. Emp	**HH Survey**
Number of the HH with on-site sanitation having OTHER (i.e. cesspools, holding tanks) in the city using Mec. Emp	**HH survey**
Number of the HH with on-site sanitation having pits in the city using Man. Emp	**HH survey**
Number of the HH with on-site sanitation having septic tanks in the city Using Man. Emp	**HH Survey**
Number of the HH with on-site sanitation having OTHER (i.e. cesspools, holding tanks) in the city using Man. Emp	**HH Survey**
Typical volume of the septic tank (SV)	**5 m^3**
Typical volume of the pits (PV)	**2.6 m^3**
Typical volume of the Cesspool/Holding tanks (CV)	**5 m^3**
Fecal sludge ratio on pits	**0.6**
Fecal sludge ratio on septic tanks	**1**
Number of Users	**5**
Number of trucks	**Vary from city to city**
Capacity of trucks	**Varies among**

FS Collection Calculations	Source
	operators
Number of trips per truck per year (Assume 4 trips for every 3 days in 6 days of week for 52 weeks)	From the Survey

The Household survey data against the national population data in the methodology is then used to infer the actual estimates of sanitation facilities available at Households.

Data on Mechanical and Manual emptying frequencies, type of facility and volume emptied per year is obtained from the HH survey. The HH Survey data is used to populate the table below.

Emptying Frequency (Survey Data)	% of pits =100%	# pits to be Emptied/yr	% of septic tanks =100%	# Septic tanks to be Emptied/yr	% of Cesspools =100%	# cesspools to be Emptied/yr
2 times/yr	%		%		%	
Once/yr	%		%		%	
Once/2 yrs	%		%		%	
Once/3yrs	%		%		%	
2-4 yrs	%		%		%	
Once/4 yrs	%		%		%	
Over 10 yrs	%		%		%	
Other(once every 3 months)	%		%		%	
	100 %		**100 %**		**100 %**	

Fecal Sludge Collection Computation

Market Size Computation

This formulation aggregates the volume sludge obtained from the various sanitation facilities namely pit latrines, septic tanks and cess pools.

Market Size =	**Total VOLUME of sludge TO BE emptied / year**	**(A x PV) + (B x SV) +(C x CV)**

Mechanical Fecal Sludge Collection Formula

This formula computes the volume of FS ferried by trucks.

Current FS COLLECTED =	**[(Number of trucks x m^3 capacity of trucks x number of trips per year)**

Manual Fecal Sludge Collection Formula

This formula computes the volume of FS moved by manual emptiers.

Current FS COLLECTED =	**(number of pits emptied manually per year x PV) + (number of septic tanks emptied manually per year SV)]**

Where:

A= Number of Pit latrines emptied per year
B= Number of Septic tanks emptied per year
C= Number of Cesspools emptied per year
PV= Pit latrine Volume
SV = Septic tank Volume

Therefore total FS collected in $City^{-1}$ = FS Collected by Manual Emptiers in $City^{-1}$ + FS Collected by Mechanical Emptiers in $City^{-1}$.

2.5 Financial Analysis Methodology

The financial analysis follows the framework and methodology provided in BMGF Study guide. This required the preparation of the income statements, balance sheet and statement of cash flows in the prescribed format (Table 2-4).

Table 2-4 : Financial Analysis Framework

Financial Analysis Frameworks	
Income statement	**Balance sheet**
Revenue	**Assets**
Emptying services	**Non-Current Assets**
Other revenue sources	Trucks
TOTAL ANNUAL REVENUE	Current Assets
Operating costs - Fixed	Cash
Fixed annual salary costs:	Total Assets
Driver	Liabilities
Turn boy	Owner's equity
Management	Opening equity
Rent:	Retained Earnings
Office Rent	Net owner's equity
Parking Rate	Total Owners equity and liabilities
Telephone	**Statement of Cash flows**
Electricity	Investment Activities
Tyres	
Annual maintenance	Nets Investment Cash flow
Insurance	
License : Business License	Operating Activities
: NEMA	Cash flow from operation
: NCWSC/MOWASCO/KIWASCO	Net Profit After Tax &Depreciation
Dumping Fees	Add Back : Depreciation
Misc other costs	
Total Fixed Opex	Net Cash flow from Operation
GROSS MARGIN	
Operating costs - Variable	Financing Activities
Fuel	Purchase of trucks
Transport	Net Cash flows financing activities
Extraction	
Variable wages (casuals)	Net Cash flows
Driver	
Turn boy	Opening Cash Balance
Total variable Expenses	
TOTAL ANNUAL OPEX	Closing Cash Balance
Net operating cash flow	

CHAPTER 3. RESULTS AND ANALYSIS OF URBAN FSM PRACTICE

A 3.1 Situational Analysis of Extraction/Transportation (Kisumu)

A 3.1.1 Demographics of Kisumu City

According to the 2009 National Census, the population of Kisumu is spread in 32 Sub-Locations and the population by locality is shown in Table 3-1.

Table 3-1 : Population of Kisumu by Locality

Locality	Population	Percent
Core Urban	259,258	63.2
Peri Urban	129,053	31.4
Rural Area	21,617	5.3
Total	409,928	100.0
Total No. of Households	102,508	

For the purposes of the Household Survey, 18 of the 32 sub-locations (56%) were selected for the FSM study – with a combined total population of 82,961 households – i.e. over 80% of the total City households.

With regard to the socio-economic categorization of the sampled sub-locations, 2 were classified as falling under the high income category; 7 in medium income; and 9 in low income category. The sample sizes (Table 3-2) were proportionately calculated from the number of households in each income category.

Table 3-2 : Sample Size per Sub-Location (Kisumu)

	Name of Sub-Location	Income category	No. of households	Sample size
1.	Town – Southern	High	2,476	12
2.	Town – Northern	High	2,107	10
3.	Kaloleni	Medium	3,658	18
4.	Migosi	Medium	4,795	23
5.	Nyalenda 'B'	Medium	8,561	41
6.	Manyatta 'B'	Medium	7,808	38

	Name of Sub-Location	Income category	No. of households	Sample size
7.	Kogony	Medium	5,164	25
8.	Bandari	Low	1,921	9
9.	Manyatta 'A'	Low	12,525	60
10.	Nyawita	Low	4,099	20
11.	Kasule	Low	4,880	24
12.	Nyalunya	Low	2,731	13
13.	Nyalenda 'A'	Low	8,070	39
14.	Korando	Low	3,773	18
15.	Kanyakwar	Low	3,553	17
	PERI-URBAN AREAS			
16.	Wathorego	Low	2,849	14
17.	Chiga	Medium	2,168	10
18.	Ojolla	Medium	1,823	9
Total			**82,961**	**400**

Table 3-3 below shows the demographics of the sample investigated in the 18 sub-locations

Table 3-3 : Demographics of the Sample Surveyed in Kisumu

No.	Demographic Characteristics	%	Observations
1.	Sex of the Respondent Female Male	 52.0 48.0	Majority of the respondents were female
2.	Household Headship Head Yes Not Head	 65.0 35.0	Nearly two-thirds of the respondents were heads of households
3.	Educational Level Secondary Primary Tertiary (College, University) Non Formal/Adult None	 38.0 32.0 28.0 1.0 1.0	The Kisumu adult population is relatively highly literate – with over two-thirds (68%) having attained secondary level education and above. Only less than 1% was non-literate
4.	Status of Household Head Tenant	 62.8	Most of the household heads were tenants – with owners constituting only

No.	Demographic Characteristics	%	Observations
	Owner Other	36.7 5	about over 37% of the sample
5.	Average No. of Persons Living in Household	6	
6.	Main Occupation of Household Head Salaried Self-Employed Trader Artisan Farmer Other None	 38.0 34.0 16.0 3.0 3.0 3.0 1.0	Majority of the household heads were in self-employment occupations – 66%, whilst those in salaried occupations accounted for nearly 40% of the total surveyed

A 3.1.2 Drinking Water Supply Coverage for Kisumu City

The survey sought to find out the proportion of the sampled Kisumu households which have access to safe water supplies ("potable water"). To assess the coverage, the answers to the question of: source of water supply was posed. The pattern of response was as indicated in the Table 3-4.

Table 3-4 : Main Source of Water Supply – Kisumu City

	Main Source	% of Households
1.	Individual Connection – KIWASCO	21.0
2.	Individual Connection – Private	6.0
3.	Water Kiosk	26.0
4.	Water Vendors	11.0
5.	Borehole	18.0
6.	Well	7.0
7.	Surface Water	9.0
8.	Others	2.0

Over 53% of Kisumu households derive their water supplies from piped systems: with a significant 21% obtaining it from the city utility: Kisumu Water and Sewerage Company (KIWASCO). Private sources supply some 6% of the households. Water Kiosks (or piped system to public taps), account for a significant 26% of the City households, whilst the level of access

from boreholes and wells is 25%. Eleven percent of households obtain their drinking from unsafe surface water sources.

Compared to the national urban figures (Table 1-1), Kisumu has a higher coverage from piped sources and also from boreholes and wells. From this study however, Kisumu emerges with a higher percentage of households using unsafe surface water sources (11.0%) than the national average of 9.2%.

Data obtained from KIWASCO during field discussions with officials from the Commercial Department, indicate that, through a recent water supply improvement program – with funding from AFD (French Development Agency), KIWASCO increased its water supply capacity from about 17 m^3 per day, to today's 44 m^3 per day. However, with only 27% of the current potential capacity of the water supply system being utilized, it means that, the supply side in Kisumu now surprisingly, far exceeds the current demand.

A 3.1.3 Sanitation Coverage for Kisumu City

In order to find out the level of sanitation coverage in the City, 3 specific questions were posed to the respondents:

a. Access to a sanitation facility within the household premises,
b. Where respondents without access to sanitation facility at home, go to answer a call of nature; and
c. The kind of sanitation facility installed.

In terms of "safe or hygienic management of human waste" in non-sewered urban areas of the City, Kisumu scores fairly well - compared to the national urban patterns. For instance, whereas only about 6% nationally use the VIP Latrine, this is about 20% in Kisumu. For the septic tank and cess pool, Kisumu's coverage is 19.0% whilst nationally, this is only 8.7%.

With the now much improved availability of water supply, Kisumu's sewer connection coverage is bound to rise significantly in the near future. Discussions with the officials of the Commercial Department at KIWASCO indicated that, of the 11,921 water consumers, only 4,530 or 38% are on sewer. Table 3-5 shows the level of access to and coverage of sanitation systems in Kisumu City.

Table 3-5 : Sanitation Coverage in Kisumu

No.	Coverage Indicator		%	Observations
1.	Access to a Sanitation Facility within Household Premises	Yes	88.0	An encouraging 88% of the households have access to a sanitation facility of one type or another, within their compound
		No	12.0	
2.	Average No. of Households Sharing Sanitation Facility			This high number households sharing a facility – mainly on-site, means that it fills up fast – hence requiring frequent (unaffordable) emptying
3.	Place of Excreta Disposal (For the Disadvantaged 14% of Households)	Neighbor	51.0	A worrying 19% of these without access to a sanitation facility dispose human waste in open spaces and drainage channels. Another 21% are assumed to use other unsafe methods. This certainly contributes greatly to environmental pollution – thus posing danger to human health in the respective areas of the City
		Public Toilet	9.0	
		Open Space	15.0	
		Drainage Channel	4.0	
		Other	21.0	
4.	Type of Sanitation Facility Installed (For the 86% who Have Access)	Ordinary Pit Latrine	51.0	The ordinary pit latrine predominates but majority are really of questionable standards of construction. Nevertheless, an encouraging 43% use facilities that may be categorized as constituting safe or hygienic management of human waste
		VIP Latrine	20.0	
		Septic Tank	17.0	
		Cess Pool	2.0	
		Sewerage Connection	4.0	

KIWASCO previously had an exhauster truck to serve the un-sewered areas of the City. It is however no longer functional (since 2009) – leaving the void to be filled by private mechanical and manual operators.

The only currently functional FS treatment plant in Kisumu – Kisat, is currently undergoing complete rehabilitation and modernization – with funding from AFD. The French financier is equally supporting the revival of the City's second long collapsed treatment plant – at Nyalenda. (Nyalenda Treatment Plant which is a stabilization pond type).

A 3.1.4 Institutional and Legal Framework for FSM at the City Level (Kisumu)

Interrelationship in the FSM System

There are 5 main actors in the FSM system at the city level. These are: the National Environmental Management Authority (NEMA); the City/Municipal Council; the Water and Sewerage Service Provider (WSP) for the city; the various companies and informal Emptying Operators; and to certain extent, NGOs (Figure 3-1). These collectively may be referred to as **the City FSM Service Providers (CFSPS)**. The roles of the main actors in fecal sludge service delivery are summarized below.

a. The National Environmental Management Authority (NEMA)

NEMA is the supreme authority in the country for enforcing the law for the protection and conservation of the environment – under the Environmental Management and Coordination Act (EMCA) 1999. EMCA also provides for the gazettement of regulations to control operations regarding various environmental protection concerns.

For instance, for fecal sludge management, the relevant Environmental Protection Order is the **Environment and Coordination (Waste Management) Regulations 2006**. These regulations are meant to streamline the handling, transportation and disposal of various types of waste. This is intended to protect human health and the environment.

Under these Regulations also, NEMA **licenses operators** who use waste transport vehicles, e.g. for fecal sludge management, “to prevent occurrence of odor or health hazard and to ensure that transported waste is disposed off at sites designated by the Authority.”

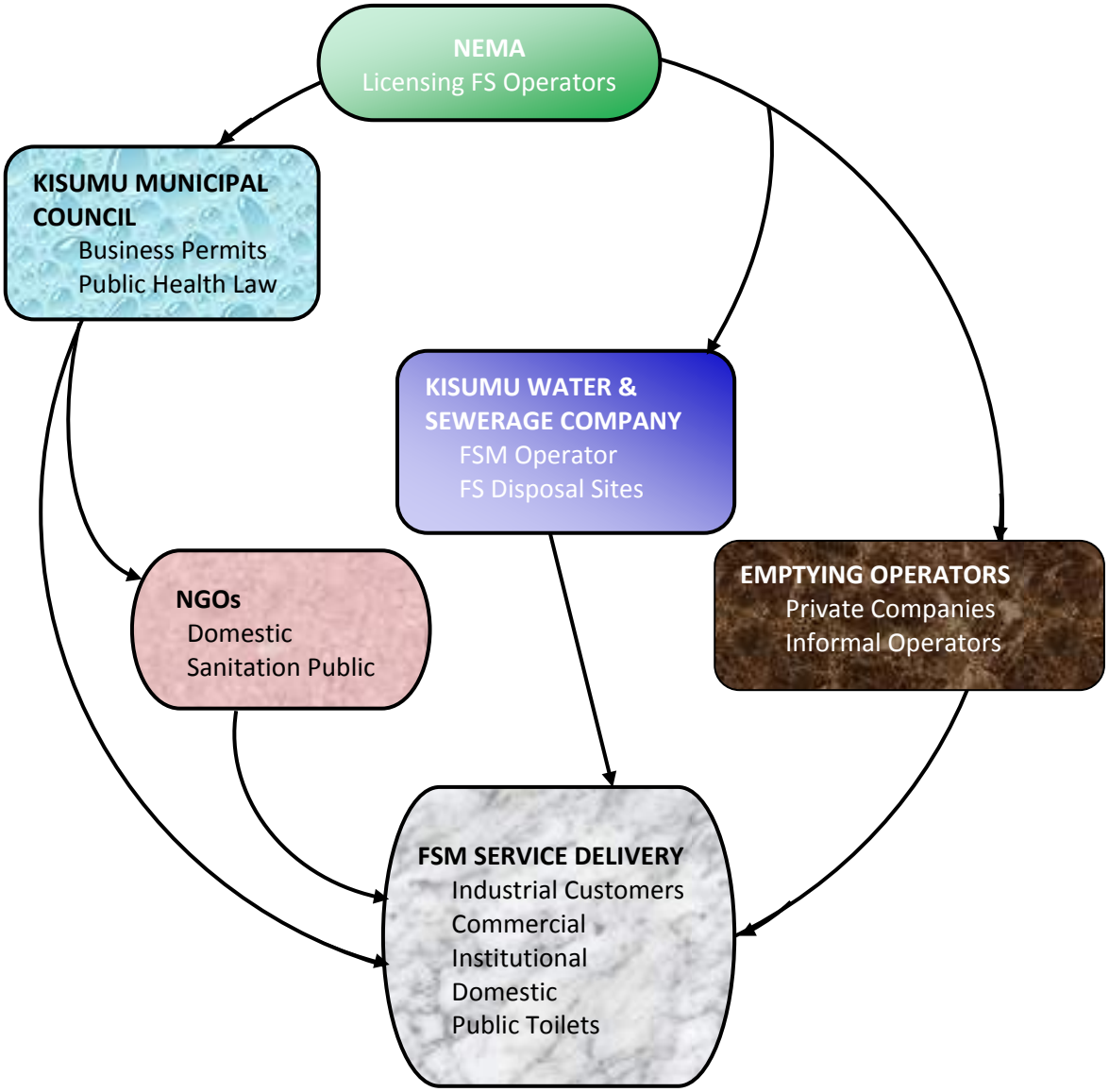


Figure 3-1 : The Institutional Framework for FSM at the City Level (Kisumu)

The Municipal Council of Kisumu

These local government authorities (LGAs) are mandated by the Public Health Act, Cap 242, "to take all lawful necessary and reasonably practicable measures, to maintain in their jurisdiction, clean and sanitary condition and, to prevent occurrence of conditions liable to be injurious or dangerous to human health."

The city/municipal councils may also undertake the construction and operation of public toilets – either by themselves, or by appropriate concessioning to private sector actors – under the Public Private Partnership (PPP) arrangement.

Two line departments of the Municipal Council of Kisumu (MCK) have a close relationship with the FSM issue, viz, the Department of the Environment and the Public Health Department. We held discussions with Deputy Director of Environment, and the Chief Public Health Officer. Whereas the Department of the Environment is involved in the development of physical infrastructure and the protection and conservation of the environment, the Public Health Department enforces the relevant laws and regulations.

In the sanitation sector for example, the Department of the Environment undertook the construction of 6 public toilets in the various parts of the city – which were later handed over to self-help groups to operate. On its part the Public Health Department ensures that they are well maintained to the required hygienic condition.

Another department of MCK – the Revenue Department, is involved in issuing business permits to exhauster operators – to allow them to operate as legal business enterprises within the city. The amount payable in this regard is Kshs 21,800 (US$ 232) p.a, per truck operated.

Role of Kisumu Municipal Council

The roles of the municipal council as indicated by the respondents were as shown in Table 3-6.

Table 3-6 : Roles of Kisumu Municipal Council

Advocacy for access to sanitation facilities for all	Ensure proper drainage is kept
Arrest those who go against good waste management and disposal	Establish and maintain sanitation facilities
Bring mechanical emptying services	Extend the sewer lines
Channel the sewer lines in the right places	Facilitates management of sludge

Collect and dispose garbage	Making and implementing by laws
Control pollution by companies and factories	Provide clean water and good sewer system
Create awareness on hygiene practices	Provide disinfectant to spray in the latrines
Employ more garbage collectors	Repair and maintain sewer systems
Enforce the legal requirement and introduce litter bins to slums	Specify dumping areas for garbage
Ensure each household has a sanitation facility	Take action on unethical fecal sludge management

b. The Kisumu Water and Sewerage Company (KIWASCO)

Established under the provisions of the Water Act 2002, KIWASCO is a public utility owned by the Local Government Authority – Municipal Council of Kisumu, but managed under arrangement by the Ministry of Water. Under the Act, KIWASCO as a Water and Sewerage Services Service Provider (WSSP) is charged with the responsibility of providing water and sewerage services to the residents of Kisumu City. The utility's sewerage treatment plants provide disposal sites for sludge from the private operators.

Water Supply

Through a recent water supply improvement program – with funding from AFD (French Development Agency), KIWASCO increased its water supply capacity from about 17,000 m^3 per day, to today's 44,000 m^3 per day. However, data available at the Commercial Department (– Dep. Commercial Manager), indicate that so far, only a total of 11,921 consumers have been connected. This translates to only 27% of the potential water supply capacity in the city is currently being utilized – meaning supply far exceeds the current demand!

Sewerage Services

Of the total 11,921 water consumers connected to KIWASCO, only 4,530 are on sewer i.e. 38%. This indicates that most of the customers use other methods of fecal sludge disposal from their premises – most certainly, mechanical or manual emptying services.

KIWASCO previously had an exhauster truck to serve the un-sewered areas of the City. It is however no longer functional (since 2009) – leaving the void to be filled by private operators.

KIWASCO operates a sewerage treatment plant at Kisat – which uses the conventional treatment methods. Currently only 3 sections of the installed capacity of 6 are functional. However, through the AFD funding, the facility is currently undergoing complete rehabilitation and modernization.

Another KIWASCO sewerage facility is at Nyalenda – which has long since been non-operational. It is currently however being used as the designated disposal site for exhauster trucks operating in the City. Plans are underway with financing obtained from AFD to revive the Nyalenda facility.

With the modernization of the Kisat treatment plant and the revival of the Nyalenda facility, in addition to the availability of sufficient water supplies, Kisumu is poised to increase the sewerage coverage tremendously. Nonetheless, the demand for exhauster services will still continue to exist – until this level is reached – estimated to be in the long term.

Role of the Water and Sanitation Utility

The role of the Water and Sanitation Utilities as indicated by the respondents are as shown in Table 3-7.

Table 3-7 : Role of the Water and Sanitation Utility – Kisumu

Educate on importance of better sanitation	Extending sewer lines
Engage in sludge recycling logistics	Fund sanitation projects
Ensure by laws are observed	Manage water and sewer lines
Ensure proper drainage and sanitation	Offer exhauster services
Ensure proper sewerage systems are put up	Regular supply of clean safe water
Establish more sanitation facilities	Repair burst sewer pipes

c. The Fecal Sludge Emptying Operators

The WSSPs are supposed to provide all residents of their cities with efficient and effective water borne sewerage services. However, currently, Kisumu can provide only 10%.

Hence, there is a huge gap in the provision and demand for water borne sewerage services. Consequently, private sector players – both formal and informal, have stepped in to fill the

wide gap – particularly for providing emptying services in the un-sewered parts of the respective cities.

Licensed Exhauster Service Providers

There are only 4 licensed exhauster trucks in operation in Kisumu – owned by 3 operators. KIWASCO is not currently involved in this line of sanitation service provision.

The 3 Kisumu exhauster service providers are small businesses with the "largest" owning only 2 old trucks. This service level is really not adequate for the City. And given the low sewerage coverage, potential for investment in the sector is great: demand for the service far outstrips the current supply.

Informal Fecal Sludge Emptiers

Informal fecal sludge emptiers carry out their trade illegally, i.e. they are not licensed to do so; have not been granted business permits; and do not comply with the provisions of the Public Health Act. Consequently, they conduct their operations mainly in slum areas, at night – to avoid being arrested by NEMA and KMC law enforcers. Their tools of trade are rather crude and extraction and disposal methods characteristically unhygienic.

For this reason, it is pretty difficult to penetrate their world of clandestine operation: they suspect anybody trying to obtain information from them as being agents of NEMA or the Council! Through an acceptable contact however, we were able to interview one leading manual operator in the City and valuable insights were made on the various aspects of their operations.

One undeniable fact stands out from the discussions with these informal operators: that they are an indispensable component of the FSM system in Kisumu, particularly in the slums and other low income areas. The authorities can continue to disregard them as non-existent and illegal. But to the residents of low income areas of the City, they are essential "service providers." So, how could this "essential service" be regularized and mainstreamed into the FSM service delivery framework? The Study Team proposes organized community groups as entry points.

d. Non-Governmental Organizations (NGOs) in the Sanitation Sector

The roles of the NGOs operating in the city as indicated by the respondents were as captured in Table 3-8.

Table 3-8 : Role of NGOs

Assist in recycling of sludge	Fund and monitor development projects
Assist the needy	Harmonize resource for sanitation improvement
Build toilets	Help in eradication of poverty through educating people
Champion campaigns on environmental conservation	Offer support to projects and groups on FSM
Develop sanitation facilities in slums	Partner with water providers
Educate people on proper waste management and disposal	Provide employment opportunities to people
Education on cleanliness of the environment	Provide health services to slum dweller
Engage in community development	Provide mobile toilets
Ensure good sanitation in slums and reduce disease outbreak	Support CBOs and projects towards FSM
Extend health services to slums	Support orphans and widows and vulnerable children
Finance mechanical emptying service	

A list of identified NGOs operating in the city is as captured in Table 3-9.

Table 3-9 : List of NGOs operating in Kisumu City

1	APEX ACHIEVERS	14	NIPPON
2	CARE KENYA	15	OGRA FOUNDATION
3	CCF	16	OHPS
4	CDC,	17	PLAN INTERNATIONAL
5	CDS	18	SANA INTERNATIONAL
6	COLEP	19	STIPA(ECOSAN TOILET)
7	CONCERN WORLDWIDE	20	TEMAK
8	EAD	21	UMANDE-KENYA
9	GDI	22	UNDUGU SOCIETY
10	HAPPY VILLAGES	23	WAENET
11	IPA	24	WESTERN CHILDHOOD LABOUR
12	KMET	25	WORLD CARE
13	KWAP	26	WORLD VISION

Of this number two are noticeably the most prominent in the Kisumu City sanitation scene. These are Sustainable Aid in Africa International (SANA) and Umande Trust. The two NGOs are supporting sanitation projects in the slums of Kisumu – the latter bio-toilets in the Nyalenda slums.

Umande Trust

Umande is a rights-based agency supporting community-based initiatives in Kenya. It currently has operations in Nairobi (where its head office is located), Kisumu and Embu town. It is main focus area of operation is water and sanitation: financing investment and eco-friendly technologies.

In Kisumu, it has operations in 4 slums of Bandani, Obunga, Manyatta and Nyalenda – where it has financed community members' sanitation facilities through its Sanitation Development Fund (SANDEF). Umande's flagship initiative however is the Bio-Sanitation Center of which there are currently 4 in operation: one in each settlement and 2 under construction.

A Bio-sanitation center is a facility installed by the Trust using anaerobic digestion technology, which transforms human waste into bio-gas and liquid fertilizer. At the bio-center community managed toilets and showers are provided at a fee; and a community resource and meeting center established.

Sustainable Aid in Africa International

SANA is a specialist water and sanitation sector NGO, implementing projects in Nyanza – in both urban and rural areas of the province. Through its commercial arm – SANA Holdings Ltd, the NGO is currently offering **credit to 7 water and sanitation associations** in Nyanza, enabling some 35,000 people to access safe water supplies and sanitation.

The Study Team found the SANA Credit for Water and Sanitation model quite an interesting initiative – which could fittingly be replicated in the FSM system. Here below is highlighted the main features of the SANA Model.

1. Previous sanitation initiatives – mainly through donor grants, have failed to improve access to sanitation by the majority of the population, mainly because of high jacking by the rich and unsustainability of installed facilities.
2. Sanitation has in the past been accorded a rather low priority – vis-à-vis water – resulting in sanitation being denied access to adequate investment finance.

3. Hence, the main objective of sanitation loans is to enable for the establishment of a revolving loan fund pool – exclusively dedicated to sanitation development: at the household level and public places – in low income areas.
4. The target beneficiaries are women groups and self-help groups (50% must be women) – with a membership of 10-30 people. Whilst the group acts as the main security for the loans disbursed, individual members are expected to save monthly into the collective pool and service disbursed loans.
5. After servicing sanitation loans, members can venture into other related income generating activities, e.g. solid waste management (and hence possibility exists here for FSM?)

A 3.1.5 Flow of Money Chart for FSM Transactions

The service channels in FSM showed different financial transaction opportunities. The more immediate being clients (Institutional/individuals) paying for FS management services to emptiers (Figure 3-2). However, underlying this is the indirect payment to the FSTP/WWTP through licensing by the utility company which manages the FSTP/WWTP. More directly the FSTP/WWTP receives payments for the sale of treated FS to end users.

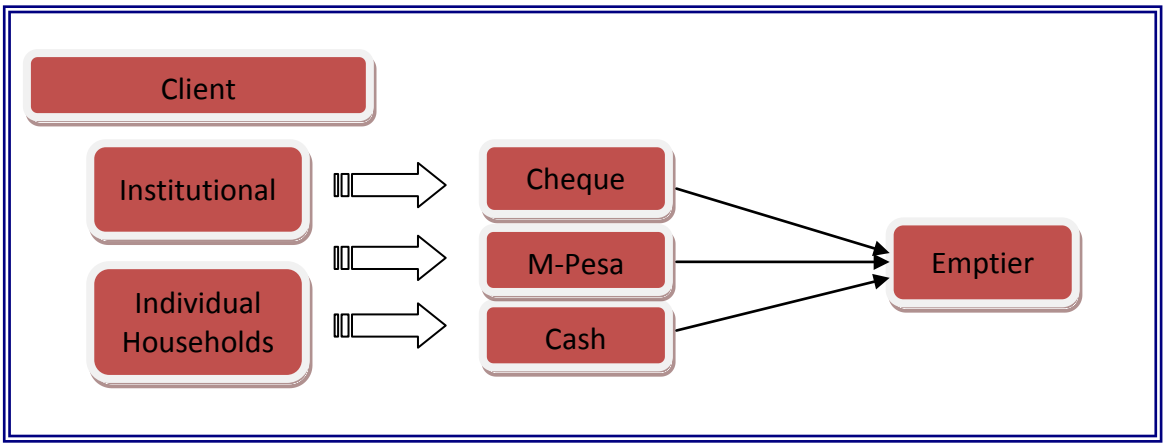


Figure 3-2 : Flow of Money Chart for FSM Transactions

Fecal Sludge management value chain

Therefore an expanded value chain of FS management value shows multiple flow of funds among stakeholders as was noted in Kisumu. Improvements to this value chain are likely to increase the demand for the services particularly by sealing leakages through unauthorized burying of FS which occurs during manual empting. In addition the Kisumu FSTP may be willing to pay to receive the FS for onward processing to sell the final product to end users in a biogas-generation process.

In Kisumu the FS evacuation is undertaken by private entities. There is no public body providing FS evacuation services. The private operators invest in their enterprises to provide these services. Their key sources of finance are:

1. Personal savings and savings from friends and relatives
2. Pension savings
3. Loans from financial institutions

The Utility Company and the WWTP receive funds from two broad sources. The first source is sales and service revenues from water sales- as a water utility and sewer connection fees plus FS management licensing fees. The second source of funds is from the national exchequer as part of budget allocation, grant and multilateral loan guarantees. There are formulations of private-public partnerships that are being considered as a way of generating revenues. In Kisumu the mechanical emptiers pay a dumping fee of USD 434 per truck per annum, and this is

charged in advance of tipping by the truck. The fee is payable to the Utility company which operates the dumping site.

Table 3-10 below summarizes financial transaction data for FSM services in Kisumu. In Kisumu the average tariff is not comparable as the trucks operating are of different capacities. There is no dumping fee charged by KIWASCO. Kisumu has two WTP, namely Kisat Treatment Works with a design capacity of 6,800 m^3/day initially completed in 1957 and once rehabilitated in 1987. This WTW produces treated FS through a conventional system with the sludge conditioned in cold digestion tanks and dried in sludge drying beds before disposal to the land for sale. The treated sludge re-sale price is fixed by the utility company which operates the treatment plant. However at present there is no sale of sludge. The second WTP is Nyalenda Sewerage Treatment Works which comprises of stabilization tanks. This is the WTP designated as the dumping site for FS emptying by mechanical and manual emptiers.

Table 3-10 : Financial Transaction Data for FSM services

Client Category	Emptiers	Tariffs	Dumping fee (KIWASCO)	End User	Re-sale Price
➢ **Individual Households**	Operator I	$ 52 per trip	$ 434 per truck per annum	➢ Households (Farm)	$ 1,120 per tonne
➢ **Commercial premises**	Operator II			➢ Households (Electricity)	

A 3.1.6 FS emptying business owners' profile (Kisumu)

Following a landscape review of the operators, it was decided to interview a number of the mechanical truck operators operating in Kisumu City. Information from one operator per every operating capacity was used to develop the emptier profile for purposes of comparison between cities (Table 3-11 and Table 3-12).

Table 3-11 : FS Emptying Business Owners Profile - Kisumu

Operator	Business Premises	Business Type	Age of business owner	Business Plan
1	None	Sole proprietorship	65	None
2	None	Sole proprietorship	60	None
3	None	Sole proprietorship	60	None

Table 3-12 : Fs Emptying Business Profile

Operator	Form of Business	No of Trucks	Started Operation in	Number of Customers per year	Mode of Operation
1	Sole proprietor	2	2004	528	• Within town • No formal offices • Three employees per truck • Permanent Employment
2	Sole proprietor	1	2008	46	• Within town • No formal offices • Two employees per truck • Casual Employment
3	Sole proprietor	1	2011	288	• Within town • No formal offices • Two employees per truck • Casual Employment

B 3.1 Situational Analysis of Extraction/Transportation (Mombasa)

B 3.1.1. Demographics of Mombasa City

According to the 2009 National Census, the population of Mombasa is spread in 32 Sub-Locations and the population by locality is shown in Table 3-13.

Table 3-13 : Population of Mombasa by Locality

Locality	Population	Percent
Core Urban	915,101	97.5
Peri Urban	23,030	2.5
Total	938,131	100.0
Total No. of Households	268,700	

For the purposes of the Household Survey, 30 of the 34 sub-locations (88%) were selected for the FSM study – with a combined total of 256,658 households – i.e. over 95.5% of the total City population.

With regard to the socio-economic categorization of the sampled sub-locations, 5 were classified as falling under the high income category; 9 in medium income; 10 low income; and

15 informal settlements. The sample sizes (Table 3-14) were proportionately calculated from the number of households in each income category.

Table 3-14 : Sample Size per Sub-Location – Mombasa

Sub-Location	Households No	Status	Samples
Bamburi	4,831	**HI**	6
Maunguja	236	**MI**	8
Mwakirunge	1267	**IS**	11
Mwembelengeza	8006	**MI**	8
Shanzu	2458	**MI**	8
Ganjoni	2583	**HI**	6
Kizingo	1543	**HI**	6
Mwembe Tayari	1806	**MI**	8
Railway	2110	**MI**	8
Tononoka	3849	**LI**	24
Tudor 4	3436	**HI**	6
Tudor Estate	5791	**HI**	6
Junda	11,845	**IS**	11
Kisauni	22762	**LI**	24
Magogoni	23,896	**LI**	24
Kongowea	19332	**LI**	24
Maweni	12,742	**IS**	11
Chaani	19,492	**LI**	24
Changamwe	2,914	**MI**	8
Portreitz	19,863	**LI**	24
Miritini	8,159	**MI**	8

Sub-Location	Households No	Status	Samples
Jomvu Kuu	10,294	**LI**	24
Kwashee	10,642	**MI**	8
Birikani	5,937	**LI**	24
Mtongwe	7,951	**IS**	11
Vyemani	3,980	**IS**	11
Vijiweni	3,243	**IS**	11
Bofu	9,450	**LI**	16
Likoni	6,879	**MI**	8
Timbwani	19,361	**LI**	24
Total	**256,658**		**400**

Table 3-15 shows the demographics of the sample investigated in the 18 sub-locations.

Table 3-15 : Demographics of the Sample Surveyed in Mombasa

No.	Demographic Characteristics	%	Observations
1.	Sex of the Respondent Female Male	 46.0 54.0	Majority of the respondents were male
2.	Household Headship Head Yes Not Head	 65.0 35.0	Nearly two-thirds of the respondents were heads of households
3.	Educational Level Secondary Primary Tertiary (College, University) Non Formal/Adult None	 35.0 24.0 36.0 3.0 2.0	The Mombasa adult population is relatively highly literate – with over 71% having attained secondary level education and above. Only less than 2% was non-literate
4.	Status of Household Head Tenant Owner Other	 59.0 38.0 3.0	Most of the household heads were tenants – with owners constituting only 38% of the sample
5.	Average No. of Persons Living in Household	5	
6.	Main Occupation of Household Head Salaried Self-Employed Trader Artisan	 52.0 33.0 4.0 1.0	Majority of the household heads were in salaried occupations – 52%, whilst those in self-employment occupations accounted for nearly 40% of the total surveyed

	Farmer Other None	1.0 1.0 8.0	

B 3.1.2. Drinking Water Supply Coverage for Mombasa City

The survey sought to find out the proportion of the sampled Mombasa households which have access to safe water supplies ("potable water"). To assess the coverage, the answers to the question of: source of water supply was posed. The pattern of response was as indicated in Table 3-16.

Table 3-16 : Main Source of Water Supply – Mombasa City

No.	Main Source	% of Households
1.	Individual Connection – MOWASCO	29.0
2.	Individual Connection – Private	2.0
3.	Water Kiosk	28.0
4.	Water Vendors	11.0
5.	Borehole	21.0
6.	Well	9.0
7.	Surface Water	-
8.	Others	-

Over 59% of Mombasa households derive their water supplies from piped systems: with a significant 29% obtaining it from the city utility: Mombasa Water Supply and Sewerage Company (MOWASCO). Private sources supply only 2% of the households. Water Kiosks (or piped system to public taps), account for a significant 8% of the City households, whilst the level of access from boreholes and wells is 30%.

Compared to the national urban figures (Table 1-1), Mombasa has a higher coverage from piped sources and also from boreholes and wells.

Like in the case of Kisumu City, the French Development Agency (AFD) is in the process of financing a water and sewerage project for MOWASCO – to substantially increase coverage in

the City. The household Survey above indicates that 59% of Mombasa households are connected to piped water supply. This clearly confirms the 2009 National Census findings – which then showed Mombasa had 56.6% piped system coverage.

B 3.1.3. Sanitation Coverage for Mombasa City

In order to find out the level of sanitation coverage in the City, 3 specific questions were posed to the respondents:

a. Access to a sanitation facility within the household premises,
b. Where respondents without access to sanitation facility at home, go to answer a call of nature; and
c. The kind of sanitation facility installed.

In terms of "safe or hygienic management of human waste" in non-sewered urban areas of the City, Mombasa scores fairly well - compared to the national urban patterns. For instance, whereas only about 6% nationally use the VIP Latrine, this is about 10% in Mombasa. For the septic tank and cess pool, Mombasa's coverage is 41% whilst nationally, this is only 8.7%.

With a project to improve availability of water supply underway, Mombasa's sewer connection coverage is bound to rise significantly in the near future.

Table 3-17 shows the level of access to and coverage of sanitation systems in Mombasa City.

Table 3-17 : Sanitation Coverage in Mombasa

No.	Coverage Indicator		%	Observations
1.	Access to a Sanitation Facility within Household Premises	Yes	91.0	A relatively high proportion of the households (91%) have access to a sanitation facility of one type or another, within their compound
		No	9	
2.	Average No. of Households Sharing Sanitation Facility		4	Compared to the other 2 Study cities, Mombasa has a much lower (and manageable) number of households sharing a sanitation facility
3.	Place of Excreta Disposal (For the Disadvantaged 14% of Households)	Neighbor	44.0	A worrying 47% of those without access to a sanitation facility dispose human waste in open spaces and drainage channels. Another 6% are assumed to use other unsafe methods. This certainly contributes greatly to environmental
		Public Toilet	6.0	
		Open Space	41.0	
		Drainage Channel	3.0	

		Other	6.0	pollution – thus posing danger to human health in the respective areas of the City
4.	Type of Sanitation Facility Installed (For the 86% who Have Access)	Ordinary Pit Latrine	38.0	The ordinary pit latrine predominates but majority are really of questionable standards of construction. Nevertheless, an encouraging 62% use facilities that may be categorized as constituting safe or hygienic management of human waste
		VIP Latrine	10.0	
		Septic Tank	19.0	
		Cess Pool	22.0	
		Sewerage Connection	11.0	

MOWASCO previously had an exhauster truck to serve the un-sewered areas of the City. It is however no longer functional (since 2009) – leaving the void to be filled by private mechanical and manual operators.

B 3.1.4. Institutional and Legal Framework for FSM at the City Level (Mombasa)

Interrelationship in the FSM System

There are 5 main actors in the FSM system at the city level. These are: the National Environmental Management Authority (NEMA); the City/Municipal Council; the Water and Sewerage Service Provider (WSP) for the city; the various companies and informal Emptying Operators; and to certain extent, NGOs (Figure 3-3). These collectively may be referred to as **the City FSM Service Providers (CFSPS)**. The roles of the main actors in fecal sludge service delivery are summarized below.

a. The National Environmental Management Authority (NEMA)

NEMA is the supreme authority in the country for enforcing the law for the protection and conservation of the environment – under the Environmental Management and Coordination Act (EMCA) 1999. EMCA also provides for the gazettement of regulations to control operations regarding various environmental protection concerns.

For instance, for fecal sludge management, the relevant Environmental Protection Order is the **Environment and Coordination (Waste Management) Regulations 2006**. These regulations are meant to streamline the handling, transportation and disposal of various types of waste. This is intended to protect human health and the environment.

Under these Regulations also, NEMA **licenses operators** who use waste transport vehicles, e.g. for fecal sludge management, "to prevent occurrence of odor or health hazard and to ensure that transported waste is disposed off at sites designated by the Authority."

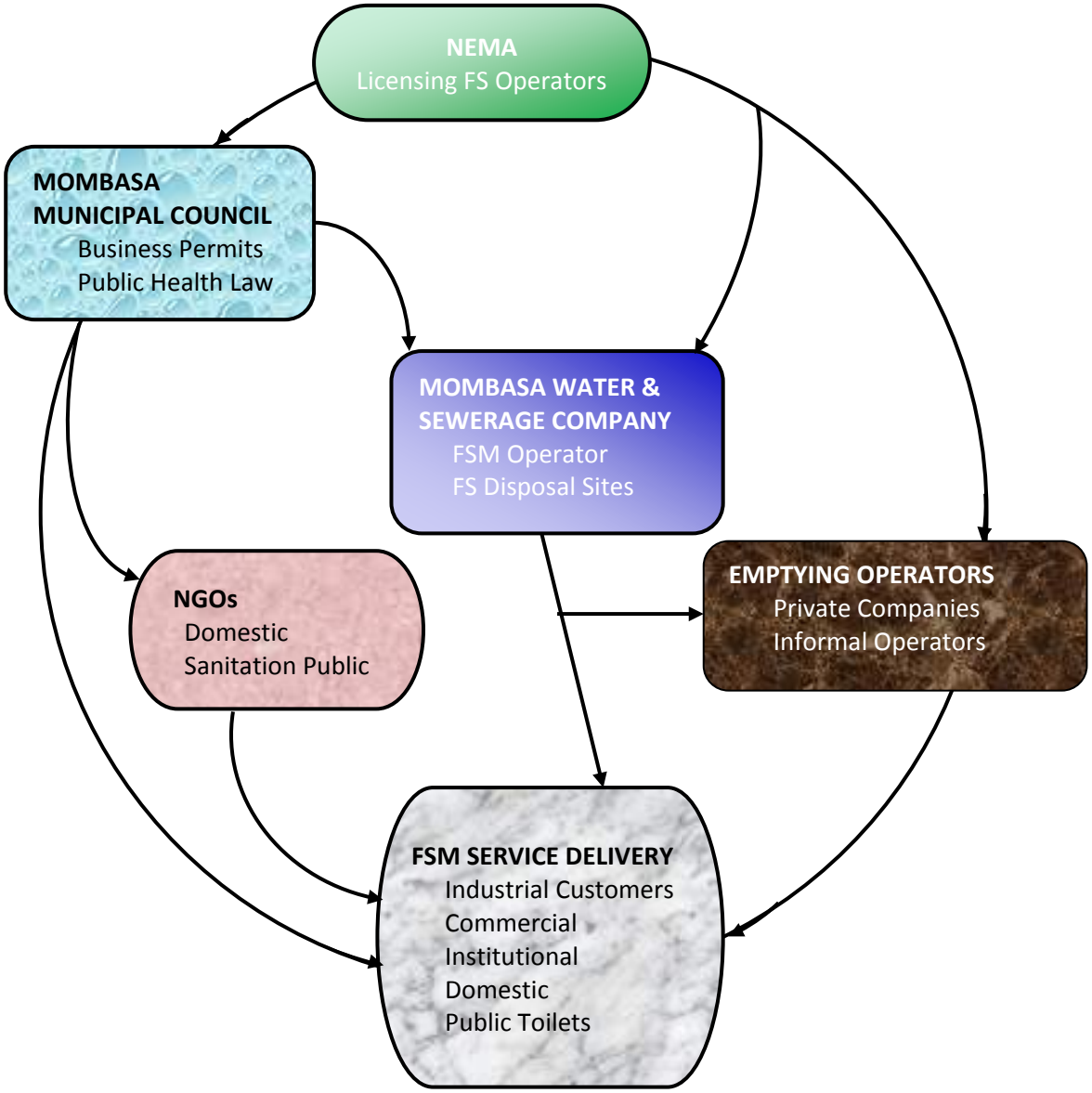


Figure 3-3 : The Institutional Framework for FSM at City Level (Mombasa)

b. The Municipal Council of Mombasa (MCM)

Like all the other LGAs, MCM is empowered by the law to enforce the provisions of the Public Health Act and protection of the environment from pollution.

Specifically in the sanitation area, MCM through the Department of the Environment has entered into a 10 year concession arrangement (Public/Private Partnership) with a private firm; Excloosive Ltd, to establish and operate 8 public toilets in the City: 6 septic tanks and 2 sewer connections.

The other organ of the Council – the Public Health Department, is active in ensuring that fecal sludge is transported and disposed off, in ways that do not compromise health of the residents of the city.

Residents Perception of the Role of the Mombasa Municipal Council

During the HH Survey process, respondents were asked to give their opinions on: "What should be the role of the Municipal Council?" The answers preferred were varied – but quite relevant to the broad issue of sanitation and the environment. Here below is a summary of the answers given as contained in the Mombasa HH Survey Report:

Role of City/Municipal Councils

The roles of the municipal council as indicated by the respondents were as shown in Table 3-18.

Table 3-18 : Role of Mombasa Municipal Council

Build adequate sanitation facilities	Inspect buildings to ensure they have sanitation facility
Provide washing detergents	Collect tax and clean the environment
Provide emptying services within the city	Provide free exhausting services
Provide vehicle to collect waste	Arrest those who dump waste in wrong places
Connect residents to sewer lines	Have weekly inspections
Repair broken sewer lines	Offer services to all
Recycle the sludge	Clean the garbage site
Improve the drainage system	Improve living standard
Treat sewage	Inspect their workers
Treat stagnant water	Provide dustbins for dumping waste

Maintain sewerage system	Sensitize people on hygiene issues
Create defined dumping sites	Implement by-laws on FSM
Clean the environment	Implement by-laws on FSM
Provide municipal workers with necessary equipment and uniforms	Provide a conducive environment for the people
Build public toilets in slums	Check on pollution
Timely waste collection	Provide water tanks

c. The Mombasa Water and Sanitation Company (MOWASCO)

Established under the provisions of the Water Act 2002, MOWASCO is a public utility owned by the Local Government Authority – Municipal Council of Mombasa, but managed under arrangement by the Ministry of Water. Under the Act, MOWASCO as a Water and Sewerage Services Service Provider (WSSP) is charged with the responsibility of providing water and sewerage services to the residents of Mombasa City. The utility's sewerage treatment plants provide disposal sites for sludge from the private operators.

Water Supply

MOWASCO is the water and sewerage service provider for the Mombasa city. According to the 2009 Kenya Census, 56.6% of households in Mombasa are connected to piped water supply, but only 14% of households have direct connection to sewer.

Like in the Kisumu case cited earlier, the French financing agency – AFD is equally funding a water and sewerage Project for MOWASCO – to increase coverage in the City.

Sewerage Services

Role of the Water and Sanitation Utility

The role of the Water and Sanitation Utilities as indicated by the respondents are as shown in Table 3-19.

Table 3-19 : Role of Water and Sanitation Utility – Mombasa

Provide water and sanitation facilities	Check on illegal connections
Extend the sewer lines	Provide quality services

Ensure no waste dumping within the city	Arrest those who vandalize sewer/water pipes
Improve the drainage system	Reduce the number of days water is rationed
Provide water at lower cost	Install water lines in slum areas
Supply adequate water	Read meters and avoid sending estimates
Repair broken taps	Supervise environment management
Ensure continuous water supply	Improve living standards
Repair burst pipes	Offer free education to the people
Supply safe/treated water	Issue correct billing
Perform regular maintenance of sewer lines	Establish more boreholes
Treat borehole water	Conserve water resources

The Fecal Sludge Emptying Operators

Licensed Exhauster Service Providers

Ten (10) trucks have so far been licensed by NEMA to provide FSM services in Mombasa. The detailed operations of the sampled FSM service providers in Mombasa are contained in the subsequent relevant sections of this Chapter.

Informal Fecal Sludge Emptiers

There are numerous informal sludge emptiers in Mombasa, who carry out their trade illegally – i.e. they do not have trade permits from the Municipal Council to operate, nor the environmental disposal license from NEMA.

The informal FS emptiers operate mainly in the un-sewered low income areas and informal settlements of the City using mainly manual methods of pit emptying. Their relatively low charges for the service are fairly affordable by the residents of these settlements.

Interviews with some mechanical FS operators in the City indicated that, there exists a strong collaboration mechanism between them and the manual emptiers. In one classic case: of an unusual licensed operator, it is the manual emptiers who fill the 200-litre drums with FS extracted from customers' pits, which are then loaded onto a truck (which carried 28 No. when full), and disposed off at MOWASCO's Kipevu WWTP. The operator has 2 trucks for the business.

Nevertheless, even in their own right, the manual emptying activity represent some potential for commercial undertaking – in that they do provide basic services which the public sector or the formal licensed mechanical operators, are unable – or unwilling to provide.

d. Non-Governmental Organizations (NGOs) in the Sanitation Sector

The roles of the NGOs operating in the city as indicated by the respondents were as captured in Table 3-20.

Mobilize and teach people how to manage sanitation	Educate on hygiene
Fund the digging of boreholes and wells	Invest in alternative forms of waste disposal
Help maintain the environment	Subsidize bills on exhausting services
Increase water supply	Do campaign on proper sanitation
Build toilets for the poor	Champion for environmental conservation
Train CBOs	Support the locals
Co-ordinate with youth groups	Educate locals on improved sanitation
Support the youth in the area	Chip in services the government is not in a position to offer
Build proper latrines	Provide civic education
Finance projects	Educate people on sanitation
Provide technical advice	Assist the municipal to deliver services
Educate people on environmental management	To build water tanks

Table 3-20 : Roles of NGOs in Mombasa

Mobilize and teach people how to manage sanitation	Educate on hygiene
Fund the digging of boreholes and wells	Invest in alternative forms of waste disposal
Help maintain the environment	Subsidize bills on exhausting services
Increase water supply	Do campaign on proper sanitation
Build toilets for the poor	Champion for environmental conservation
Train CBOs	Support the locals
Co-ordinate with youth groups	Educate locals on improved sanitation
Support the youth in the area	Chip in services the government is not in a position to offer
Build proper latrines	Provide civic education
Finance projects	Educate people on sanitation
Provide technical advice	Assist the municipal to deliver services

Educate people on environmental management	To build water tanks

A list of identified NGOs operating in the city is as captured in Table 3-21.

Table 3-21 : List of NGOs operating in Mombasa city

1	ACTION AID	6	JAFER FOUNDATION
2	AFRICAN MUSLIM AGENCY(AMA)	7	LICODEP
3	AMREF	8	PLAN INTERNATIONAL
4	CARE INTERNATIONAL	9	RED CROSS
5	CARE KENYA	10	WORLD VISION

The roles of the CBOs operating in the city as indicated by the respondents are as captured in Table 3-22.

Table 3-22 : Role of local CBOs in Mombasa

Keep the area clean	Support environmental cleaning
Repair burst pipes	Coordinate with city council
Educate people on health issues	Environment conservation
Educate people on FS end re-use	Ensure good living standards to the people
Educate people on sanitation	Prevent illegal dumping
Drill boreholes	Provide dumping areas
Provide toilet cleaning materials	Find ways to improve the environment
Provide cleaning service to the community	Seek donor funding
Identify problems affecting the community	Clean drainages
Link the community to NGO'S	Collect and dispose garbage properly
Assist NGO's where they need help	Unblock drains
Co-ordinate with NGO	Coordinate clean up exercises
Educate people on health issues	Enhance their involvement in community developments
Build proper latrines	Maintain environmental cleanliness
Collect garbage on time	Keep the residential area clean at reasonable prices
Ensure security	Manage community utilities

A list of identified CBOs operating in the city is as captured in Table 3-23.

Table 3-23 : List of CBOs operating in Mombasa city

1.	ACTION CENTER, AFAIM	34	KWACHIFU YOUTH GROUP
2.	AFRICAN MUSLIM GROUP	35	KWETU TRAINING
3.	ALAZHAR WATER PROJECT	36	KWFT
4.	ALHAZAR MOSQUE FOUNDATION	37	LAMKENI YOUTH GRP
5.	AMA (AFRICAN MUSLIM AGENCY)	38	LICODEP YOUTH
6.	AMAN PROJECT ORGANIZATION	39	LONGO YOUTH GROUP
7.	AZARI ARTS TROOP	40	MAENDELEO KWA VIJANA YOUTH GROUP
8.	BAMAKO YOUTH GROUP	41	MAJI SAFI YOUTH GRP

9.	BIRIKANI YOUTH GROUP	42	MAWENI YOUTH GROUP
10		43	MBUYUNI SELF HELP GROUP
11	BOFU YOUTH GROUP	44	MENDE YOUTH GROUP
12	BOMBOLULU DIRT ORG	45	MEWA,AMA
13	CHAANI UNITED	46	MINEZA YOUTH GROUP
14	CHANGAMWE MUSLIM ASSOCIATION	47	MUUNGANO YOUTH GROUP
15	CHANGAMWE MUSLIM ASSOCIATION	48	MWAOMWE YOUTH GROUP
16	CLTS,SOG	49	MWATSALAFU YOUTH GRP
17	COAST YOUTH	50	PUMZIKA YOUTH GROUP
18	DONOLINDA YOUTH ORGANIZATION	51	SAFI YOUTH GROUP
19	EDUCATE PEOPLE ON SANITATION	52	SHELLY YOUTH GRP
20		53	SUNGUSUNGU SECURITY GROUP
21	JAMII AND KIZIWI YOUTH GROUPS	54	TALENT PARTNERS
22	JESHI YA MAZINGIRA	55	TIMBNANI YOUTH GRP
23	JOHO WOMEN FOUNDATION ORG	56	TONONOKA YOUTH GROUP
24	KENYA WOMEN	57	TULIZA COMMUNITY RESOURCE
25	KHADIJA DIRT SELF HELP GROUP	58	UJAMAA
26	KINGORANI YOUTH GROUP	59	VIJIWENI YOUTH GROUP
27	KIPEVU HELP GROUP	60	WAME,AMA
28	KISAUNI YOUTH GROUP	61	YOUTH COAST
29	KISIMANI DIRT ORG	62	YOUTH DEVELOPMENT
30	KIZIWI GROUP		

B 3.1.5. Flow of Money Chart for FSM Transactions

The service channels in FS showed different financial transaction opportunities. The more immediate being clients paying for FS management services to emptiers (Figure 3-4). However, underlying this is the indirect payment to the FSTP through licensing by the Utility company (MOWASCO) which manages the FSTP. More directly the FSTP receives payments for the sale of treated FS to end users.

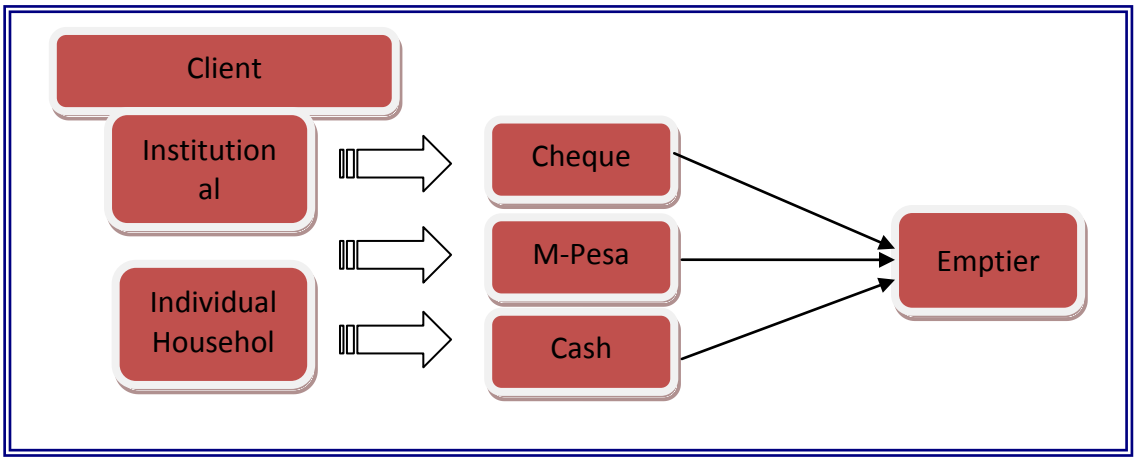


Figure 3-4 : Financial Transaction Opportunities for FSM Services in Mombasa

Fecal Sludge management value chain

Therefore an expanded value chain of FS management value shows multiple flow of funds among stakeholders as was noted in Mombasa. Improvements to this value chain are likely to increase the demand for the services particularly by sealing leakages through unauthorized burying of FS which occurs during manual empting.

In Mombasa the FS evacuation is undertaken by private entities. There is no public body providing FS evacuation services. The private operators invest in their enterprises to provide these services. Their key sources of finance are:

1. Personal savings and savings from friends and relatives
2. Loans from financial institutions

The Utility Company and the FSTP receive funding from two broad sources. The first source is sales and service revenues from water sales- as a water utility and sewer connection fees plus FS management licensing fees. The second source of funds is from the national exchequer as part of budget allocation, grant and multilateral loan guarantees. There are formulations of private-public partnerships that are being considered as a way of generating revenues. In Mombasa the mechanical emptiers pay a dumping fee of USD10.87 per trip, and this is charged in advance of tipping by the truck. The fee is payable to the Utility company which operates the dumping site.

Table 3-24 summarizes financial transaction data for FSM services. In Mombasa the average tariff is not comparable as the trucks operating are of different capacities. The dumping fee of USD 10.87 charged by MOWASCO is similar for the trucks regardless of the capacity. The treated sludge re-sale price is fixed by the utility company which operates the treatment plant. Mombasa has two main sewerage treatment plants, the Kizingo Wastewater Treatment Works located in Mombasa Island and Kipevu Wastewater Treatment Works in West Mainland. The Kizingo WTW is not in operation. The Kipevu Wastewater Treatment Works in West Mainland receives FS by mechanical operators and processes any FS for resale. However at present there is no sale of treated sludge.

Table 3-24 : Financial Transaction Data for FSM Services - Mombasa

Client Category	Emptiers	Tariffs	Per Truck Licensing fee (MOWASCO)	End User	Re-sale Price
➢ **Individual Households**	Operator I	$ 124	$ 10.87 per truck	➢ Households (Farm)	
➢ **Commercial premises**	Operator II	$ 108		➢ Households (Electricity)	
	Operator III	$ 205		➢	

B 3.1.6. FS emptying business owners' profile (Mombasa)

Following a landscape review of the operators in Mombasa, it was decided to interview at least one mechanical truck operator in each category of truck owners. Data (Table 3-25 and Table 3-26) from these operators was validated by a process of interviewing their employees.

Table 3-25 : FS Emptying Business Owners' Profile - Mombasa

Operator	Business Premises	Business Type	Age	Business Plan
1	Yes-office block	Partnership (family business)	More than 20 years in business	Yes
2	None	Sole proprietorship	More than 10 years	None

3	Yes –office block	Limited liability	About 2 years in business	Yes

Table 3-26 : FS Emptying Business Profile - Mombasa

Operator	Form of business	No of trucks	Started operation in	customers per year	Mode of operation
1	Partnership (family business)	4	More than 20 years in business	326	Not diversified
2	Sole proprietorship	2	More than 10 years	258	Not diversified
3	Limited liability	1	About 2 years in business	124	diversified

C 3.1 Situational Analysis of Extraction/Transportation (Nairobi)

C 3.1.1 Demographics of Nairobi City

According to the 2009 National Census, the population of Nairobi is spread in Sub-Locations and the population by locality is shown in Table 3-27.

Table 3-27 : Population of Nairobi by Locality

Locality	Population	Per Cent
Core Urban	3,133,518	100
Peri Urban	-	-
Total	3,133,518	100
Total No. of H/Holds	985,016	

For the purposes of the Household Survey, 46 of the 113 sub-locations (41%) were selected for the FSM study – these totaling 380,342 households – i.e. 38.6% of the total City households.

With regard to the socio-economic categorization of the sampled sub-locations, 8 were classified as falling under the high income category; 13 in medium income; 15 low income; and 10 Informal settlements. The sample sizes (Table 3-28) were proportionately calculated from the number of households in each income category.

Table 3-28 : Sample Size per Sub-Location – Nairobi

Sub-Location	Income Category	Household Population	Sample size
Gatina	**LI**	15,987	17
Kirigu	**LI**	3,694	4
Mutuini	**LI**	1,760	2
Ruthimitu	**MI**	4,434	5
Uthiru	**MI**	5,434	6
Kabiria	**LI**	2,948	3
Waithaka	**LI**	6,491	7
Ng'ando	**LI**	11,162	12
Riruta	**LI**	20,245	21
Karen	**HI**	2,861	3
Kibera	**IS**	3,237	3
Lindi	**LI**	1,151	1
Makina	**LI**	7,926	8
Siranga	**LI**	6,164	6
Gatwikira/Olympic	**IS**	15,597	16
Laini Saba	**IS**	9,927	10
Mugumo-ini	**MI**	8,478	9
Hardy	**MI**	2,568	3
Embakasi	**MI**	19,815	21
Mihango	**MI**	6,167	6
Mukuru kwa Njenga	**IS**	49,198	52
Njiru	**MI**	7,496	8
Saika	**MI**	7,945	8

Sub-Location	Income Category	Household Population	Sample size
Ngundu	**MI**	2,532	3
Ruai	**MI**	7,316	8
Githurai	**LI**	17,966	19
Kamuthi	**LI**	1,190	1
Zimmerman	**MI**	10,309	11
Gitathuru	**IS**	6,480	7
Korogocho	**IS**	3,129	3
Nyayo	**IS**	1,300	1
Mabatini	**IS**	9,809	10
Mathare	**IS**	6,617	7
Huruma	**IS**	23,800	25
Kiamaiko	**LI**	10,217	11
Muthaiga	**HI**	3,225	3
Karura	**HI**	4,721	5
Highridge	**HI**	8,075	9
Gichagi	**LI**	6,409	7
Kangemi	**LI**	15,256	16
Mt. View	**MI**	5,194	6
Kileleshwa	**MI**	4,592	5
Kitisuru	**HI**	2,105	2
Kyuna	**HI**	2,130	2
Loresho	**HI**	5,907	6
Spring valley	**HI**	1,378	2
Total		**380,342**	**400**

Table 3-29 below shows the demographics of the sample investigated in the 18 sub-locations

Table 3-29 : Demographics of the Sample Surveyed in Nairobi

No.	Demographic Characteristics	%	Observations
1.	Sex of the Respondent Female Male	 58 42	Majority of the respondents were female
2.	Household Headship Head Yes Not Head	 59 41	Majority of the respondents were heads of households
3.	Educational Level Secondary Primary Tertiary (College, University) Non Formal/Adult None	 40 28 27 4 1	The Nairobi adult population is relatively highly literate – with over two-thirds (67%) having attained secondary level education and above. Only less than 1% was non-literate
4.	Status of Household Head Tenant Owner Other	 68 30 2	Most of the household heads were tenants – with owners constituting only 30% of the sample
5.	Average No. of Persons Living in Household	5	
6.	Main Occupation of Household Head Salaried Self-Employed Trader Artisan Farmer Other None	 38 26 15 4 1 8 8	Majority of the household heads were in self-employment occupations – 54%, whilst those in salaried occupations accounted for a significant 38% of the total surveyed

C 3.1.2 Drinking Water Supply Coverage

The survey sought to find out the proportion of the sampled Nairobi households which have access to safe water supplies ("potable water"). To assess the coverage, the answers to the question of: source of water supply was posed. The pattern of response was as indicated in the Table 3-30.

Table 3-30 : Main Source of Water Supply – Nairobi city

No.	Main Source	% of Households
1.	Individual Connection – NCWSC	44
2.	Individual Connection – Private	3
3.	Water Vendors	25
4.	Water Kiosks	22
5.	Borehole	2
6.	Well	4
7.	Surface Water	-
8.	Others	1

Forty-Seven per cent (47%) of Nairobi households derive their water supplies from piped systems: with a significant 23.1% obtaining it from the city utility: Nairobi City Water and Sewerage Company (NCWSC). Private piped sources supply account for only 3% of the households. Water vendors – using mainly handcarts and trucks, supply a quarter of the City households, whilst the level of access from boreholes and wells is only 6%. Only 1% of households obtain their drinking from unsafe (unspecified) water sources.

Compared to the national urban figures (Table 1-1), Nairobi has a higher coverage from piped sources but much lower from boreholes and wells. From this study too, Nairobi emerges with no households using unsafe surface water sources (0%) against the national average of 9.2%.

C 3.1.3 Sanitation Coverage

In order to find out the level of sanitation coverage in the City, 3 specific questions were posed to the respondents:

a. Access to a sanitation facility within the household premises,
b. Where respondents without access to sanitation facility at home, go to answer a call of nature; and
c. The kind of sanitation facility installed.

In terms of "safe or hygienic management of human waste" in non-sewered urban areas of the City, Nairobi scores fairly well - compared to the national urban patterns. For instance, whereas only about 6% nationally use the VIP Latrine, this is about 12% in Nairobi. For the septic tank and cess pool, Nairobi's coverage is 29% whilst nationally, this is only 8.7%.

Table 3-31 shows the level of access to and coverage of sanitation systems in Nairobi City.

Table 3-31 : Sanitation Coverage in Nairobi

No.	Coverage Indicator		%	Observations
1.	Access to a Sanitation Facility within Household Premises	Yes	85	An encouraging 85% of the households have access to a sanitation facility of one type or another, within their compound
		No	15	
2.	Average No. of Households Sharing Sanitation Facility		12	This high number households sharing a facility – mainly on-site, means that it fills up fast – hence requiring frequent (unaffordable) emptying
3.	Place of Excreta Disposal (For the Disadvantaged 15% of Households)	Neighbor	34	A worrying 12% of these without access to a sanitation facility dispose human waste in open spaces and drainage channels. Another 7% are assumed to use other unsafe methods. This certainly contributes greatly to environmental pollution – thus posing danger to human health in the respective areas of the City
		Public Toilet	46	
		Open Space	8	
		Drainage Channel	5	
		Other	7	
4.	Type of Sanitation Facility Installed (For the 85% who Have Access)	Ordinary Pit Latrine	44	The ordinary pit latrine predominates but majority are really of questionable standards of construction. Nevertheless, an encouraging 56% use facilities that may be categorized as constituting safe or hygienic management of human waste
		VIP Latrine	12	
		Septic Tank	11	
		Cess Pool	18	
		Sewerage Connection	13	

C 3.1.4 Institutional and Legal Framework for FSM at the City Level

Interrelationship in the FSM System

There are 5 main actors in the FSM system at the city level. These are: the National Environmental Management Authority (NEMA); the City Council of Nairobi; Nairobi City Water

and Sewerage Company the various companies and informal Emptying Operators; and to certain extent, NGOs (Figure 3-5). These collectively may be referred to as **the City FSM Service Providers (CFSPS)**. The roles of the main actors in fecal sludge service delivery are summarized below.

a. The National Environmental Management Authority (NEMA)

NEMA is the supreme authority in the country for enforcing the law for the protection and conservation of the environment – under the Environmental Management and Coordination Act (EMCA) 1999. EMCA also provides for the gazettement of regulations to control operations regarding various environmental protection concerns.

For instance, for fecal sludge management, the relevant Environmental Protection Order is the **Environment and Coordination (Waste Management) Regulations 2006**. These regulations are meant to streamline the handling, transportation and disposal of various types of waste. This is intended to protect human health and the environment.

Under these Regulations also, NEMA **licenses operators** who use waste transport vehicles, e.g. for fecal sludge management, "to prevent occurrence of odor or health hazard and to ensure that transported waste is disposed off at sites designated by the Authority."

During the current year (2011), NEMA has licensed 60 trucks to operate the FSM business in Nairobi City.

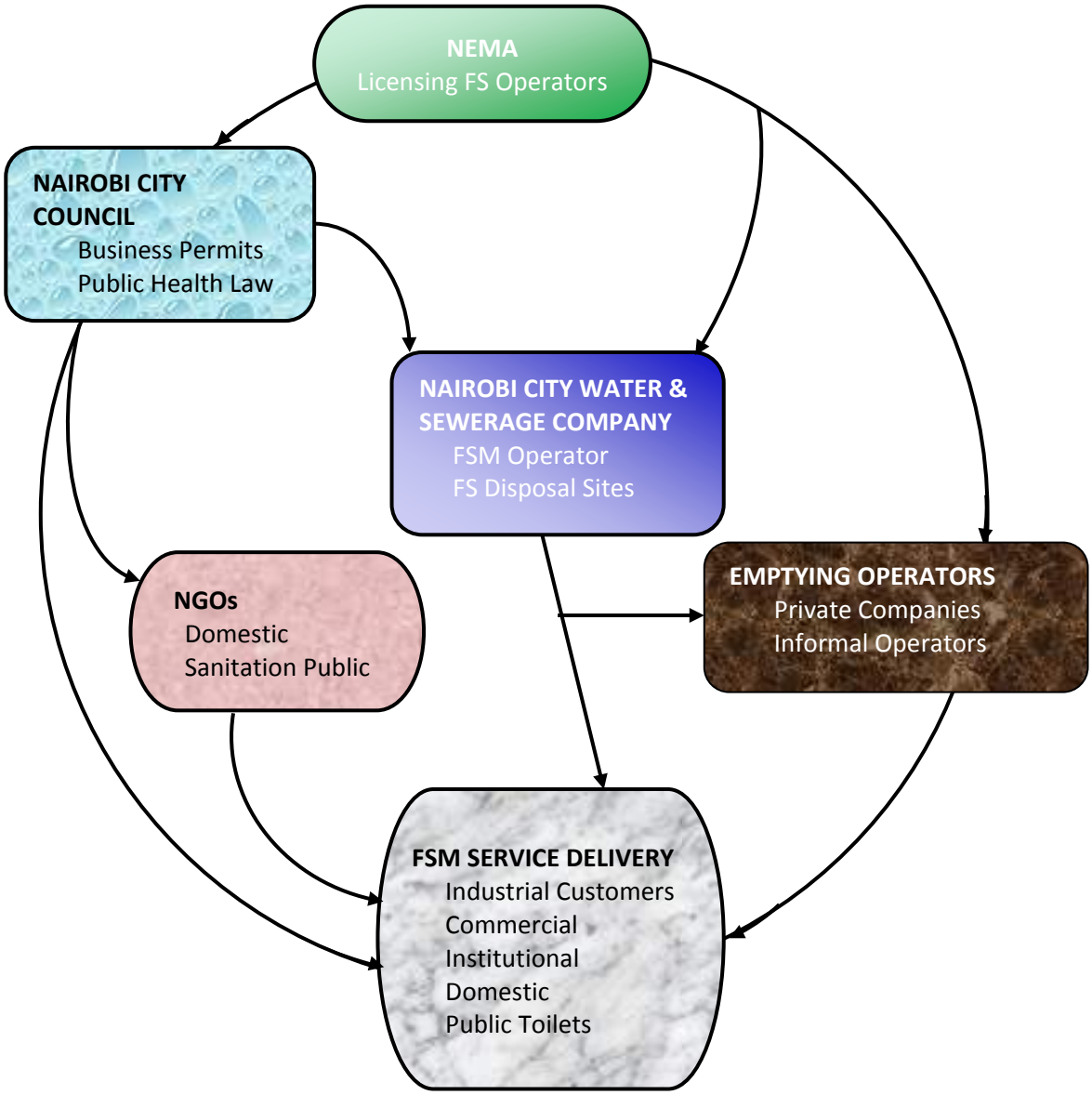


Figure 3-5 : The Institutional Framework for FSM at City Level (Nairobi)

b. The City Council of Nairobi (CCN)

Like the other local government authorities (LGAs) CCN is mandated by the Public Health Act, Cap 242, "to take all lawful necessary and reasonably practicable measures, to maintain in their jurisdiction, clean and sanitary condition and, to prevent occurrence of conditions liable to be injurious or dangerous to human health."

The city/municipal councils may also undertake the construction and operation of public toilets – either by themselves, or by appropriate concessions to private sector actors – under the Public Private Partnership (PPP) arrangement.

Two line departments of the City Council of Nairobi have a close relationship with the FSM issue, viz, the Department of the Environment and the Public Health Department. Whereas the Department of the Environment is involved in the development of physical infrastructure and the protection and conservation of the environment, the Public Health Department enforces the relevant laws and regulations.

Through the Public Private Partnership (PPP) CCN – through the Department of the Environment, has in the past partnered with the Nairobi Central Business District Association (NCBDA) to Build, Operate and Transfer public toilets – on five year concession arrangement. After 5 years, CCN leased these facilities to a number of private operators and youth groups.

A similar concession has been made by CCN to Iko Toilets – on a Build, Operate and Transfer (BOT) basis – which is still in operation.

In total, the City Council has concessioned 102 public toilets to be operated by private companies and youth groups in various parts of the City.

During the Household Survey interviews, respondents were asked to give opinion as to; "What should be role of the City Council (in FSM)". Here below is summarized the wide range of responses from the respondents:

Role of Nairobi City Council

The roles of the municipal council as indicated by the respondents were as shown in Table 3-32.

Table 3-32 : Role of Nairobi City Council

Build accessible sanitation facilities	Garbage collection and infrastructure development
Build sanitation facilities and maintain them	Keep environment clean
Cater for environmental cleanliness	Modernize operations for quality services
Collect garbage and monitor the water and sewer lines	Monitor hygiene standards

Develop infrastructure and monitor sanitation	Provide garbage disposal sites
Enforce by-laws in sanitation and hygiene	Provide public toilets
Ensure all settlements have sanitation facilities	Provide rubbish bags and coordinate disposal
Ensure people live in habitable area	Provide water and clean the environment
Establish sewerage system	Provision of cheaper exhauster services
Extend sewer line	Repairs in case of damages
Facilitate street lighting in concert with KPLC	

c. The Nairobi City Water and Sewerage Company (NCWSC)

Established under the provisions of the Water Act 2002, NCWSC is a public utility owned by the Local Government Authority – City Council of Nairobi, but managed under arrangement by the Ministry of Water. Under the Act, NCWSC as a Water Services Service Provider (WSSP) is charged with the responsibility of providing water and sewerage services to the residents of Nairobi City. The utility's sewerage treatment plants and other designated points, provide disposal sites for sludge from the private operators.

Role of the Water and Sanitation Utilities

The role of the Water and Sanitation Utilities as indicated by the respondents were as shown in Table 3-33.

Table 3-33 : Role of the Water and Sanitation Utility – Nairobi

Clean drainage systems	Offer exhaust services
Construct sewer lines and avail water	Provide affordable and treated water to all households
Curb illegal connections	Provide chemicals to suppress the smell of toilets
Educate on importance of health and sanitation	Provide continuous water supply
Ensure there's clean water	Provide improved sanitation facility
Ensure they research on sanitation problems facing	Provide piped water

the people	
Meter reading	Provide water infrastructure
Monitor against dumping	Regulate water bills
Monitor sewerage infrastructure and water systems	Regulate water delivery services
Offer advice on septic construction	Upgrade sanitation services

d. The Fecal Sludge Emptying Operators

The WSSPs are supposed to provide all residents of their cities with efficient and effective water borne sewerage services. However, currently, Nairobi can provide only 65%.

Hence, there is a huge gap in the provision and demand for water borne sewerage services. Consequently, private sector players – both formal and informal, have stepped in to fill the wide gap – particularly for providing emptying services in the un-sewered parts of the respective cities.

Licensed Exhauster Service Providers

There are 60 licensed exhauster trucks in operation in Nairobi – owned by 24 operators. NCWSC is not currently involved in this line of sanitation service provision. This service level is not adequate for the City. And given the low sewerage coverage, potential for investment in the sector is great: demand for the service far outstrips the current supply.

The Informal Fecal Sludge Emptiers

In Nairobi, the informal FS emptiers tend to work in small groups of 5-15 people – who are engaged in manual emptying of pit latrines in the informal settlements. One such group visited in the Korogocho slums has 15 active members – operating in sub-groups of 5.

Manual emptiers thrive in the slums because, due to overcrowding, there is no vehicular access. Moreover, the heavy sludge from the latrines is, not suited for mechanical pumping into the trucks.

To transport the FS most groups of manual emptiers in Nairobi use 200 litre drums – loaded onto handcarts and transported for disposal at a designated NCWSC points in the vicinity. But the methods and tools they use still remain crude, unhygienic and stigmatized.

e. Non-Governmental Organizations (NGOs) in the Sanitation Sector

Respondents in the Household Survey were asked to state what they perceived to be the role of NGOs and further, to identify the NGOs in their areas currently active in water and sanitation sectors.

Role of NGOs

The roles of the NGOs operating in the city as indicated by the respondents were as captured in Table 3-34.

Table 3-34 : Role of NGOs – Nairobi

Adopt modern sanitation technology and educate locals	Educate locals on use of sanitation facilities
Assist community in water and sanitation issues	Educate locals on water conservation
Clean-up programs	Educate people how to treat water
Community sensitization	Empower communities to improve life
Community support in marginalized area and informal settlements	Initiate water projects and funding
Community support through project finance	Offer training
Construct public toilets	Provide relief services through economic empowerment
Create job opportunities through bio-centres	Put up projects recycling water and wastes
Create new strategies of dealing with waste	Sensitize public on essence of clean environments
Develop infrastructure	Tap community's' potential
Develop technology and assist marginalized communities	Upgrade slums
Disseminate information and adopt new technologies	Vet right contractors for projects
Drill boreholes	

A list of identified NGOs operating in the city is as captured in Table 3-35. A brief mention of one of these 26 identified NGOs – i.e. Umande Trust – which is directly involved in FS issues, is made here below.

The Umande Trust

Umande Trust was earlier highlighted as being involved in water and sanitation activities in Kisumu City. In Nairobi, the Trust has developed 44 community managed Bio-sanitation centers in 4 informal settlements: 16 in Kibera; 14 in Korogocho; 12 in Mukuru; 1 in Muji wa Huruma (Runda); and 1 in Kibagare.

The Umande model provides an economically viable approach for attaining sustainable sanitation services in the informal settlements.

a. It combines the social objective of affordable basic service provision of the underserved, with economic empowerment of participating communities. This is really an underdeveloped social enterprise model.
b. For fecal sludge management, Umande has trained a corps of manual pit latrine emptiers – equipped with hygienic tools of the trade, to provide services in the crowded settlements. This has further been upgraded technologically, by the introduction of the Gulper Pump: a small hand operated mechanical pump for FS emptying.
c. The active partnership adopted by Umande with public agencies, private sector, and other NGOs, ensures that there exists strong community organizational infrastructure, to achieve real, longstanding and practical solutions to WAS problems in the informal settlements.

Social Enterprise Firms

A social enterprise focused firm is one that combines business approaches to essentially socially based service provision – in this case water supply and sanitation services.

Ecotact Ltd of Nairobi is a classic case of a social enterprise-driven business firm in the WASH sector in Kenya.

Ecotact's WASH delivery is based on 3 models (a) The (core) Urban-scape Model – operating in the town's central business district; (b) The Slum-scape Model – focusing on informal settlements; and (c) The School Model. In all the 3 models Ecotact's flagship is the Ikotoilet technological innovation.

The Ikotoilet is a complete toilet "mall", which in addition to providing basic sanitation facilities for the slum dwellers also incorporates micro-business, in high demand in the area, such as snack shops, barber/salon; advertising points; and recreation facilities.

The Ikotoilet is established on Public Private Partnership framework and operates on a Build-Operate and Transfer basis. However, Ecotact Ltd incorporates community participation by partnering with a local committee in the management of the facility.

Undoubtedly, the Ecotact Model provides an innovative social enterprise business model that could be replicated in the FSM framework.

Table 3-35 : List of NGOs operating in Nairobi city

1	ALVIDA	13	MONEY TRUST
2	AMREF	14	MSF BELGIUM
3	AUSTRALIA EVANGELIST	15	MYSA
4	BUKUNGU	16	OXFAM
5	CAROLINA	17	PAMOJA TRUST
6	ITALIAN CO-OPERATION	18	PLAN INTERNATIONAL
7	KICOSHEP	19	PLAN KENYA
8	KIVULI CENTRE	20	SAN FRONTIERS
9	KOINONIA	21	UMANDE TRUST
10	KWAHO	22	WASSUP
11	LIVING WATER INTERNATIONAL	23	WORLD VISION
12	MAJI NA UFANISI	24	

C 3.1.5 Flow of Money Chart for FSM Transactions

The service channels in FS showed different financial transaction opportunities. The more immediate being clients paying for FS management services to emptiers (Figure 3-6). However, underlying this is the indirect payment to the FSTP through licensing by the Utility company (NCWSCO) which manages the FSTP. More directly the FSTP receives payments for the sale of treated FS to end users.

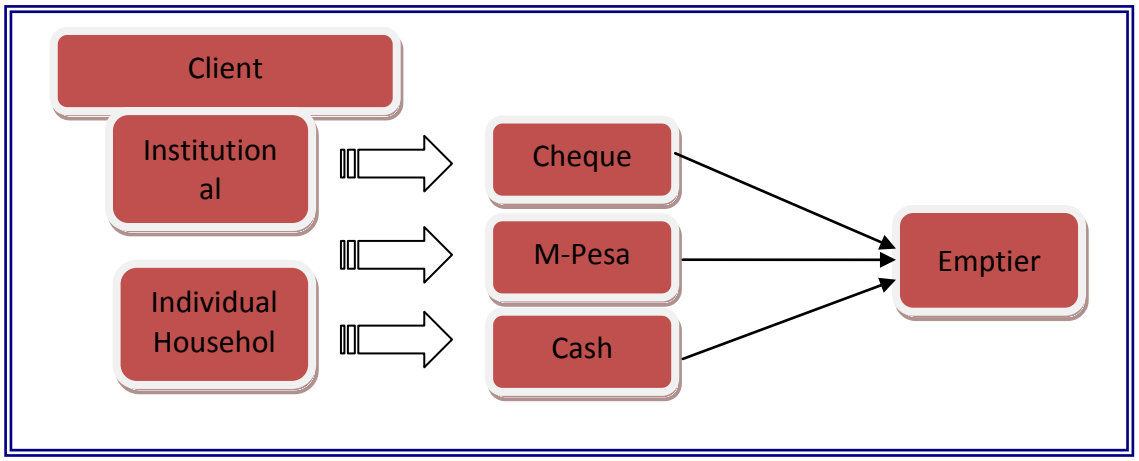


Figure 3-6 : Financial Transaction Opportunities for FSM Services - Nairobi

Fecal Sludge management value chain

Therefore an expanded value chain of FS management value shows multiple flow of funds among stakeholders as was noted in Nairobi. Improvements to this value chain are likely to increase the demand for the services particularly by sealing leakages through unauthorized burying of FS which occurs during manual empting.

In Nairobi the FS evacuation is undertaken by private entities. There is no public body providing FS evacuation services. The private operators invest in their enterprises to provide these services. Their key sources of finance are:

1. Personal savings and savings from friends and relatives
2. Loans from financial institutions

The Utility Company and the FSTP receive funds from two broad sources; sales and service revenues from water sales- as a water utility and sewer connection fees plus FS management licensing fees. The second source of funds is from the national exchequer as part of budget allocation, grant and multilateral loan guarantees. There are formulations of private-public partnerships that are being considered as a way of generating revenues. In Nairobi the mechanical emptiers pay a dumping fee of USD 2.00 per trip and this is charged in advance of tipping by the truck. The fee is payable to the Utility company which operates the dumping site.

Table 3-36 summarizes financial transaction data for FSM services. In Nairobi the average tariff is not comparable as the trucks operating are of different capacities and from different locations. The dumping fee of USD 2 charged by NCWSCO is similar for the trucks regardless of the capacity. The treated sludge re-sale price is fixed by the utility company which operates the treatment plant. Nairobi has 2 waste treatment plants. The one located at Njiru which receives FS by mechanical operators and it does no process any FS for resale. The treatment and resale of FS takes place at the Kariobangi WTP which is at another location.

Table 3-36 Tariffs and Fees for FSM Services - Nairobi

Client Category	Emptiers	Tariffs	Number of Trucks	Licensing fee Per Month (NCWSCO)	End User	Re-sale Price
➢ **Individual Households** ➢ **Commercial premises**	I	91	1	50	➢ Households (Farm) ➢ Households (Electricity)	
	II	71	1	50		
	III	81	1	50		
➢ **Individual Households** ➢ **Commercial premises**	IV	70	2	50	➢ Households (Farm) ➢ Households (Electricity)	
	V	79	2	50		
	VI	108	2	50		
	VII	82	2	50		
	VIII	88	2	50		
	IX	75	2	50	➢ Households (Farm) ➢ Households (Electricity)	
➢ **Individual Households** ➢ **Commercial premises**	X	79	4	50	➢ Households (Farm) ➢ Households (Electricity)	
	XI	77	4	50		

C 3.1.6 FS emptying business owners' profile (Nairobi)

Following a landscape review of the operators in Nairobi, it was decided to interview a number of the mechanical truck operators across the spectrum of truck owners. Data from these eleven operators was validated by a process of interviewing their employees.

Table 3-37 FS Emptying Business Owners' Profile - Nairobi

Operator	Business Premises	Business Type	Age	Business Plan
1	Yes-office block	Limited liability	About 1 year in business	
2	None	Sole proprietorship	About 1 year in business	
3	Yes-office block	Sole proprietorship	About 2 year in business	
4	None	Sole proprietorship	About 2 years in business	
5	Yes-office block	Partnership	About 5 years in business	
6	None	Sole proprietorship	About 4 years in business	
7	None	Sole proprietorship	About 10years in Business	
8	Jua Kali	Sole proprietorship	About 2 year in business	
9	Home	Partnership	About 6 year in business	
10	Yes-office block	Limited liability	About 10 years in Business	
11	Yes-office block and garage	Sole proprietorship	About 8 years in Business	

Table 3-38 : FS Emptying Business Profile - Nairobi

Operator	Form of business	No of trucks	Started operation in	customers per year	Mode of operation
1	Limited liability	1	About 1 year in business	347	Not diversified
2	Sole proprietorship	1	About 1 year in business	347	Diversified
3	Sole proprietorship	1	About 2 year in business	347	Not diversified
4	Sole proprietorship	2	About 2 years in business	480	Diversified
5	Partnership	2	About 5 years in business	504	Diversified
6	Sole proprietorship	2	About 4 years in business	624	Diversified
7	Sole proprietorship	2	About 10years in Business	696	Not diversified
8	Sole proprietorship	2	About 2 year in business	528	Diversified
9	Partnership	2	About 6 years in	528	Diversified

Operator	Form of business	No of trucks	Started operation in	customers per year	Mode of operation
			business		
10	Limited liability	4	About 10 years in Business	1,632	Not diversified
11	Sole proprietorship	4	About 8 years in Business	1 ,056	Not diversified

3.1.7 Household Survey Results and Analysis for the three Cities

In the previous sections, a situational analysis of the FSM practice has been made on a city-by-city basis, in which the results of the Household Surveys conducted in each city have been highlighted. The full results of the surveys are presented in **Volume II of II** of this Report – which contains the stand-alone outputs for each city as follows:

- Kisumu City Households Survey Report
- Mombasa City Households Survey Report
- Nairobi City Households Survey Report

For the purposes of this section, it has been found necessary that the household survey results and analysis need not be repeated here – as this has been sufficiently covered in the preceding sections. And for more detailed presentation, one may wish to refer to Volume II of II of this Report.

Nevertheless, in order to compare the situation between the three Study cities, this section has been deemed the ideal place to highlight such comparisons. And to present the comparisons, the Study Team had adopted the BMGates' *Country Data Master Sheet* – which truly captures the *"Landscape Analysis"* essence of the Study – comprehensively presented in tabular form.

Table 3-39 below, presents the comparative data spectrum for each of the three cities: at a glance.

Table 3-39 : Summary of Socio-Economic Aspects of FSM Across the Three Cities

Source: From LITERATURE REVIEW DATA:			
	Kisumu	**Mombasa**	**Nairobi**
1. Population	409,928	938,131	3,138,369
Number of HH in city	102,508	268,700	985,016
Number of HHs with septic tanks	4,735	35,307	95,410
Number of HH with pits	3,836	15,888	26,477

Number of HH with holding tank/cesspools	145	3,698	10,489
Source for all rest: HOUSEHOLD SURVEY DATA			
Consultant HH survey data:			
HH survey sample size	400	400	400
What % of HH in the city does this sample represent?	2.5%	0.15%	0.05%
2. Access to Drinking Water			
% HH with Piped systems to household	27.0	31.0	47.0
% HH using piped systems to public taps (kiosks)	26.0	28.0	22.0
% HH using Wells	7.0	9.0	4.0
% HH using Private vendors	11.0	11.0	25.0
% HH using Boreholes	18.0	21.0	2.0
% using Other Sources	2.0	-	1.0
3. Types of Sanitation facilities:			
% HH with no sanitation	12.0	9.0	15.0
% HH with direct connection to sewer	4.0	11.0	13.0
% HH with Septic Tank	17.0	19.0	11.0
% HH with holding tank/cesspools	2.0	22.0	18.0
% HH with pit latrines	57.0	38.0	44.0
% HH with VIP	20.0	10.0	12.0
% HH with septic tanks to sewer network	-	-	-
% HH with pits to sewer network	-	-	-
%% with Other (describe “other”)	-	-	-
4. Usage of the sanitation facility from survey			
Number of people per HH	6	5	5
Average users per toilet	8	4	12

3.1.8 FSM Emptying Practices and Technologies Used: Manual and Mechanical

FSM Emptying Practices and Technologies: Kisumu City

The methods of fecal sludge emptying were determined from the HH survey.

Based on the HH survey, the estimates for method of FS emptying were obtained by analyzing the responses to questions and inferring based on those estimates the actual number of HH with reference to the national population.

The questions respondents were asked were;

Q17: What kind of facility?

Q21: What kind of emptying services do you use?

The data collection instruments used in this regard are included as Appendix A and also in Volume II of II of this report.

When Q17 and Q21 are transposed, they provide the breakdown of type of facility and method of emptying which then when summed up gives the answers to method of FS emptying. Similarly when Q21 is adjusted for sewered respondents, it provides the answer to the global method of FS emptying.

The results (Table 3-40**)** indicate 25% of of the HH's use mechanical operators while 75% use manual methods of empting. Detailed analysis is included in this report as appendix B.

Table 3-40 : Methods of Emptying Fecal Sludge in Kisumu

Number of the city HH with On-site sanitation		124,830
Number of the HH with on-site sanitation having pits in the city using Mec. Emp		16,977
Number of the HH with on-site sanitation having septic tanks in the city using Mec. Emp		11,512
Number of the HH with on-site sanitation having cesspool in the city using Mec. Emp		2,498
Total number of HH with on-site sanitation emptied mechanically		30,987
Number of the HH with on-site sanitation having pits in the city using Man. Emp		82,887
Number of the HH with on-site sanitation having septic tanks in the city using Man. Emp		10,209
Number of the HH with on-site sanitation having cesspool in the city using Man. Emp		373
Total number of HH with on-site sanitation emptied mechanically		93,469
	Mechanical (%)	**Manual (%)**
% of Method of Emptying by HH with on-site sanitation	25%	75%
% of Share of Volume of FS emptied by method	2%	98%

% of the HH with on-site sanitation having pits in the city emptied	17%	83%
% of the HH with on-site sanitation having septic tanks in the city emptied	53%	47%
% of the HH with on-site sanitation having cesspool in the city emptied	87%	13%

To derive the share of manual and mechanical for the whole population;

93,469/124,830 = 75% that is percentage of HH with on-site sanitation using manual emptying

30,987/124,830 = 25% that is percentage of HH with on-site sanitation using mechanical emptying

As the HH survey revealed, the manual emptying included: closing the pit when full and digging another one, burying the pit, directing the sludge into existing drainage channels or directing liquid sludge into farms, closing the pit when full and reusing it after some time when the sludge has reduced. Further analysis of the responses of "other" indicated that respondents would rather respond that the facility is not yet full instead of alluding to manual emptying. Therefore, during amalysis, respondeds clustered under "other" were included in the manual emptying category.

The operations of mechanical operators are insufficient to meet the existing demand of emptying services, though neither is the effective demand sufficient to cause the operators to operate at full capacity.

There are 3 private mechanical FS services businesses in Kisumu who between them operate 4 trucks. Table 3-41 provides data of these mechanical.

Table 3-41 : Data on Mechanical Operators in Kisumu

	Kisumu
# of private mechanical businesses in city	3
# of trucks run by private businesses	4
# of trucks owned by utilities	0
What are utility trucks used for (HH? Govt. institutions use, sewer cleaning?	N.A
# of private businesses that are small (1 truck)	2
# of pvt businesses that are medium (2-5 trucks)	1
# of pvt businesses that are large (>5 trucks)	0
What are the capacities of private trucks (m^3)	8 m^3
What are capacities of Utility trucks (m^3)	0

Price for new truck (15 m^3 capacity) USD	48,913
Price for USED truck (9 m^3 capacity) USD	20,000

One of the operators runs the FS emptying service as part of an existing business. The trucks currently in use in Kisumu are old and fairly unreliable, experiencing frequent breakdowns. In addition they are all local assembly type model.

The trucks in use by the operators are old and delicate (Figure 3-7).

Figure 3-7 : Trucks in Kisumu for FS Services

Kisumu has 3 mechanical operators who own a total of 4 trucks (Table 3-42 and Table 3-43). They operate from a common area within the town, but do not have a designated parking. The operator businesses are sole proprietorships and partnerships. The operators do not have formal offices, and clients generally find them by visiting the common parking area or by stopping the trucks on the road whenever they see them.

Table 3-42 : Truck Characteristics - Kisumu

Truck characteristics			
		Volume in Cubic meters m^3	**Year of manufacture**
Operator 1			
Truck	1	6 m^3	1984
	2	8 m^3	1988
Operator 2			
Truck	1	6 m^3	1984
Operator 3			
Truck	1	10 m^3	1984

Table 3-43 : Commencement and Customers of Mechanical Operators – Kisumu

Operators	No. of Trucks	Year of Commencement	Number of Customers/year	
1	2	2004	528	
2	1	2008	46	
3	1	2011	288	Projections

Employees

The operators do not have female employees. In general a truck has three employees which include a driver, a pump operator and a plumber cum turn boy. Two of the operators pay their employees a daily casual wage while one operator has three employees on monthly wages.

Licensing

All operators are required to have 3 (three) licenses which include

1. Trading license obtained from the Municipal Authority but issued as a business license. This is renewed annually.
2. Environmental license issued by the national environmental office located in Kisumu and issued on a per truck basis. This is renewed annually.
3. Tipping licensing issued by the utility firm. This permit is issued on per truck basis and is renewed annually.

Operations

Each of the 3 operators uses similar management structures. Operator 1 parks his trucks overnight at the local administration police office. Operator 2 and 3 park their trucks in their personal compounds. There are no charges for this. In the morning the drivers and their crew pick the trucks and relocate to the common space in town to “hawk” for business. The driver fuels the truck based on earnings from clients where the typical arrangement is for the client to make a deposit. In some instances the driver retains USD 10 of the previous day’s sales as float to fuel the vehicle at the beginning of the following day.

Table 3-44 : Per Trip Fees for FSM Services – Kisumu

Within Municipal -Per Trip fees (irrespective of whether HH or Corporate)			
Tariffs	**Operator 1**	**Minimum fee USD**	**Maximum fee USD**
Truck	1	27	43
	2	38	59
	Operator 2	27	48
	Operator 3	38	65

Once a client contacts the truck, a deposit is received and they drive to the location. The service charge is on a trip and distance basis. Customers pay for either a single trip, multiple trips and as many trips as are necessary to empty the pit latrine or septic tank. Thus, the shorter the distance the lower the charge. The driver and his crew collect all earnings and submit these to the truck owner at end of day or whenever the truck owner calls upon them in the field. There is an allowance for lunch. The driver and his crew are responsible for refueling the truck in the course of the day as they operate. At fueling stations, the truck crew does not necessarily obtain any receipts.

At the end of day, the truck crews, with the driver acting as team leader submit their verbal report of earnings, number of trips and expenses to the owner. The truck owner has no way of verifying the number of trips, the fee paid by each customer nor the amount spent on fuel and lubricants if the need arises. As a matter of general policy the truck crew is not permitted to undertake any major vehicle repairs nor take the car to the garage for general service. These two activities are conducted only by the truck owner and handles the payments.

Table 3-45 : Mechanical Emptiers Truck Crew – Kisumu

	# of employees	**Type of employment**	**Organization of employees (truck crew)**
Operator 1	3	Permanent on monthly wage	1 Driver, 1 Pump attendant 1 Pump Assistant
Operator 2	2	Casual employees paid on a daily basis on a per trip basis -No trip no pay	1 Driver cum pump operator assistant 1 Pump attendant
Operator 3	2	Casual employees paid on a daily basis on a per trip basis -No trip no pay	1 Driver cum pump operator assistant 1 Pump attendant

Trips and customers

The number of trips per day reported to the truck owner does not always tally with the actual trips made by the crew.

It was observed that the truck crew will report different number of trips, and in addition the truck crew tend to inflate fuel expenditure on any given day. As such number of trips, revenues per truck and amounts paid by customers are difficult to track or estimate with a high degree of accuracy. There is no receipting system except for corporate customers who often require evidence of payment.

A number of reasons may exist for lack of customer receipting in the industry. Foremost receipts are only absolutely necessary for

1. Expense claims process-where the customer may have the service paid for by employer or landlord
2. Where the customer maintains book keeping records such as a corporate client-hotel, factory etc.
3. Where the customer makes a VAT return and therefore the service VAT incurred is INPUT TAX and is useful for offsetting purposes

Dumping site

There is one official dumping site for FS, which is Nyalenda Wastewater Treatment Works (Figure 3-8). Generally there are no reported cases of sludge dumping in unauthorized areas in Kisumu though the dump site is not well secured by a fence. The site is not manned by security guards is open on a 24 hour basis on a 7 day week basis. Dumping takes place all days of the week and almost at all hours. At the dumping site, the trucks discharge to a man-hole of which there are two available. These man-holes are connected by sewer line to the FSTP. The facility is not well maintained at present, and no records are kept of dumping activity. However there is planned rehabilitation to include fencing and re-organize the management.

Figure 3-8 : FS Disposal at the inlet of Nyalenda TP (left) and access to the plant (right)

The dumping site does not charge a tipping fee as this has already being included in the license fee charged by the utility company which is responsible for operating the dumping site.

Trucks

Three of the 4 trucks operating in Kisumu have similar pumps and suction technologies (Figure 3-9), which use robust pumps to suction FS from the septic tank and pit latrines. There are no vacuum trucks in operation. One of the operators who has a single truck (6 m^3) on the other hand uses a conventional water pump to suction FS. Given the limitations of this water pump, this operator can only empty cess pools as the machinery in use is weak to de-sludge septic tanks and pit latrines. Nonetheless the average age of all trucks in use in for mechanical emptying in Kisumu is over 25 years.

Figure 3-9 : Location of Pumps in Trucks - Kisumu

Number of Trips per Day

Two of the three operators report at least 1 trip per day every day on a 22 working day cycle. The third operator has about 1 trip per week. While the number of trips obtained from the operators is 1 per day on average, based on interviews on the truck crews they make 5 trips every 3 days per truck, indicating that between 30% and 40% of trips are not disclosed to the owner. The nature of the undisclosed trips however appears to be small in value and to be short distance trips.

Fuel Consumption and Expenditure

In Kisumu, the distance of a single trip-from park to client to dump site and back to park-is 12 km for the longest distance and for short distances this could be less than 4km. Based on the vehicle models in use though the trucks are old, the average distance per litre is 3 to 3.5 kilometers. The pump technologies in use by the 3 trucks require about 30minutes to fill 8000 litres. The suction process consumes between 2.5 and 3 litres of fuel. Therefore the cost of servicing a short distance client is 5 litres and a long distance client is between 8 and 9 litres. Thus the fuel cost of a single trip is between USD 5.9 to USD 9.4, and the undisclosed trips are charged between USD 10 and USD 15, whereas fees for disclosed trips range between USD 26 and USD 53.

Operations Audit and Supervision

The absence of a tipping fee and permit means that there is no active record keeping of vehicle trucks. As such the truck owners conduct random inspection of the operations of their trucks, but this system is incomplete because the truck owner has to drive around covering several kilometers to validate the number of trips reported. This is not done on a regular basis especially because such supervision requires the owner to spend on fuel on a private car. One way of undertaking active supervision is by being stationed at the dumping site, but even this works only if the place is secured. The truck owners in Kisumu expressed frustration with the lack of tipping point security and record keeping.

The exception to active monitoring is one operator (owner of two trucks) who owns a motor cycle which he rides daily into town to monitor the movement of his trucks. These varied methods of monitoring are not dependable. As the odometers in all the trucks do not work it is precisely difficult for the truck owner to establish the total number of kilometers covered by a

truck on any given day. In addition if the owner is pre-occupied with monitoring, it leaves little room for business development functions which are necessary to grow the business.

Marketing

Marketing activities include on truck telephone listing and distribution of flyers directly to households.

Table 3-46 and Table 3-47 summarize the operations and a number of the challenges highlighted by some of the operators interviewed.

Table 3-46 : Summary of Operations – Kisumu

Operator 1	Marketing	Word of mouth, flyers and door to door house visits
	Supervision	Owns a motorcycle for occasional random truck tracking, keeps a record based on the information provided by truck crew.
	Challenge	Vehicle odometers do not work
	Challenge	Dumping site register is not maintained
Operator 2	Supervision	Word of mouth by driver but keeps a record and uses information comparison from his 2 employees
	Challenge	Vehicle odometers do not work
	Challenge	Dumping site register is not maintained
Operator 3	Marketing	Word of mouth
	Supervision	Does not have ability to “run around”
	Challenge	Vehicle odometers do not work
	Challenge	Dumping site register is not maintained

Table 3-47 : Challenges Faced by Mechanical Operators in Kisumu

#	Operator 1	Operator 2	Operator 3
1	Licenses	Maintenance costs	Manual operators
2	Equipment failure	Licenses	Unfair competition
3	Cost of credit	Equipment failure	Lack of marketing
4	Maintenance costs		lack of operations control
5	Manual operators		
6	Unfair competition		

Clients Receipting and Payments

With the exception of clients who contact the owner of a truck or who are known to the truck owner, the truck crew has discretion in presenting sales information to the truck owner. There are no receipts issued especially to domestic clients. Institutions demand for receipts, which are issued. The daily sales as reported by the crew cannot be independently determined. The use of mobile phone based payment service such as M-pesa has not been adopted by the mechanical emptiers and hence the truck crew still handle a lot of cash based on day to day operations.

Credit services

Only one operator offers credit services, particularly to old customers. There is no extra fee charged for this, though the credit extended is only for a portion of the total fee. Usually the operator extends the credit for 30 days but requires the customer to raise an initial amount sufficient to cover fuel expenses. The other 2 operators only provide services on a cash basis.

Payment systems

Two operators accept payment by way of cheques, especially from institutional clients and payments by M-pesa from domestic clients. However, the truck crew do not encourage M-pesa because they require part of the payment in order to fuel the truck, while M-pesa payments are made directly to the owner. In majority of payments, the most used mode of payment is cash on site after suction. Where multiple trips may occur, clients pay in advance or in arrears. The truck crew does no encourage pre-payments since the truck may break down and this would place them in bad light with the customer. The owner of the two trucks however would like to encourage advance payment for multiple trips as one of the trucks can be on stand-by in such cases to complete the process. However this would only work well in this particular instance if the two trucks were not of different sizes.

Hire of third party trucks to service a client

None of the operators sub-contracts competitors' trucks for use to service clients. Instead each operator opts to stall the service demands by the client until the operator's own truck is available to offer the service. When this is not possible, the operator gives up the business opportunity.

Collaboration with Manual Empties

One operator collaborates with manual emptiers to identify and desludge septic tanks and pit latrines. The truck operator in this situation transports and dumps the FS and this often occurs when the client does not wish to bury the FS in the ground. The manual emptiers in this case are used to liquefy the FS by the owner.

Emptying Practices and Technologies: Mombasa City

The methods of fecal sludge emptying were determined from the HH survey.

Based on the HH survey, the estimates for method of FS emptying were obtained by analyzing the responses to questions and inferring based on those estimates the actual number of HH with reference to the national population.

The questions respondents were asked were;

Q17: What kind of facility

Q21: What kind of emptying services do you use?

The data collection instruments used in this regard are included as Appendix A and also in Volume II of II of this report.

When Q17 and Q21 are transposed, they provide the breakdown of type of facility and method of emptying which then when summed up gives the answers to method of FS emptying. Similarly when Q21 is adjusted for sewered respondents, it provides the answer to the global method of FS emptying.

The results (Table 3-48) indicate a small number of HH using mechanical operators (7%) than manual (93%). Detailed analysis is incuded in this report as appendix B.

Therefore to derive the share of manual and mechanical for the whole population;

106,632/115,228 = 93% that is %tage of HH with on-site sanitation using manual emptying

8,596/115,228 = 7% that is %tage of HH with on-site sanitation using mechanical emptying

Table 3-48 : Methods of Emptying Fecal Sludge in Mombasa

Number of the city HH with On-site sanitation		115,228
Number of the HH with on-site sanitation having pits in the city using Mec. Emp		4,356
Number of the HH with on-site sanitation having septic tanks in the city using Mec. Emp		1,936
Number of the HH with on-site sanitation having cesspool in the city using Mec. Emp		2,305
Total number of HH with on-site sanitation emptied mechanically		8,596
Number of the HH with on-site sanitation having pits in the city using Man. Emp		57,868
Number of the HH with on-site sanitation having septic tanks in the city using Man. Emp		22,262
Number of the HH with on-site sanitation having cesspool in the city using Man. Emp		26,502
Total number of HH with on-site sanitation emptied mechanically		106,632
	Mechanical (%)	**Manual (%)**
Method of Emptying by HH with on site sanitation	7%	93%
Share of Volume of FS emptied by method	10%	90%
% of the HH with on-site sanitation having pits in the city emptied	7%	93%
% of the HH with on-site sanitation having septic tanks in the city emptied	8%	92%
% of the HH with on-site sanitation having cesspool in the city emptied	8%	92%

As the HH survey revealed, the manual emptying included: closing the pit when full and digging another one, burying the pit, directing the sludge into existing drainage channels or directing liquid sludge into farms, closing the pit when full and reusing it after some time when the sludge has reduced. Further analysis of the responses of “other” indicated that respondents would rather respond that the facility is not yet full instead of alluding to manual emptying. Therefore, during amalysis, respondeds clustered under “other” were included in the manual emptying category.

The operations of mechanical operators are insufficient to meet the existing demand of emptying services, though neither is the effective demand sufficient to cause the operators to operate at full capacity.

There are fourteen (14) private mechanical FS services businesses in Mombasa who between them operate ten (10) trucks. Table 3-49 provides data of these mechanical operators.

Table 3-49 : Data on Mechanical Operators in Mombasa

	Mombasa
# of private mechanical businesses in city	14
# of trucks run by private businesses	10
# of trucks owned by utilities	0
What are utility trucks used for (HH? Govt. institutions use, sewer cleaning?	N.A
# of private businesses that are small (1 truck)	3
# of pvt businesses that are medium (2-5 trucks)	2
# of pvt businesses that are large (>5 trucks)	0
What are the capacities of private trucks (m^3)	10 m^3
What are capacities of Utility trucks (m^3)	0
Price for new truck (15 m^3 capacity) USD	48,913
Price for USED truck (9 m^3 capacity) USD	20,000

Some of the operators run the FS emptying service as part of existing businesses. Most of the trucks currently in use in Mombasa are old and fairly unreliable, experiencing frequent breakdowns.

The trucks in use by most operators are old and delicate (Figure 3-10).

Figure 3-10 : Typical Mombasa FS Servces Truck

FS Management Mechanical Operators

Mombasa has 14 mechanical operators who own a total of 10 trucks (Table 3-50).

They operate from different locations within the Island town and do not have a designated parking. The operator businesses are sole proprietorships and partnerships. Most of the operators do not have formal offices, and clients generally find them by visiting the parking area or by stopping the trucks on the road whenever they see them.

Table 3-50 : Truck Characteristics - Mombasa

Operators	Truck	Volume in Cubic meters m^3	Year of manufacture
Operator 1	1	22	1990's
	2	22	1990's
	3	20	1990's
	4	18	1990's
Operator 2	1	5.6	1980's
	2	5.6	1980's
Operator 3	1	5.6	1980's
Operator 4	1	9	1990's
Operator 5	1	9	1990's
Operator 6	1	9	1990's

Employees

In general a truck has two employees to it which includes a driverand a plumber cum turn boy. Most of the operators pay their employees a daily casual wage while other operators have their employees on full monthly wages. Two operators in Mombasa have diversified operations in sanitation. They have in place fully fledged sales and marketing departments which are tasked with seeking business opportunities. These departments are in both instances managed by ladies.

Licensing

All operators are required to have 3 (three) licenses which include

1. Trading license obtained from the Municipal Authority but issued as a business license. This is renewed annually.
2. Environmental license issued by the national environmental office located in Mombasa and issued on a per truck basis. This is renewed annually.
3. Tipping permit and fee licensing issued by the utility firm. This permit is issued on a dumping trip basis.

Table 3-51 : Commencement and Customers of Mechanical Operators - Mombasa

Operators	No. of Trucks	Year of Commencement	Number of Customers/year
1	4	1996	326
2	2	2000	258
3	1	2005	142
4	1	0	0
5	1		0
6	0		0
7	0		0
8	0		0
9	0		0
10	0		0
11	0		0
12	0		0
13	0		0
14	0		0

Operations

The mechanical operators can be classified into different categories by number of trucks, business type and type of technology used to de-sludge.

In general operators make an assessment of the required de-sludging and then quote a fee. The fees are fixed per trip of the vehicle. As the vehicles sizes are different fees vary (Table 3-52 and Table 3-53). However, fees range from USD 110 to USD 236 for 5.6 m^3 to 22 m^3 which is a range of 50-93 USD per cubic meter. There are few instances where the rate varies because of distance.

Table 3-52 : Per Trip Fees for FSM Services – Mombasa

Operator	Trucks	Tariff ($)
1	4	205
2	2	108
3	1	124

Table 3-53 : Per Trip Fees for Different Types of Trucks for FSM Services – Mombasa

	Truck #	Truck CC	Make of Truck	Tariff USD
Operator 1	1	22	Mack	205
	2	22	Mack	205
	3	20	Mack	205
	4	28	Mack	205
Operator 2	1	5.6	Bedford	108
	2	5.6	Bedford	108
Operator 3	1	5.6	Bedford	124
Operator 4	1	9	Isuzu	108
Operator 5	1	9	Isuzu	108
Operator 6	1	9	Isuzu	108

During the day the trucks operate from different locations as there is no designated central location for this group of service providers. At night the service providers have secured parking lots for their trucks but these are not exclusive. Some park by the road side, while others have hired parking lots near office blocks.

The business practice is payment after service. The fee is usually agreed in advance. The client pays the truck driver once the sludge has been loaded onto the truck. Some operators issue

receipts while others do not. For commercial clients receipts are issued because the service is taxable (vatable) and this tax can be claimed back.

The truck driver generally collects payments from the client. Though this is becoming less common with the availability of mobile phone based payment system, in particular M-pesa (Table 3-54) in Kenya. As a result most clients pay directly by phone-through M-pesa – to a designated number which often is the telephone line of the principal. Commonly a single truck has a crew of two people. Some of the operators have their employees on a fixed wage though the majority engage their truck crew on a casual (daily wage) basis (Table 3-55).

Dumping permits are obtained from the Utility Company at a fee of USD 10.87 per trip. Upon payment, the permit is issued. When dumping the sludge at the FSTP plant the truck is required to register itself and surrender the permit and receipt of fee payment. Truck owners use the dumping permits to reconcile the number of trips per day with number of customers served. However, use of the mobile phone is extensive as a way of tracking the movement of the truck.

The levels of organization for the operators are varied. While some are sole proprietors or partnerships with the owner operating the truck, others have an elaborate structure comprising of an operations manager, accountant, drivers, plumbers and plumbing assistants.

With the exception of one firm -which has centralized its fueling operation, fueling of trucks is undertaken by the truck crew and is based on collections from clients. However, for all firms, the daily collections are remitted net of fuel amounts to begin operations the following day which ranges from USD 5 to USD 10 per truck. In some instances, the truck crew ensures they have received enough money in advance from their office to fund a long distance trip to a customer.

Table 3-54 : M-PESA Service in Kenya

M-Pesa service (M for Mobile and Pesa for money in Swahili); is a mobile-based money transfer services pioneered by Safaricom a mobile telecommunication services provider in Kenya.
The product concept is one that allows an M-Pesa customer to send money quickly, safely and across great distances through a mobile phone to another M-Pesa customer.
M-Pesa was developed by mobile phone operator Vodafone and launched commercially by its Kenyan affiliate Safaricom in March 2007.
To access the service, customers must first register at an authorized M-Pesa retail outlet. They are then assigned an individual electronic money account linked to their phone number and accessible through an application stored on the subscriber identification module (SIM) cards of their mobile phones.
Functions
The application has two main functions.
First, it allows customers to deposit cash to and withdraw cash from their accounts by exchanging cash for electronic value at a network of retail stores to day there are more than 23,000 such outlets. (M-Pesa Agencies)
Second, it allows users to transfer funds to others, to pay bills, and to purchase mobile airtime credit. Retail stores (M-Pesa Agents) are paid a fee by Safaricom each time they exchange cash for M-Pesa credit on behalf of customers. All M-Pesa transactions are authorized and recorded in real time using secure short messaging service (SMS) and are capped at $500.
M-Pesa registration is free, as is making deposits into the system. Customers are charged flat fees of approximately$0.403 for person-to-person (P2P) transfers and bill payments, $0.33 for withdrawals (for transactions under $33) and $0.013 for balance inquiries.
Individual customer accounts are maintained in a server that is owned and managed by Vodafone, but Safaricom deposits the full value of its customers' balances in the system in pooled accounts in two regulated banks. Thus, while Safaricom issues and manages the M-PESA accounts, the value of the accounts is fully backed by highly liquid deposits at commercial banks.
Rather than paying customers interest on the balance in their M-Pesa accounts, Safaricom sets aside a small percentage of account balances in a not-for-profit trust fund.
The purpose of these funds has not yet been decided.
M-Pesa's function as a retail payment platform is important because it reaches a large number of people compared with other financial services outlets in Kenya.

Table 3-55 : Mechanical Emptiers Truck Crew – Mombasa

Operator	Number of employees	Type of Employment	Organization of Employees (truck Crew)
1	8	Permanent/ Casual	Driver/Turn boy
2	4	Permanent/ Casual	Driver/Turn boy
3	2	Permanent/ Casual	Driver/Turn boy

Trips and customers

In Mombasa each trip by a truck is always recorded at the dumping site. This is because of the use of a dumping fee and receipting system by the FSTP operator is regularly reconciled by the finance office of the Utility Company. However revenues per truck are difficult to track as there are no customer receipts, therefore there are difficulties in determining the exact amounts paid by customers.

A number of reasons may exist for lack of customer receipting in the industry. Foremost receipts are only absolutely necessary for:

1. Expense claims process-where the customer may have service paid for him by his employer or landlord
2. Where the customer maintains book keeping records such as a corporate client-hotel, factory etc.
3. Where the customer makes a VAT return and therefore the service VAT incurred is INPUT TAX and is useful for offsetting purposes

Dumping site

There is one official dumping site for FS, which is Kipevu Wastewater Treatment Works in West Mainland (Figure 3-11). The WWTP is under rehabilitation. Generally there are no reported cases of sludge dumping in unauthorized areas. The dump site is well secured by a fence and a single entry gate. The site is manned by security guards on a 24 hour basis. Dumping takes place between Monday to Saturday and the gates are closed at 1800 hrs. At the dumping site, the trucks discharge to a man-hole which is connected by sewer line to the WWTP. The facility is tidy and well maintained, without odors, and a record is maintained of every truck dumping visit. No dumping is permitted by a truck without a valid dumping permit and payment of fee. However during the rehabilitation, some dumping has occurred in the general area of the dumping site especially by drum truck operators who use the combined technology.

Figure 3-11 : Kipevu WWTP (TL), Access (TR), disposal point (BL), Truck emptying

TL-Top Right, TR-Top Right, BL-Bottom Left

The dumping site and the WWTP are managed by the water and sewerage utility (MOWASCO). The WWTP has a designed capacity of 17,100 cubic meters but currently operates well below 10%.

Trucks

There are 10 trucks operating in Mombasa while there are 14 registered operators. The business is controlled by 6 operators who account for 99% of the business and own the 10 trucks. There are 8 operators who do not have any trucks but hire periodically from the mainstream operators. Of the registered trucks 3 use a unique combination of technologies where 200 litre drums are placed at the back of the truck and a water pump or manual emptiers are used to fill these drums. These 3 trucks two which belong to one operator and one for another operator have difficulties emptying sludge at the manhole provided for dumping at

FSTP. Part of the rehabilitation includes designing a receiving bay to act as a dump location for these trucks.

The trucks in Figure 3-12 have a capacity of 22,000 litres and are oil cooled as opposed to water cooled. This system is much more fuel efficient and delivers almost 5km per litre.

Figure 3-12 : Fuel Efficient Trucks in Mombasa

The capacity of trucks in Mombasa varies from 9000 litres to 22,000 litres. The drum combination trucks have a lower capacity of 5600 litres and 7200 litres. However, all trucks charge on a per trip basis. The longest distance for discharge is 20 km comprising of from client to dumpsite to parking bay, while the shortest distance is 6 km. Most trips have a total distance of 7 km.

Number of Trips per Day

There are least 3 trips to the dumping site every day between Monday and Saturday. Two of the 6 operators report at least 1 trip per day every day on a 22 working day cycle while another 2 report a trip every two days. One operator reports at least a trip every week. The 8 operators without trucks often sub contract those with trucks for their services. There are reports of manual emptying taking place and illegal dumping and connection of septic tanks to the storm drain. Two of the operators – those using the drum trucks-work closely with manual emptiers. Manual emptiers reported that only 50% of their emptying is transported by truck. The total dumping trips by drum trucks in a year is estimated at 180. This means that every 2 days there is manual emptying taking place with the FS being either dumped into the storm drain or being buried into the ground.

Fuel Consumption and Expenditure

In Mombasa, the average distance of a single trip-from park to client to dump site and back to park-is 12 km. Based on the vehicle models there are significant variations in fuel expenditure. Local assembly trucks are in use by all Mombasa operators except for one operator who uses exclusively imported trucks. The local assembly trucks have an integrated pump system, while the reconditioned second hand trucks have nonintegrated pump system. On the imported truck, the average distance per litre is 4.5 kilometers. The pump technologies in use by on imported trucks requires about 30 minutes to fill 20,000 litres. The suction process consumes between 1 and 1.5 litres of fuel. This is the pump system of the imported vehicle. It operates with its own generator.

Therefore the cost of servicing a short distance client of 12km is 5 litres and a long distance client is between 8 and 9 litres. Thus the fuel cost of a single trip is between USD 5.9 to USD 9.4. These imported trucks whose capacity ranges from 18000 to 22000 litres use oil based cooling system and have separate pump engines. One of these engines can run for 8 hours on 4 litres.

This pump system shown in Figure 3-13 is more fuel efficient and operationally safe.

Figure 3-13 : Fuel Efficient Pump System of an Imported Vehicle - Mombasa

Where the system runs on the engine of the vehicle, during operations the driver has to “rev” the vehicle to drive the pump system. In this system, the pump is connected to the engine via a pulley system- fan belt at RHS of pump (Figure 3-14). This is driven by a central shaft, which the driver moves by pressing the pedal while the vehicle is not in gear. The vehicle is reconfigured to switch to this mode during pump operation. This is the more common pump installation

technique for mechanical operators. The pump here was found to be the most common in use by truck owners.

Figure 3-14 : Pump System coupled to Shaft of Truck - Mombasa

The local assembly trucks in use by other operators in Mombasa perform an average distance of 4 kilometer per litre. These trucks range from 9,000 litres to 11,000 litres in capacity. The drum trucks have smaller capacity. The pump technologies in use by local assembly trucks require about 30 minutes to fill 8000 litres. The suction process consumes between 2.5 and 3 litres of fuel. Therefore the cost of servicing a short distance client of 12 km is 5 litres and a long distance client is between 8 and 9 litres.

However, the larger capacity trucks charge between USD 160 and USD 220 per trip while the smaller trucks charge between USD 80 and USD 120 per trip.

Operations Audit and Supervision

The dumping permit system at the FSTP provides an audit mechanism for the truck owners to monitor the number of trips per truck per day. In the absence of this, it would be difficult to confirm actual trips as most trucks have defective odometers. The 6 dominant operators in Mombasa have organizational structures that allow them to conduct random inspections on the movement of the trucks. The approach is to call the truck driver and request for his location, then hire out a small taxi-tuk tuk- to the location to confirm. Given the inexpensive fares

charged by these tuk-tuks management personnel in these firms are able carry out regular checks on the movement of trucks. In other instances the operator management personnel locate themselves along a route and place a call to the truck crew when they are passing by and seek confirmation of their location. This takes places on a regular basis in the course of the day.

Challenges Faced by Mechanical Operators in Mombasa

Some of the challenges highlighted include:

- Difficulties in extracting latrines due to disposal of solid waste into the latrines
- Low customer awareness
- Extortion , penalties , expensive, permits, bribes by the local authorities
- High maintenance cost
- High fuel prices
- Limited sources of capital

Table 3-56 summarizes some of the operations and operator challenges highlighted by some of the operators interviewed.

Table 3-56 : Summary of Operations and Operator Challenges – Mombasa

Operator1	Marketing	Has an active operations and marketing manager, word of mouth and established reputation
	Supervision	Operations manager actively supervises the truck and most transactions are formally recorded
	Challenge	Unfair practices
	Challenge	Manual emptying still undertaken with complicity of the officials
Operator2	Marketing	Collaborates with many manual emptiers and pays a commission for finding the work
	Supervision	Owner also acts as a truck driver, and negotiates all contracts directly
	Challenge	Harassment by city council officials
	Challenge	Dumping site is not well suited for the drum truck technology
Operator 3	Marketing	Uses related business in outdoor activities to advertise, there is a marketing manager
	Supervision	Rotational drivers and truck crew
	Challenge	municipal should stop discharge to storm drains
	Challenge	Manual emptiers are very active, fuel costs are high

Marketing

Marketing activities include on truck telephone listing, on truck posters and wall posters in

Figure 3-15 : Marketing FSM Services - Mombasa

Clients Receipting and Payments

Domestic clients generally do not require receipts and thus revenue accounting is mostly dependent on the truck crew. Commercial clients on the other hand-restaurants, land lords and factories do require receipts for these sanitation services. Most commercial clients prefer to make cheque payments as opposed to cash. Domestic clients on the other hand pay in cash.

Credit services

All operators do offer credit services, but this is often to the commercial clients. Domestic clients only known to the business proprietor receive credit while all others pay upon service delivery. The operators' primary reason for extending credit is to retain the business relationship as opposed to giving price discounts.

Payment systems

Three payment systems are observed in the industry, cash, mobile phone based systems and cheques. Domestic clients tend to pay in cash or by mobile phone system. Commercial operators pay either in cash or by cheque but predominantly by cheque.

Hire of third party trucks to service a client

Hire of third party trucks to service a client occurs at two levels. In the first instance those operators who do not own any trucks but are able to secure "exhausting contracts" from households and commercial entities. Under such circumstances the renting contractor negotiates varied pricing. In the second instance, some operators when overwhelmed by orders prefer to hire the trucks of their industry colleagues in order to serve the clients. In this second instance the pricing system is commission based.

Collaboration with Manual Empties

The 2 Drum truck operators who own 3 trucks were noted to have strong collaboration with manual emptiers (Figure 3-16). This is because the drum-trucks are more affordable and mostly in use where conventional trucks may not be able to access.

Figure 3-16 : Drum Truck Operators and Mannual Emptiers

FSM Emptying Practices and Technologies: Nairobi City

The methods of fecal sludge emptying were determined from the HH survey.

Based on the HH survey, the estimates for method of FS emptying were obtained by analyzing the responses to questions and inferring based on those estimates the actual number of HH with reference to the national population.

The questions respondents were asked were;

Q17: What kind of facility?

Q21: What kind of emptying services do you use?

The data collection instruments used in this regard are included as Appendix A and also in Volume II of II of this report.

When Q17 and Q21 are transposed, they provide the breakdown of type of facility and method of emptying which then when summed up gives the answers to method of FS emptying. Similarly when Q21 is adjusted for sewered respondents, it provides the answer to the global method of FS emptying.

The results (Table 3-57) indicate 52% of of the HH's use mechanical operators while 48% use manual methods of empting. Detailed analysis is included in this report as Apendix B.

Table 3-57 : Methods of Emptying Fecal Sludge in Nairobi

Number of the city HH with On-site sanitation		502,839
Number of the HH with on-site sanitation having pits in the city using Mec. Emp		126,112
Number of the HH with on-site sanitation having septic tanks in the city using Mec. Emp		46,412
Number of the HH with on-site sanitation having cesspool in the city using Mec. Emp		88,701
Total number of HH with on-site sanitation emptied mechanically		261,225
Number of the HH with on-site sanitation having pits in the city using Man. Emp		205,762
Number of the HH with on-site sanitation having septic tanks in the city using Man. Emp		18,957
Number of the HH with on-site sanitation having cesspool in the city using Man. Emp		16,895
Total number of HH with on-site sanitation emptied mechanically		241,614
	Mechanical (%)	**Manual (%)**
Method of Emptying by HH with on site sanitation	52%	48%
Share of Volume of FS emptied by method	32%	68%

% of the HH with on-site sanitation having pits in the city emptied	38%	62%
% of the HH with on-site sanitation having septic tanks in the city emptied	71%	29%
% of the HH with on-site sanitation having cesspool in the city emptied	84%	16%

Therefore to derive the share of manual and mechanical for the whole population;

241,614/502,839 = 48% that is %tage of HH with on-site sanitation using manual emptying

261,225/502,839 = 52% that is % tage of HH with on-site sanitation using mechanical emptying

As the HH survey revealed, the manual emptying included: closing the pit when full and digging another one, burying the pit, directing the sludge into existing drainage channels or directing liquid sludge into farms, closing the pit when full and reusing it after some time when the sludge has reduced.

The operations of mechanical operators are insufficient to meet the existing demand of emptying services, though neither is the effective demand sufficient to cause the operators to operate at full capacity.

There are 26 private mechanical FS services businesses in Nairobi who between them operate sixty trucks. Table 3-58 provides data of these mechanical operators.

Table 3-58 : Data on Mechanical Operators in Nairobi

	Nairobi
# of private mechanical businesses in city	26
# of trucks run by private businesses	60
# of trucks owned by utilities	4
What are utility trucks used for (HH? Govt. institutions use, sewer cleaning?	Not in Use
# of private businesses that are small (1 truck)	8
# of pvt businesses that are medium (2-5 trucks)	18
# of pvt businesses that are large (>5 trucks)	0
What are the capacities of private trucks (m^3)	10
What are capacities of Utility trucks (m^3)	10
Price for new truck (10 m^3 capacity) USD	48,000
Price for USED truck (10 m^3 capacity) USD	20,000

Some operators run the FS emptying service as part of existing businesses. The trucks currently in use in Nairobi are old and fairly unreliable, experiencing frequent breakdowns.

Some of the trucks in use by the operators are new and sophisticated while some are old and delicate (Figure 3-17).

Figure 3-17 : Typical Nairobi Trucks

Nairobi has 26 mechanical operators who own a total of 60 trucks (Table 3-59).

The trucks in Nairobi operate from diverse areas, outside and within the town, but do not all have a designated parking. The operator businesses are sole proprietorships, limited liability and partnerships. Some operators do not have formal offices, and clients generally find them by visiting the known parking area or by stopping the trucks on the road whenever they see them. A few have formal offices. Customers generally contact mechanical operators by calling the telephone numbers painted on the emptying trucks. It is a common practice for emptying trucks to have a telephone number painted on the body of the tank.

Table 3-59 : Truck Characteristics - Nairobi

Operators	Truck	Volume in m^3	Year of manufacture
1	1	20	2010's
2	1	10	2010's
3	1	10	
4	1	10	2009
	2	18	2011
5	1	11	1988
	2	11	1992
6	1	10	2007
	2	10	2010

7	1	10	2005
	2	12	2009
8	1	10	2005
9	2	10	2002
10	1	10	2006
	2	10	2006
	3	20	2007
	4	20	2008
11	1	15	2009
	2	15	1989
	3	15	2002
	4	10	1994

Employees

In general each truck has two employees who include a driver and a plumber cum turn boy. Most of the operators pay their employees a daily casual wage while the other operators have their employees on full monthly wages. Six operators in Nairobi have diversified operations in sanitation. They have in place fully fledged sales and marketing departments which are tasked with seeking business opportunities.

Licensing

All operators (Table 3-60) are required to have 4 (four) licenses which include:

1. Trading license obtained from the City Council Authority but issued as a business license. This is renewed annually.
2. Environmental license issued by the national environmental office located in Nairobi and issued on a per truck basis. This is renewed annually.
3. Exhausting license issued by the utility company and issued on a truck basis
4. Tipping permit issued by the utility firm. This permit is issued on a dumping trip basis.

Table 3-60 : Commencement and Customers of Mechanical Operators - Nairobi

Operators	No. of Trucks	Year of Commencement	Number of Customers/year
1	1	2010	347
2	1	2010	347
3	1	2009	347
4	2	2009	480

5	2	2000	504
6	2	2007	624
7	2	2005	696
8	2	2009	528
9	2	2005	528
10	4	2000	1632
11	4	2002	1056

Operations

The mechanical operators can be classified into different categories by number of trucks, business type and type of technology used to de-sludge.

In general operators make an assessment of the required de-sludging and then quote a fee. The fees are fixed per trip of the vehicle. As the vehicles sizes are different fees vary (Table 3-61). However, fees range from USD 70 to USD 108 for 10 m^3 to 18 m^3 which is a range of 6-7 USD per cubic meter. The fees charged also tend to vary with distance; there are few instances where the rate varies because of distance.

Table 3-61 : Per Trip Fees for FSM Services – Nairobi

Tariff in USD						
One Truck Operator						
	Operator I	**Operator II**	**Operator III**			
Long Distance	100	80	100			
Short Distance	70	50	35			
Average Tariff	91	71	81			
Two Trucks Operators						
	Operator I	**Operator II**	**Operators III**	**Operator IV**	**Operator V**	**Operator VI**
Long Distance	80	100	120	100	95	90
Short Distance	45	30	80	40	70	40
Average Tariff	70	79	108	82	88	75
Four Trucks Operators						
	Operator I	**Operator II**				
Long Distance	100	80				
Short Distance	30	70				
Average Tariff	79	77				

During the day the trucks operate from different locations as there is no designated central location for this group of service providers. At night the service providers have secured parking lots for their trucks but these are not exclusive. Some park by the road side, while others park at the nearest gas station.

Table 3-62 : Per Trip Fees for Different Types of Trucks for FSM Services – Nairobi

Operator	Truck #	Truck CC	Make of Truck	Max fee USD	Min fee Usd
1	1	20	Mercedes	100	70
2	1	10	Isuzu	80	50
3	1	10	Isuzu	100	35
4	1	10	Isuzu	100	40
	2	18	Mercedes	100	40
5	1	11	Isuzu	95	70
	2	11	Isuzu	95	70
6	1	10	Isuzu	80	45
	2	10	Isuzu	80	45
7	1	10	Tata	90	40
	2	12	Mercedes	90	40
8	1	10	Nissan	100	30
	2	10	Ford	100	30
9	1	10	Isuzu	120	80
	2	10	Isuzu	120	80
10	1	10	Mercedes	100	30
	2	10	Renault	100	30
	3	20	Mercedes	100	30
	4	20	Mercedes	100	30
11	1	15	Isuzu	80	70
	2	15	Isuzu	80	70
	3	15	Nissan	80	70
	4	10	Nissan	80	70

The business practice is payment after service. The fee is usually agreed in advance. The client pays the truck driver once the sludge has been loaded into the truck. Some operators issue receipts while others do not. For commercial clients receipts are issued because the service is taxable (vatable) and this tax can be claimed back.

The truck driver generally collects payments from the client. Though this is becoming less common with the availability of mobile phone based payment system, in particular M-pesa in

Kenya. As a result most clients pay directly by phone-through M-pesa – to a designated number which often is the telephone line of the principal. Commonly a single truck has a crew of two people. Some of the operators have their employees on a fixed wage though the majority engages their truck crew on a casual (per trip/ daily) basis.

Operators pay a sum of USD 2.00 as the tipping fee per trip to the Utility Company. When dumping the sludge at the FSTP plant the truck is required to register itself and surrender the permit and dumping fee receipt of payment. Truck owners use the dumping permits to reconcile the number of trips per day with number of customers served. However, use of the mobile phone is extensive as a way of tracking the movement of the truck. Records kept at the dumping site cannot be validated.

The levels of organization for the operators are varied. While some are sole proprietors or partnerships with the owner operating the truck, others have an elaborate structure comprising of an operations manager, accountant, drivers, and plumbing assistants.

In most instances fueling of trucks is undertaken by the truck crew (Table 3-63) and is based on collections from clients. However, for all firms, the daily collections are remitted net of fuel amounts to begin operations the following day which ranges from USD 25 to USD 30 per truck for the first trip of the day. In some instances, the truck crew ensures they have received enough money in advance from their office to fund a long distance trip to a customer.

Table 3-63 : Mechanical Emptiers Truck Crew – Nairobi

Operator	Number of employees	Type of Employment	Organization of Employees (truck Crew)
1	2	Permanent	Driver/Turn boy
2	2	Permanent/ Casual	Driver/Turn boy
3	2	Casual	Driver/Turn boy
4	4	Casual	Driver/Turn boy
5	4	Casual	Driver/Turn boy
6	4	Casual	Driver/Turn boy
7	4	Casual	Driver/Turn boy
8	4	Casual	Driver/Turn boy
9	4	Permanent	Driver/Turn boy
10	8	Casual	Driver/Turn boy
11	8	Casual	Driver/Turn boy

Trips and customers

The number of trips per day reported to the truck owner cannot be confirmed to always tally with the actual trips made by the crew to the dumping site. This is despite the use of a dumping fee and receipting system by the FSTP operator. Revenues per truck are also difficult to track. As there are no customer receipts there are therefore difficulties in knowing the exact trips by a truck and amounts paid by customers.

A number of reasons may exist for lack of customer receipting in the industry. Foremost receipts are only absolutely necessary for

1. Expense claims process-where the customer may have service paid for him by his employer or landlord.
2. Where the customer maintains book keeping records such as a corporate client-hotel, factory etc.
3. Where the customer makes a VAT return and therefore the service VAT incurred is INPUT TAX and is useful for offsetting purposes

Tipping point

In Nairobi, all trucks tip at Njiru tipping point. Figure 3-18 shows a typical tipping scenario at the Njiru Tipping point and one of the largest trucks (green truck) which has a capacity of 18,000 litres. The maximum number of trucks that can tip at a given time is four. Most trucks have a capacity of between 10,000 – 15,000 litres.

Figure 3-18 : Njiru Tipping Point in Nairobi

Trucks

Some of these trucks are sophisticated in nature and very effective. The truck on the left of Figure 3-19 is a locally fabricated unit (tank) built on a new chassis.

Figure 3-19 : Some of the Trucks Operating in Nairobi.

The capacity of trucks varies from 10,000 litres to 20,000 litres. However, all trucks charge on a per trip basis. The longest distance for discharge is 50 km comprising of from client to dumpsite, while the shortest distance is 4 km. Most trips have an average distance of 27 km.

Number of Trips per Day

On average for a single truck operator there are least 4 trips every three days, which translates to 8 trips for a week of six days. There are reports of manual emptying taking place and illegal dumping and connection of septic tanks to the storm drain. In the low income areas manual emptying is very common. It certain parts of the City, connections to the storm drain of on-site sanitation facilities in particular septic tanks and cess pools was very prevalent.

Fuel Consumption and Expenditure

In Nairobi, the average distance of a single trip-from park to client to dump site and back to park-is 27 km. Based on the vehicle models there are significant variations in fuel expenditure. The local assembly trucks have an integrated pump system while the reconditioned second hand trucks have nonintegrated pump system. On the imported truck, the average distance per litre is 4.5 kilometers. The pump technologies in use by this type of trucks require about 30

minutes to fill a 20,000 litre's tank. The suction process consumes between 1 and 1.5 litres of fuel. Table 3-20 shows the pump system of an imported vehicle.

Figure 3-20 : Pump System of an Imported Vehicle

The pump system operates with its own generator. This system is more fuel efficient and operationally safe compared to the alternative system where the pump mechanism runs on the engine of the vehicle and during operations the driver has to "rev" the vehicle to drive the pump system.

The imported type trucks are gaining popularity amongst mechanical emptiers and many when interviewed indicated that if they were to obtain a new truck, this type would be their preferred option.

Different pump positions

In the local assembly vehicle type, the pump system is mechanically fitted as an add on.The pump is connected to the engine via a pulley system- fan belt at RHS of pump. This is driven by a central shaft, which the driver moves by pressing the pedal while the vehicle is not in gear. The vehicle is reconfigured to switch to this mode during pump operation. This is the most common pump installation technique for mechanical operators in Nairobi.

In Nairobi, local assembly trucks mount their pumps at different positions on the chassis of the vehicles. Most of them have been mounted on the sides near the battery whereas others are

on top, below and even behind (Figure 3-21). These types of trucks were reported by owners to consume far much more fuel than the imported type both per kilometre basis for transportation as well as on the pumping process. For instance it was reported that the local truck pump technologies require about 30 minutes filling 8,000 litres. The suction process consumes between 2.5 and 3 litres of fuel and the average distance per litre is 3.5km to 4 km.

Figure 3-21 : Different Pump Positions for Locally Assembled Trucks

Operations Audit and Supervision

The dumping permit system at the FSTP provides an audit mechanism for the truck owners to monitor the number of trips per truck per day. In the absence of this, it would be difficult to confirm actual trips as trucks tend to have defective odometers. The dominant operators in Nairobi have organizational structures that allow them to conduct random inspections on the movement of the trucks. The approach is to call the truck driver and request for the trucks location, then ride on a public transport vehicle locally known as- Matatu-to the location to confirm. Given the inexpensive fares charged by these –Matatus-management personnel in these firms are able carry out regular checks on the movement of trucks. In other instances the operator management personnel locate themselves along a route and place a call to the truck crew when they are passing by and seek confirmation of their location. This takes places on a regular basis in the course of the day.

Marketing

Most operators in Nairobi market through listing the telephone number of the office on the body of the truck (Figure 3-22).

Figure 3-22 : Using Trucks to Market FSM Services

Challenges Faced by Mechanical Operators in Nairobi

Some of the challenges faced include:

- Long distance to discharge point
- Difficult to extract latrines due to disposal of solid waste into the latrines
- Low customer awareness
- Extortion , penalties , expensive, permits, bribes by the local authorities
- High maintenance cost
- High fuel prices
- Poor roads infrastructure
- Limited sources of capital

Table 3-64 summarizes a number of the challenges highlighted by some of the operators interviewed.

Table 3-64 : Summary of Operations and Operator Challenges – Nairobi

Operator 1	Marketing	Has been in business for long and has an active list of clients many of whom own multiple flat complexes
	Supervision	Employs close relative to work on each truck as driver
	Challenge	Unfair practices by other ME
	Challenge	illegal connections to storm drains
Operator 2	Marketing	Has an active list of clients, but uses word of mouth in most cases
	Supervision	Owner is actively engaged in monitoring of truck movement
	Challenge	Harassment by police officers
	Challenge	Dumping site is too far and police officers along the route have to be paid
Operator 3	Marketing	Word of mouth, , posters on truck and an active marketing function by the branch manager
	Supervision	All client activities are centralized at the office, and operations manager monitors truck movements through work-ticket process.
	Challenge	Dumping Permit processing can be made better
	Challenge	Manual emptiers are very active, fuel costs are high finance is expensive dumping site is too far in some instances illegal connections to storm drains

Clients Receipting and Payments

Domestic clients generally do not require receipts and thus revenue accounting is mostly dependent on the truck crew. Commercial clients on the other hand-restaurants, land lords and factories do require receipts for these sanitation services. Most commercial clients prefer to make cheque payments as opposed to cash. Domestic clients on the other hand pay in cash but more predominantly now by M-pesa.

Credit services

All operators offer credit services, but this is often to the commercial clients. Domestic clients only known to the business proprietor receive credit while all others pay upon service delivery. The operators' primary reason for extending credit is to retain the business relationship as opposed to lowering the price.

Payment systems

Three payment systems are observed in the industry, cash, mobile phone based systems and cheques. Domestic clients tend to pay in cash but more predominantly by mobile phone payment system. Commercial operators pay either in cash or by cheque but more often by cheque.

Hire of third party trucks to service a client

Hire of third party trucks to service a client occurs at two levels. In the first instance, those operators who do not own any trucks but are able to secure "exhausting contracts" from households and commercial entities. Under such circumstances the renting contractor negotiates varied pricing. In the second instance, some operators when overwhelmed by service orders prefer to hire the trucks of their industry colleagues in order to serve the clients. In this second instance the pricing system is commission based.

Collaboration with Manual Empties

There is collaboration with manual emptiers at varied levels. In the low income areas, public sanitation blocks commonly referred to as bio-centres are often located in areas inaccessible by vehicles. Such bio-centres therefore engaged a combination of manual and mechanical operators.

3.1.9 Overview of all WWTP, FSTP or dumping sites

Overview of Kisumu WWTP and dumping Sites

Kisumu has two FS treatment plants operated by the Kisumu Water and Sanitation Company (KIWASCO). One plant is of the stabilization ponds type which is the Nyalenda Sewerage Treatment Works located at the edge of Kisumu City. The system consists of the preliminary, secondary and tertiary treatment process. The inlet works with screening and grit removal then followed by 3 facultative ponds in parallel and 6 maturation ponds in parallel pairs. Effluent is discharged to an adjacent water course, from whence it percolates to the lake via the Nyalenda papyrus swamp. Estimated inflow of 2000 m^3/d at present is very low compared to design capacity of 11,000 m^3/d. The Nyalenda plant currently is the dumping facility for the mechanical emptiers operating in the city. The feacal sludge from the mechanical operators is emptied at the inlet of the treatment pond system where it mixes with incoming sewage (Figure 3-8). There is no separate fee (other than the license paid to KIWASCO) for the mechanical emptiers

to discharge into this facility. This pond wastewater treatment system does not separate faecal sludge from the treated wastewater stream.

The second treatment plant is Kisat Wastewater Treatment plant (Figure 3-23) which is a conventional type facility. It is currently under rehabilitation. It provides primary and secondary treatment to domestic, commercial and industrial wastewater.

Figure 3-23 Sedimentation Tanks at the Kisat Wastewater Treatment Plant

Faecal sludge is conditioned in cold digestion tanks and dried in sludge drying beds before disposal (Figure 3-24).

Figure 3-24 : FS Drying Beds (left) and dried FS (right) at the Kisat WWTP

Overview of Mombasa WWTP and dumping Sites

Mombasa has two main sewerage treatment plants, the **Kizingo Wastewater Treatment Works** located in Mombasa Island and **Kipevu Wastewater Treatment Works** in West Mainland both operated by Mombasa Water and Sewerage Company (MOWASCO). The West Mainland system has continually expanded since the first one which was built in 1952. The Island has had minimal expansion since it was initially built in 1962.

Kizingo Wastewater Treatment Works

The Treatment Plant at Kizingo was designed to provide only preliminary treatment (screening and grit removal) and primary treatment (sedimentation). The Inlet Works was designed for a Dry Weather Flow of 32,500 m^3/day. The Treatment Plant has been out of operation for many years. Most of the equipment is missing and the wastewater flows by-pass the Works and are discharged directly to the ocean through a 40 m long outfall pipe at Ras Serani.

When the plant was operational, no treatment was provided to the sludge collected from the Sedimentation Tanks, instead, it was pumped directly into the ocean each day through the outfall pipe during periods when the tide was going out, so that it would be transported by the tide out to deep water for greater dilution. At present this WWTP is not operational.

Kipevu Wastewater Treatment Works

A new treatment plant at Kipevu in West Mainland was commissioned in 2003. Originally, it employed the use of biological filters and the treated effluent was discharged directly into the creek at Port Reitz close to Kilindini Harbour. A new extended Aeration Treatment Plant, utilising an Oxidation Ditch System, was constructed to replace the original biological filter plant. Its nominal design capacity is 17,000 m^3/day of wastewater with a BOD of 560 mg/l and the design BOD/SS effluent standard is 20/30. The mechanical and electrical equipment at the plant is currently undergoing extensive rehabilitation.

Fecal sludge collected by both manual (operators use buckets to empty feacal sludge into large containers which are carried in lorries) and mechanical operators is currently discharged at the Kipevu Wastewater Treatment Plant (Table 3-65).

Table 3-65 : Data on Wastewater Treatment Plant in Mombasa

What is the official dumping site for city? (WWTP, FSTP, wetlands, landfill, official open land, or nothing?	Kipevu Wastewater Treatment Plant
What is the m^3 capacity of this treatment facility?	17, 100 m^3
Where is it located? (Center of city, edge of city, outside city?)	Edge of the city
What is the dumping fee truckers have to pay? USD (Per Truck)	10.87
Is this payment per trip or per month or m3 or?	Per Trip

The Kipevu plant is currently under rehabilitation. The plant located at Kizingo is not in use, but there is planned rehabilitation. Consequently, almost all the sewage collected flows into the sea at various points.

Overview of Nairobi WWTP and dumping Sites

Nairobi City has numerous treatment plants. The main ones are Dandora and Kariobangi Sewage treatment plants. Dandora was commissioned in 1977 whereas Kariobangi was commissioned in 1964. Currently, Kariobangi is functioning at 40 per cent of its design capacity of 32,000 m^3/day.

Kariobangi

The sewage treatment plant employs conventional waste treatment technology for primary and secondary treatment. The construction of the facilities was done in two phases. Phase 1 was commissioned in 1961 and Phase 2 in 1963 with a dry weather design flow of 16,000 m^3/day for each phase, with combined capacity of 32,000 m^3/day. However, due to ageing of some of the equipment, the capacity has significantly reduced to estimated 40 per cent of its design capacity.

Dandora estate sewerage treatment plant

Dandora sewerage treatment plant is located at Ruai, 30 km east of the city centre along Kangundo Road. It uses stabilization ponds and has a dry weather capacity of 80,000 m^3/d. Both industrial and domestic sewage are discharged at the plant.

There are two designated fecal sludge discharge points; Ruai Treatment Works and Njiru. Currently, only Njiru is in use (Table 3-66). These points are designated to only discharge domestic waste and not industrial effluent. An annual licence fee is payable as sewage discharge fee and is not based on the load capacity of the exhauster tank.

Table 3-66 : Data on Wastewater Treatment Plant in Nairobi

What is the official dumping site for city? (WWTP, FSTP, wetlands, landfill, official open land, or nothing?	Dandora estate sewerage treatment plant (Ruai)
What is the m3 capacity of this treatment facility?	80,000 m^3
Where is it located? (Center of city, edge of city, outside city..?)	Edge of the city
What is the dumping fee truckers have to pay? USD (Per Truck)	2.17
Is this payment per trip or per month or m3 or?	Per Trip

After treatment of wastewater, at Kariobangi treatment plant, the sludge is pumped to a series of drying beds (Figure 3-25). The beds have underdrains which drain excess wastewater back to the treatment plant. The wastewater is used for seeding incoming wastewater. Drying of the treated sludge depends on weather conditions. It takes an average of two (2) weeks for complete drying of the treated sludge. Currently there are no storage facilities for dried sludge, thus it is sold directly to farmers. Farmers use it a night soil for such crops as tea, coffee and agroforestry.

Figure 3-25 : FS Drying Beds - Kariobangi WWTP Nairobi

3.1.10 FS End Re-Use in the three cities Kisumu, Mombasa and Nairobi

FS re-use in all the cities is acceptable among the local residents. However, due to the under performance of the FSTP facilities, there are no regular sales of treated FS. Across the three cities, the management of the FSTP's however would like to carry out public sensitization and awareness campaigns to increase the acceptability of treated FS particularly in agro forestry.

3.2 Market Analysis per City

The methodology for market size calculation is presented in **section 2.4** of this report.

There are 148,494 households in Kisumu; out of which 84% have on-site sanitation facilities. The volume of fecal sludge emptied mechanically in a year is 204,049 m^3 while the volume emptied manually is 508,215 m^3. The total volume of fecal sludge emptied in a year is 712,264 m^3. The fecal sludge per capita per annum is 4.8 m^3.

There are 140,535 households in Mombasa; out of which 82% have on-site sanitation facilities. The volume of fecal sludge emptied mechanically in a year is 57,754 m^3 while the volume emptied manually is 793,727 m^3. The total volume of fecal sludge emptied in a year is 851,481 m^3. The fecal sludge per capita per annum is 6.06 m^3.

The number of household in Nairobi is 985,016; out of which 51% have on-site sanitation facilities. The volume of fecal sludge emptied mechanically in a year is 3,073,485m^3 while the volume emptied manually is 1,505,126 m^3. The total volume of fecal sludge emptied in a year is 4,578,584 m^3. The fecal sludge per capita per annum is 4.65 m^3.

3.3 Service Delivery Models Review

3.3.1 Overview of Existing Service Delivery Models

There are four service delivery models for FSM services;

- Utility companies - these provide
  - connection to sewer
  - Sewer infrastructure
- Local Authorities – these provide
  - sewer infrastructure
  - Public toilets and public toilet infrastructure

  - Mechanical emptying at a lower fee (not operational)
- Private emptiers – mechanical emptying services
  - Manual emptying services
  - Pay for use toilets often under concession or Public private partnership with local authority
  - FS treatment in collection aggregation bio centre facilities
  - FS re-use in bio-centres
- NGOs - These provide:
  - Pay for use toilets often under concession or Public private partnership with local authority
  - FS re-use in Bio-centres for onsite cooking
  - FS-re-use through delivery of bio-gas by pipe infrastructure to homes
  - FS-evacuation through disposable bags
  - FS-sanitation services through household pit latrines

3.3.2 Comparison with Solid Waste Management Service Models

Kenya has four classes of local authorities: City, Municipality, Town and County council. Nairobi is under City Council of Nairobi, Mombasa is under Municipal Council of Mombasa while Kisumu is under Municipal Council of Kisumu. There is only one official Solid Waste dumpsite in each of these cities/towns, owned and operated by the respective councils.

In the three councils, the collection and transportation of municipal solid waste is carried out by four organizations:

- The Council
- Contractors subcontracted by the Council
- Private Service Providers
- CBOs

There are three service delivery models in solid waste management;

- Local authorities – These:
  - Garbage Collection
  - Provide dumping site
  - Regulatory enforcement
  - Licenses-environmental restoration – greening

- Private operators- are involved in:
    - Garbage collection
    - Garbage disposal to dump-site
    - Solid waste processing
    - Solid waste re-use applications
- NGOs – are involved in:
    - Solid waste re-use- energy
    - Environmental restoration
    - Solid waste re-use - plastic poles
    - Solid waste re-use in fertilizer processing
    - Environmental restoration- a forestation

3.3.2.1 Similarities between Fecal sludge management and solid waste management

- Participants- utility companies, emptiers and households. These are the key participants in both FSM and SWM
- Legal enforcement – Dumping site for both fecal waste and solid waste is under a central authority (Utility Company/ City Council) who take charge of the dumping sites and ensure that operations are conducted in orderly manner.

3.3.2.2 Differences between Fecal sludge management and solid waste management

- Nature of waste – there are important differences in the nature of FS and SW.
- Enforcement agencies - During inception the enforcement agencies were similar in both cases, however at some point separation took place creating different mandates.
- Infrastructure - the infrastructure required to effectively transport and dispose varies with the kind of waste in question. The means of transporting fecal sludge is different from how solid waste can be transported and therefore require varying infrastructure.

3.4 Financial and Business Model Analysis

3.4.1 Financial and Business Model Analysis for Kisumu, Mombasa and Nairobi

3.4.1.1 Demand and supply in each city

Kisumu City

The city has three mechanical operators operating a total of four trucks among them. It has an estimated annual demand for mechanical FS management services of 691,903 m^3 and the mechanical supply for those services is estimated to cater for only 6,240 m^3 representing a 1% service delivery rate. On the other hand, the manual supply has an annual demand of approximately 508,431 m^3 and a corresponding 266,549 m^3 annual supply from manual operators which represents about 52% service delivery rate (Table 3-67).

Table 3-67 : Demand and Supply of FSM Services in Kisumu

Market Demand and Supply	Mechanical Emptying	Manual Emptying	Total
Fecal sludge Produced (Demand)	183,472 m^3	508,431 m^3	691,903 m^3
Supply (emptied) p.a.	6,240 m^3	266,549 m^3	269,966 m^3
Deficit	177,232 m^3	241,882 m^3	419,114 m^3

Mombasa City

The annual demand for FS management services is estimated at 853,341 m^3 of which 3 per cent is services by mechanical emptiers and 33 per cent by manual emptiers. The estimated mechanical demand is at 50,930 m^3 and the supply is approximately 28,142 m^3 representing a 54% service delivery rate. On the other hand, the manual supply has an annual demand of approximately 802,411 m^3 with a corresponding annual supply of 261,766 m^3 from manual operators which represents about 33% service delivery rate (Table 3-68).

Table 3-68 : Demand and Supply of FSM Services in Mombasa

Market Demand and Supply	**Mechanical Emptying**	**Manual Emptying**	**Total**
Fecal sludge Produced (Demand) p.a.	50,930 m^3	802,411 m^3	853,341 m^3
Supply (emptied) p.a.	28,142 m^3	261,766 m^3	289,908 m^3
Deficit	22,787 m^3	540,645 m^3	563,433 m^3

Nairobi City

The annual demand for mechanical FS management services is estimated at 2,796,692 m^3 and the estimated supply from mechanical emptiers is at approximately 299,520 m^3 representing a 10% service delivery rate. On the other hand, the manual supply has an annual demand of approximately 1,808,010 m^3 with a corresponding annual supply of 629,766 m^3 from manual operators which represents about 35% service delivery rate (Table 3-69). The capacity to cater for more demand exists in the current operating environment both for mechanical and manual operators, however due to the hazardous nature of manual FS extraction; mechanical extraction should be promoted to meet the excess demand. To effectively meet the market demand, the operators will have to increase their annual trips to more than 4,000 trips. For 60 trucks, each truck will have to make approximately 2,000 trips every three days. This is not attainable without an increase in the number of trucks and other modification to reduce the distance to dumping sites. The gap for mechanical emptiers to meet current demand is approximately 3,675,416 m^3 which demands for more trucks to the business and additional dumping and tipping destinations.

Table 3-69 : Demand and Supply of FSM Services in Nairobi

Market Demand and Supply	Mechanical Emptying	Manual Emptying	Total
Fecal sludge Produced (Demand) p.a.	2,796,692 M^3	1,808,010 M^3	4,604,701 M^3
Supply (emptied) p.a.	299,520 M^3	629,766 M^3	929,286 M^3
Deficit	2,773,938 M^3	1,178,244 M^3	3,675,416 M^3

3.4.1.2 Company Level Financial Analysis FSM Businesses

Manual Operators

One team of manual emptiers was surveyed in each of the three cities. Manual emptiers are generally organized in teams which are sub-groups of a larger group. The larger group tends to own the equipment for emptying and the practice is to hire these out to active teams depending on work availability. It was estimated that there was one main group in each city and this is closely related to the fact that manual emptyingg tends to take place in the informal settlements, which though dispersed geographically have economic networks.

In order to obtain comparable information from manual emptiers, a format was introduced (Table 3-70). Based on the interviews it was identified that most manual emptiers perform this amongst other types of manual work and are generally engaged on a daily basis. However, the team leaders engage different groups of persons and are more engaged on manual emptying contracts.

Table 3-70 : Activity Profile of Manual Emptiers across the 3 Cities

Input data	Nairobi	Kisumu	Mombasa
Charge to hire drum and buckets -USD	1	1	1
Number of people per team	4	5	6
Size of drums in litres	2		
Size of pits in litres	25		
Charge per drum -USD	2.50		
Number of drums/latrine	13		
Welfare contribution per contract	1.50	1.50	1.50
Number of Jobs per day	2	0	0
Number of contract days in month	3	3	3
Number of days in month	24	24	24
Number of days of equip hire	6	6	6
Number of days of equip hire in month	24	24	24

Financial Performance

The income (Table 3-71) from manual emptying on a daily wage basis was comparable to wages obtained from other types of manual work. However, it was reported to be seasonal and in particular depended on the team leader for the manual contracts.

Table 3-71 : Income Statements for Manual Emptiers Across the 3 Cities

Income Statement-USD	Nairobi	Kisumu	Mombasa
Revenue			
Total income per day- USD	31.25	30.00	60.00
Total income per month-USD	93.75	90.00	180.00
Operating Costs			
Equipment hire costs per month -USD	3.00	3.00	3.00

Monthly welfare contribution-USD	4.50	4.50	4.50
Miscellaneous cost-USD	5.00	5.00	5.00
Total operating cost- USD	12.50	12.50	12.50
Profit- USD	81.25	77.50	167.50
Monthly income to each member- USD	20.31	15.50	27.92

Assumptions

- The minimum contract cost in Mombasa is USD. 60
- The minimum contract cost in Kisumu is USD. 30

Manual emptying faces a complex outlook. With the emergence of bio-centres, manual emptying is being moved away from households to these collective FS centres, where forms of mechanization are being tested. It is unlikely that manual emptying shall seize to exist, however there is a need to improve on the conditions of work in particular to provision of protective gear and medicines.

Table 3-72 provides a comparison of mechanical operators in Kisumu by number of hours worked, number of trips and number of trucks. There is observed consistency in the operations of operators with key indicators remaining relatively uniform and estimates re-appearing with regularity when estimated based on the various sources interviewed during the data collection exercise.

Table 3-72 : Comparison of Mechanical Operators - Kisumu

	Kisumu	
Macro-economic & business size data	**ONE TRUCK OPERATOR**	**TWO TRUCKS OPERATOR**
Inflation (CPI)	16%	16%
Any other inflation index	0%	0%
Number of trucks	1	2
Number of drivers	1	1
Number of turn boys per truck	2	3
Hour worked in a year(hrs)	547	1,003
Distance covered per year (Km)	1,207	4,224
Number of trips per annum	288	528
Average hours per trip	1.5	1.5
Fuel consumption Emptying& Transportation km/litre	4.5	4.5
Fuel Cost per litre (USD)	1.15	1.15
Tariffs (USD)	51.50	51.50

Table 3-73 provides a comparison of mechanical operators in Mombasa by number of hours worked, number of trips and number of trucks. As can be noted from the data, the estimates are consistent across the operators. The key variables remain, number of trips, tariffs and number of trucks.

Table 3-73 Comparison of Mechanical Operators -– Mombasa

	Mombasa		
Macroeconomic & business size data	**ONE TRUCK OPERATOR**	**TWO TRUCKS OPERATOR**	**FOUR TRUCK OPERATOR**
Inflation (CPI)	16%	16%	16%
Any other inflation index	0%	0%	0%
Number of trucks	1	2	4
Number of drivers	1	2	4
Number of turn boys per truck	2	2	2
Hour worked in a year(hrs)	213	387	489
Distance covered per year (Km)	1,207	2,193	2,771
Number of trips per annum	142	258	326
Average hours per trip	1.5	1.5	1.5
Fuel consumption Emptying& Transportation km/litre	4.5	4.5	4.5
Fuel Cost per litre (USD)	1.15	1.15	1.15
Tariffs	$124	$108	$205

Table 3-74 provides a comparison of mechanical operators in Nairobi across categories. The key variables are number of hours worked, number of trips and number of trucks. The number of trips per truck by operators appears to have the highest impact on the profitability of an operator. This is consistent as tariffs remain competitive.

Table 3-74 : Comparison of Mechanical Operators -– Nairobi

	Nairobi		
Macroeconomic & business size data	**ONE TRUCK OPERATOR**	**TWO TRUCKS OPERATOR**	**FOUR TRUCK OPERATOR**
Inflation (CPI)	16%	16%	16%
Any other inflation index	0%	0%	0%
Number of trucks	1	2	4
Number of drivers	1	2	4
Number of turn boys per truck	2	2	2
Hour worked in a year(hrs)	1,041	1,584	4,896

Distance covered per year (Km)	9,356	14,256	14,028
Number of trips per annum	347	528	1,682
Average hours per trip	3	3	3
Fuel consumption Emptying& Transportation km/litre	5.3	5.3	5.3
Fuel Cost per litre (USD)	1.15	1.15	1.15
Tariffs	$94	$108	$79

3.4.1.2.1 *Income statements*

Kisumu City

The financial analysis follows the framework and methodology provided in the study guide. Estimates have been generated after validation to ensure a higher degree of accuracy. The initial estimates are in the local currency (Kenya Shillings) which are thereafter converted to USD at the exchange rate prevailing as at the time of the survey.

The analysis (Table 3-75) shows the income statements of operators operating in Kisumu. The operators recorded varied revenues; this is because revenue is a function of two factors; the tariffs charge as well as the number of trips made throughout the year which varies from operator to operator. In determining the businesses profitability two scenarios were considered one, when depreciation is factored in and two when depreciation is excluded in computing profitability. In the first case, when depreciation is accounted for the operators are unprofitable, that is, when depreciation is included in the estimates, the businesses are unprofitable. However on a cash basis these operators remain profitable, that is, if depreciation is excluded the businesses are profitable. In general the businesses represent strong cash flows, low debtors and thin margins. Under the present circumstances, the exiting business models may be on a short term basis self-sustaining but may not be in the medium and long term. Based on the impact of depreciation on profitability, the periodic surpluses are consumed by intermittent but high cost of repairs which lower the bottom line.

Table 3-75 : Mechanical Emptiers Condensed Income Statement - Kisumu

Condensed Income Statement		**KISUMU**
	ONE TRUCK	**TWO TRUCKS**
	USD	**USD**
Revenue	14,832.00	27,192.00
Total Revenue	**14,832.00**	**27,192.00**
Operating Expenses		
Fixed Expenses	3,465.22	12,171.70
Gross Profit	**11,366.78**	**15,020.30**
Variable Expenses	7,513.04	5,739.13
Operating Profit/loss Before Dep & Tax	**3,853.74**	**9,281.17**
Depreciation	9,782.61	19,565.22
P/loss After Depreciation	**(5,928.87)**	**(10,284.04)**

The cash flow statements depict the economic character of the business. Whereas accounting profit is possible if the depreciation charge (Table 3-76) is omitted, the economic profit of the business is negative for the two operators. If the depreciation charge was a proxy of loan repayment, then the businesses would be unable to support debt obligation, at the present tariffs and number of trips.

Table 3-76 : Depreciation Charge on Mechanical Emptiers' Income Statement-Kisumu

	USD	USD
Depreciation (20%)	9,783	19,565
Adjusted for depreciation(Profit Before Tax)	(5,929)	(10,284)
Tax	0	0
After tax	(5,929)	(10,284)

Negative cash flows (Table 3-77) because of the depreciation charge reveal the lack of profits of the businesses. An increase in the tariff (fees) and an increase in the number of trips offer an appreciable increase in revenues which would offer far much higher income relative to costs for the operator. An increase in number of trips would easily offset the corresponding increase in costs.

Table 3-77 : Cash Flow Statements Charge of Mechanical Emptiers'-Kisumu

Cash flow Statement	USD	USD
Investment Cash flow	(48,913)	(97,826)

Cash flow from operation		
Net Profit After Tax &Depreciation	(5,929)	(10,284)
Add Back :		
Depreciation	9,783	19,565
Net Cash flow from Operation	3,854	9,281
Net Cash flow	**(45,059)**	**(88,545)**

Mombasa City

The financial analysis follows the framework and methodology provided in the study guide. Estimates have been generated after validation to ensure a higher degree of accuracy. The initial estimates are in the local currency (Kenya Shillings) which are thereafter converted to USD at the exchange rate prevailing as at the time of the survey.

The analysis (Table 3-78) shows the income statements of operators operating in the city. Mombasa had multiple operators under the three categories, namely one, two and four trucks operators with trucks of varied capacities and operating from different locations. The operators recorded varied revenues; this is because revenue is a function of many factors; the tariffs charge, the capacity of trucks, the distance covered and the number of trips made throughout the year which varies from operator to operator and between operators in different categories. In determining the businesses profitability two scenarios were considered one, when depreciation is factored in and two when depreciation is excluded in computing profitability. In the first case, when depreciation is accounted for, all the operators are unprofitable, that is, when depreciation is included in the estimates, the businesses are unprofitable. On a cash basis only the two and four category operators were profitable that is, if depreciation is excluded the businesses are profitable. The two and four truck operator businesses represent strong cash flows, low debtors but thin margins. Under the present circumstances the one truck operator model is not sustainable, and the exiting two and four truck business models may be on a short term basis self-sustaining but may not be in the medium and long term. Based on the impact of depreciation on profitability, the periodic surpluses are consumed by intermittent but high cost of repairs which lower the bottom line.

Table 3-78 : Mechanical Emptiers Condensed Income Statement - Mombasa

Condensed Income Statement			**MOMBASA**
	ONE TRUCK	**TWO TRUCKS**	**FOUR TRUCKS**

	USD	USD	USD
Revenue	17,608.00	27,735.00	66,961.11
Total Revenue	**17,608.00**	**27,735.00**	**66,961.11**
Operating Expenses			
Fixed Expenses	8,978.35	10,497.96	31,945.87
Gross Profit	**8,629.65**	**17,237.04**	**35,015.24**
Variable Expenses	32,413.04	8,413.04	14,882.61
Operating Profit/loss Before Dep & Tax	**(23,783.39)**	**8,824.00**	**20132.63**
Depreciation	9,782.61	19,565.22	39,130.43
P/loss After Depreciation	**(33,566.00)**	**(10,741.22)**	**(18,997.80)**

The cash flow statements illustrate the economic character of the business. Whereas accounting profit is possible if the depreciation charge is omitted, the economic profit of the business is negative for the three categories of operators. If the depreciation charge was a proxy of loan repayment, then the businesses would be unable to support debt obligation, at the present tariffs and number of trips.

Negative cash flows because of the depreciation charge reflect the absence of profits of the business and indicate the profit margin nature of the business. An increase in the tariff (fees) and an increase in the number of trips offer an appreciable increase in revenues which would offer far much higher income relative to costs for the operator. An increase in number of trips would easily offset the corresponding increase in costs.

Nairobi City

The financial analysis follows the framework and methodology provided in the study guide. Estimates have been generated after validation to ensure a higher degree of accuracy. The initial estimates are in the local currency (Kenya Shillings) which are thereafter converted to USD at the exchange rate prevailing as at the time of the survey.

Nairobi had multiple operators under the three categories, namely one, two and four trucks operators with trucks of varied capacities and operating from different locations. In Nairobi under each category several operators were interviewed. The analysis therefore followed a two step procedure, the first procedure was an intra category analysis and the second procedure was an inter category analysis, within each category as well as between categories, the operators performed differently recording different levels of revenues. This is explained by differences in number of trips and operating locations. The analysis (Table 3-79**,** Table 3-80**,** Table 3-81) show the income statements of operators operating in the city within (intra) each

category. In line with the methodology in determining the businesses profitability two scenarios were considered one, when depreciation is factored in and two when depreciation is excluded in computing profitability.

In the first case-One truck operators intra category analysis, when depreciation is accounted for all the operators are profitable and they remain profitable on a cash basis -that is when depreciation is not included. These 1 truck operator businesses represent strong cash flows low debtors and larger margins. . Under these circumstances, these one truck operator existing business models may on a short term, medium and long term basis be self-sustaining..

Table 3-79 : Mechanical Emptiers Condensed Income Statement – Nairobi 1 truck operators

One Truck Operators Condensed Income Statement			NAIROBI
	Quince Co Ltd	**Plural Services**	**Wakabura Enterprise**
	$	**$**	**$**
Revenue	31,532	24,602	27,893
Total Revenue	**31,532**	**24,602**	**27,893**
Operating Expenses			
Fixed Expenses	9,851	10,511	5,731
Gross Profit	**21,681**	**14,091**	**22,163**
Variable Expenses	9,356	9,875	12,128
Operating Profit/loss Before Dep & Tax	**12,326**	**4,216**	**10,035**
Depreciation	10,000	1,167	3,400
P/loss After Depreciation	**2,326**	**3,049**	**6,635**
Tax	**698**	**915**	**1,991**
Profit after tax	**1,628**	**2,134**	**4,645**
Profit without Depreciation	**11,628**	**3,301**	**8,045**

The highest fixed cost recorded among the one truck operators was USD 10,511 this is so because the operator has managers who run the business. The margins of these operators are analysed further.

Table 3-80 : One Truck Operators Margin Analysis- Nairobi

	Quince	**Plural Services**	**Wakabura Enterprises**
	$	**$**	**$**
Gross Margin	69%	57%	79%
Net Profit/loss Margin	7%	12%	24%
Contribution Margin	22,176	14,726	15,766

Contribution margin Per Truck	22,176	14,726	15,766
Contribution margin per trip	64	43	46
Revenue per Trip	91	71	81
Revenue Per Truck	31,532	24,602	27,893
Trip Per Truck	347	347	347
Fixed Cost per trip	28	30	17
Fixed Cost Per Truck	9,851	10,511	5,731
Variable Cost Per trip	27	29	35
Variable cost per Truck	9,356	9,875	12,128
Number of Trucks	1	1	1
Number of Trips	347	347	347
Distance Covered in KM	9,356	9,356	9,356

The net profit is largely dependent on the tariffs and and how effective the business is run while keeping costs at the lowest possible levels. All operators in this case are profitable. In the case of two truck operators intra category analysis all operators are unprofitable when depreciation is charged and only become profitable when depreciation is excluded.

Table 3-81 : Mechanical Emptiers Condensed Income Statement – Nairobi 2 trucks operators

Two Truck OperatorsCondensed Income Statement NAIROBI						
	Karanja	**Gitua**	**Tash**	**Josmag**	**Pambaza**	**Mapal**
	$	**$**	**$**	**$**	**$**	**$**
Revenue	43,368	41,712	57,024	39,360	44,100	52,200
Total Revenue	**43,368**	**41,712**	**57,024**	**39,360**	**44,100**	**52,200**
Operating Expenses						
Fixed Expenses	12,874	12,874	17,482	13,274	12,274	13,234
Gross Profit	**30,494**	**28,838**	**39,542**	**26,086**	**31,826**	**38,966**
Variable Expenses	36,928	32,392	18,800	31,360	30,488	39,512
Operating Profit/loss Before Dep & Tax	**1,166**	**8,246**	**26,342**	**4,726**	**8,138**	**6,254**
Depreciation	7,600	11,800	5,600	10,000	6,800	6,800
P/loss After Depreciation	**(6,434)**	**(3,554)**	**20,742**	**(5,274)**	**1,338**	**(546)**
Tax	**-**	**-**	**6223**	**-**	**401**	**-**
Profit after tax	**(6,434)**	**(3,554)**	**14,519**	**(5,274)**	**937**	**(546)**
Profit without Depreciation	**1,166**	**8,246**	**20,119**	**4,726**	**7,737**	**6,254**

As all the businesses are profitable with the exclusion of depreciation from determining the profit level then it implies that they are profitable only on a cash basis and therefore these businesses represent strong cash flows, low debtors and thin margins. Under these circumstances the existing business may be self sustaining on a short term basis but may not be in the medium and long term. This further indicates that any periodic surpluses are consumed by intermittent but high costs of repairs which lower the bottom line. Tash enterprises (Table 3-82) is the best performing business in this category in terms of both revenue and profitability.

Table 3-82 : Two Trucks Operators Margin Analysis- Nairobi

One Truck Operators	Karanja	Gitua	Tash	Josmag	Pambaza	Mapal
	$	$				
Gross Margin	70%	69%	69%	66%	72%	75%
Net Profit/loss Margin	-15%	-9%	36%	-13%	3%	-1%
Contribution Margin	6,440	9,320	38,224	8,000	13,612	12,688
Contribution margin Per Truck	3,220	4,660	19,112	4,000	6,806	6,344
Contribution margin per trip	1,032	1,494	7,239	1,667	2,701	1,823
Revenue per Trip	70	67	108	82	88	75
Revenue Per Truck	21,684	20,856	28,512	19,680	22,050	26,100
Trip Per Truck	312	312	264	240	252	348
Fixed Cost per trip	21	21	33	28	24	19
Fixed Cost Per Truck	6,437	20,856	28,512	19,680	22,050	26,100
Variable Cost Per trip	59	52	36	65	60	57
Variable cost per Truck	18,464	16,196	9,400	15,680	15,244	19,756
Number of Trucks	2	2	2	2	2	2
Number of Trips	624	624	528	480	504	696
Distance Covered in KM	8,451	16,902	14,256	12,960	13,608	8,451

Tash enterprises is the only one in the two truck category in Nairobi that has a positive profit margin. This indicates that profitability is strongly influenced by tariffs.

In the case of four truck operators intra category analysis (Table 3-83), the results were mixed. One operator was profitable in both instances pre and post depreciation charge. The other

operator remained unprofitable on both accounts with and without depreciation charge. The difference in performance was explained by the variation in number of trips.

Table 3-83 : Mechanical Emptiers Condensed Income Statement – Nairobi 4 trucks operators

Condensed Income Statement		**NAIROBI**
	Jipe Moyo	**Rural Urban**
	$	**$**
Revenue	128,928	81,312
Total Revenue	**128,928**	**81,312**
Operating Expenses		
Fixed Expenses	23,086	20,246
Gross Profit	**105,842**	**61,066**
Variable Expenses	57,120	62,304
Operating Profit/loss Before Dep & Tax	**48,722**	**(2,258)**
Depreciation	30,000	24,940
P/loss After Depreciation	**18,722**	**(27,198)**
Tax	5,617	-
Profit after tax	**13,105**	**(27,198)**
Profit without Depreciation	**43,105**	**(2,258)**

In the case of the profitable four trusck operator if the depreciation charge was a proxy for loan repayment, the businesses would be able to support debt servicing, at the present tariffs and number of trips. For the loss making operator adjustments would be needed to the number of trips in order to improve financial performance.

When the margins of these businesses are analysed (Table 3-84), it indicates that profitability is influenced by both tariffs and number of trips.

Table 3-84 : Four Truck Operators Margin Analysis-Nairobi

One Truck Operators	Jipe Moyo	Rural Urban
	$	$
Gross Margin	82%	75%
Net Profit/loss Margin	15%	-33%
Contribution Margin	71,808	19,008
Contribution margin Per Truck	17,952	4,752
Contribution margin per trip	44	18
Revenue per Trip	79	77
Revenue Per Truck	32,232	20,328
Trip Per Truck	408	264
Fixed Cost per trip	14	19
Fixed Cost Per Truck	5,772	5,062
Variable Cost Per trip	35	59
Variable cost per Truck	14,280	15,576
Number of Trucks	4	4
Number of Trips	1,632	1,056
Distance Covered in KM	14,029	28,512

Jipe Moyo which has a positive profit margin also has a higher number of trips and enjoys a higher tariff, but in addition does more trips.

Kisumu City

Mechanical Operators BEP Analysis –Kisumu

This analysis sought to establish the levels at which the surveyed businesses made neither profits nor losses (Break-even), and became profitable thereafter. It is assumed that breakeven is a function of either tariffs or number of trips. The break even analysis is therefore done at two levels, the tariff break even analysis and the number of trips break even analysis.

Break Even Analysis

Sales Revenue – Variable Cost = Contribution Margin

Therefore: - Contribution Margin – Fixed Cost =Operating Income or loss

The comparison analyses the performance of two categories of operators in Kisumu, namely one and two truck owners. The comparison of revenues shows that the two truck operator still has lower revenue per truck but higher contribution margins. The increase in the contribution margin shows operational economies of scale setting in. However profitability is diminished mainly by the increase in fixed cost per truck. Illustration on (Table 3-85) , this therefore means that profitability is not guaranteed by just the increase in number of trucks or trips but is also influenced by other factors such as number of truck breakdowns, the pattern of demand and variability of truck capacities. In addition the three operators in Kisumu have different models in the nature of employment of their personnel. As the industry is unregulated, it is unclear what the optimal number of trucks would be.

Table 3-85 : Mechanical Operators Margin Analysis – Kisumu

	1 Truck	2 Trucks
	USD	USD
Gross Margin	77%	55%
Net Profit/loss Margin	26%	34%
Contribution Margin	7,318.96	21,452.87
Contribution margin Per Truck	7,318.96	10,726.43
Contribution margin per trip	25.41	40.63
Revenue/Tariff per Trip	51.50	51.50
Revenue Per Truck	14,832.00	13,596.00
Trip Per Truck	288	264
Fixed Cost per trip	12.03	23.05

Fixed Cost Per Truck	3,465.22	6,085.85
Variable Cost Per trip	26.09	10.87
Variable cost per Truck	7,513.04	2,869.57

Operational Analysis

Based on their income statements the two operators are unprofitable when depreciation was charged but remained profitable on a cash basis. Thus based on standard profitability analysis for the two operators to break even they would need to increase either their tariffs or the number of trips.

Table 3-86 : Comparison of Mechanical Operators Kisumu for BEP Analysis

	KISUMU	
Macroeconomic & business size data	**ONE TRUCK OPERATOR**	**TWO TRUCKS OPERATOR**
Inflation (CPI)	16%	16%
Any other inflation index	0%	0%
Number of trucks	1	2
Number of drivers	1	2
Number of turn boys per truck	2	2
Hour worked in a year(hrs)	547	1003
Distance covered per year (Km)	2,304	4,224
Number of trips per annum	288	528
Average hours per trip	1.9	1.9
Fuel consumption Emptying& Transportation km /Km	4.5	4.5
Fuel Cost per litre(USD)	1.15	1.15
Tariffs	$ 52	$ 52

Arising from the uprofitability of the operators break even, options available are price and number of trips or unit sales. Hence for operator #1 to break even there are three options; either increase the number of trips per year to 340 or increase the tariff charge to $ 72 per trip for the same number of trips currently per year (Table 3-87). Third the operator may consider adopting a different business model from a permanent employment basis to a casual basis to reduce the fixed operating cost to an optimum level. For operator #2 with two trucks there are

two options available. Option one is increasing the tariff to $ 70 per trip or increase the number of trips to 717 per year at the same tariff rate.

Table 3-87 : Per unit BEP analysis-Kisumu

	Operator 1	Operator 2
Revenue	$ 14,832	$27,192
Fixed Expenses	$ 13,247	$ 31,565
Variable Expenses	$ 7,513	$ 5,739
Contribution Margin	$ 7,319	$ 21,453
BEP Revenue	$ 20,760	$ 37,304
Number of Trips	288	528
BEP tariffs	$ 72	$ 70
BEP # trips per year	340	717

This being a price sensitive business, increasing the tariff charge may result in loss of clients. Therefore the two operators are perhaps best served by increasing the number of trips if possible as there is still substantial unmet demand for the services.

Mombasa City

Mechanical Operators BEP Analysis –Mombasa

This analysis sought to establish the levels at which the surveyed businesses made neither profits nor losses (Break-even), and became profitable thereafter. It is assumed that breakeven if a function of either tariffs or number of trips. The break even analysis is therefore done at two levels, the tariff break even analysis and the number of trips break even analysis.

Break Even Analysis

Sales Revenue – Variable Cost = Contribution Margin

Therefore: - Contribution Margin – Fixed Cost =Operating Income or loss

The comparison analyses the performance of three categories of operators in Mombasa, namely one, two and four truck owners. The comparison of revenues shows that the two and four truck operators performed better than the single truck operators. The increases in the contribution margin shows operational economies of scale setting in with increase in trucks and in particular as both variable and fixed costs are marginally lower for the two and four truck

operators in comparison to the one truck operator. Analysis on revenue per truck (Table 3-88) indicates that profitability is not guaranteed by just the increase in number of trucks or trips but is also influenced by other factors.

The results on profitability are mixed. The one truck category operators indicated losses before and after depreciation.

Table 3-88 : Mechanical Operators Margin Analysis – Mombasa

	1 Truck	2 Trucks	4 Trucks
	$	$	$
Gross Margin	49%	62%	52%
Net Profit/loss Margin	(135%)	32%	30%
Contribution Margin	(14,805.04)	19,321.96	52,078.50
Contribution margin Per Truck	(14,805.04)	9,660.98	13,019.63
Contribution margin per trip	(104.26)	74.89	159.75
Revenue/Tariff per Trip	124.00	107.50	205.40
Revenue Per Truck	17,608.00	13,867.50	16,740.28
Trip Per Truck	142	129	81.5
Fixed Cost per trip	63.23	40.69	97.99
Fixed Cost Per Truck	8,978.35	5,248.98	7,986.47
Variable Cost Per trip	228.26	32.61	45.65
Variable cost per Truck	32,413.04	4,206.52	3,720.65

The two and four truck category operators indicated losses when depreciation was not charged but showed that they were profitable on a cash basis, that is, before depreciation was charged. Thus based on standard profitability analysis for the two operators to break even they would need to increase either their tariffs or the number of trips.

Operational Analysis

The emptier with two trucks has a greater efficiency in his operations and is able to retain more revenues as shown by a gross margin of 62 per cent compared to 49 per cent of emptier with one truck and emptier with four trucks (Table 3-88). The emptier with one truck is able to generate more revenue with a single truck as shown by revenue per truck compared with the other emptiers with two and four trucks. This shows that the emptiers with two and four trucks are unable to utilize the advantage of having more trucks to generate more revenue. Though there are two operators with two trucks, one is more productive than the other and has more

customers. However, the operators of two trucks in Mombasa also use a non-conventional technology of transporting FS,-that is the open drum technique. These truckers charge a lower fee but amounts to a higher fee per cubic metre as the truck capacities are small.

When unprofitable, in order to break even the operators have two possible courses of action, that is, they can either increase the tariff charge or increase the number of trips made annually. But, whichever way deemed prudent there are also limitations occasioned by the prevailing market tariff and the state of the truck and roads infrastructure. Increasing the tariffs will only be practical if they do not exceed the market rates due to tariff sensitivity of this business. And, on the other hand trips can be increased if the trucks are either in good condition or new so as to reduce the number of breakdowns, and two if the road infrastructure is pliable

Tariff and trips Break Even Analysis

The operators break even options available are price and number of trips or unit sales. To break even, operator #1 has two options; he can either increase the number of trips per year to 398 from 142 or increase the tariff charge to $ 347 per trip for the same number of trips per year (Table 3-89).

For the second operator with two trucks there are three options available. That is increasing the tariff to $ 162 per trip or increase the number of trips to 388 from 258 per year at the same tariff rate.

For operator #3 with four trucks there are three options are available. That is increasing the tariff to $ 284 per trip or increase the number of trips to 452 from 326 per year at the same tariff rate.

However, theoretically increasing prices is possible but in practice constraints are bound to arise. This is a price sensitive business and the action of increasing the tariff charge will most likely result in loss of clients to the any other lower cost operator who can charge less.

Table 3-89 : Per unit BEP analysis- Mombasa

	One Truck Operator 1	Two Truck Operator 2	Four Truck Operator 4
Revenue	$ 17,608	$ 27,735	$ 66,961
Fixed Expenses	$ 18,761	$ 30,063	$ 71,076

Variable Expenses	$ 32,413	$ 8,413	$ 14,883
Contribution Margin	$ (14,805)	$ 19,322	$ 52,079
BEP Revenue	$ 49,339	$ 41,874	$ 92,591
Number of Trips	142	258	326
BEP tariffs	$ 347	$ 162	$ 284
BEP # trips per year	398	388	452

Nairobi City

As there were several operators under each category of truck ownership in Nairobi who were interviewed, this analysis sought to establish the levels at which each operator within the three categories of operators in Nairobi, namely one, two and four truck owners surveyed made neither profits nor losses (Break-even), and became profitable thereafter. It is assumed that breakeven, is a function of either tariffs or number of trips. The break even analysis is therefore done at two levels, the tariff break even analysis and the number of trips break even analysis.

Break Even Analysis

The comparison analyses the performance of each operator within the three categories of operators in Nairobi, namely one-truck (Table 3-90), two-truck (Table 3-91) and four-truck (Table 3-92) owners. The comparison of revenues shows that the two and four truck operators performed better than the single truck operators. The increases in the contribution margin shows operational economies of scale setting in with increase in trucks and in particular as both variable and fixed costs are marginally lower for the two and four truck operators in comparison to the one truck operator. Illustration on (Table 3-85), on revenue per truck indicates that profitability is not guaranteed by just the increase in number of trucks or trips but is also influenced by other factors.

Sales Revenue – Variable Cost = Contribution Margin

Therefore: - Contribution Margin – Fixed Cost =Operating Income or loss

This analysis sought to establish the levels at which the surveyed businesses made neither profits nor losses (Break-even), and became profitable thereof. The break even analysis is

therefore done at two levels, the tariff break even analysis and the number trips break even analysis.

The tariff Break Even Analysis of the one truck operators in Nairobi (Table 3-90) indicates that all the operators are making profits and thus the objective to break even ceases to be the underlying objective but rather to maximize profits and to keep the tariffs at higher than BEP tariffs. Thus from a tariff point of view, this would be profit maximization attainable by way of increasing the tariffs above the current rates. Owing to the price sensitivity of this business, the alternative is only limited to the extent to which tariffs can be adjusted upwards without losing the current client base to competition. Thus the alternative to remaining very profitable is to increase the number of trips made per annum.

Table 3-90 : One Truck Operator BEP Analysis-Nairobi

One Truck operators			
	Quince	Plural Services	Wakabura Enterprises
Revenue	31,532	24,602	27,893
Fixed Expenses	9,851	10,511	5,731
Variable Expenses	9,356	9,875	12,128
Contribution Margin	22,176	14,726	15,766
BEP Revenue	19,206	20,386	17,858
Current # of Trips	347	347	347
BEP tariffs	55	59	51
BEP # trips per year	211	287	222

The number of trips Break Even Analysis for one truck operators is also informed by the tariff break even analysis. At present all the one truck operators in Nairobi are profitable, however profit maximization is the objective, this can be achieved through increase in number of trips to the highest possible level. Alternatively, the costs of operations may be reduced significantly to lowest possible levels. Cost efficiency can be attained by way of business restructuring to new models in terms of costs. At present costs the number of trips should be sustained at levels above 211, 287 and 222 respectively failure to which the businesses will become unprofitable.

- **Two truck Operators BEP Analysis**

Referring to the income statements (Table 3-81) with the exception of Pambaza services, all the other operators are making losses. The operators are profitable on a cash basis but are unprofitable when depreciation is charged.

Pambaza services is profitable on a cash basis and even when depreciation is charged. This therefore implies that the key objective of the other operators within the two truck category would be to break even and thereafter become profitable.

In order to break even the operators in this category will have to either increase their tariffs, or increase the number of trips or restructure their businesses into cost effective business models. The tariff break even analysis of two truck operators (Table 3-91) indicates that the operators should increase the tariff up from the current tariffs to USD 80, 73, 93 and 73 respectively.

Table 3-91 : Two truck Operators BEP Analysis-Nairobi

Two Truck operators				
	Karanja	Gitua	Josmag	Mapal
Revenue	43,368	41,712	39,360	52,200
Fixed Expenses	12,874	12,874	13,274	13,234
Variable Expenses	36,928	32,392	31,360	39,512
Contribution Margin	6,440	45,266	44,634	52,746
BEP Revenue	49,802	45,266	44,634	52,746
Current # of Trips	624	624	480	696
BEP tariffs	80	73	93	76
BEP # trips per year	717	677	544	703

However tariff increases cannot ignore price sensitivity of the demand for the services and the actions of other industry players. In determining what tariff to charge, the proprietors should be cautious so as not to lose customers. Their tariffs shouldn't exceed those their profitable competitors are charging since that is more likely to result to loss of customers. Unless the tariffs increase can be justified by giving premium services above those of competitors, then the other alternatives will be to increase the number of trips made per year and work on reducing costs.

The number of trips break even analysis for two truck operators indicates that the operators' practical course of action is increasing the number of trips per operator. The breakeven trips without seeking to adjust costs downwards are 717, 677, 544 and 703 respectively (Table 3-91). However, this may be limited by the state of the trucks; old trucks may not be able to meet the break even number of trips in a year.

- **Four truck Operators BEP analysis**

Referring to the income statements (Table 3-83), there are two four truck operators Jipe Moya and Rural Urban. Jipe Moyo is profitable on a cash basis and even after charging depreciation. Rural Urban on the other hand is unprofitable on both accounts and has two break even options which are either to increase the number of trips or increase the tariff.

The tariff break even analysis for this four truck operator is an increase in the tariff charge to USD 78 per trip while the number of trips break even analysis is to to increase the number of trips per year to 1,072 from 1,056 for all the four trucks.

From the BEP analysis (Table 3-92) of this operator it is evident that economies of scale do not necessarily set in as the number of trucks increases. This could be for a number of factors such as number of truck breakdowns, which is largely affected by the age of the truck and the road infrastructure, the pattern of demand and variability of truck capacities and sometimes the business model such as the nature of employment as either on casual or permanent term.

Table 3-92 : Four truck Operators BEP analysis-Nairobi

Four Truck operator	**Rural Urban**
Revenue	81,312
Fixed Expenses	20,246
Variable Expenses	62,304
Contribution Margin	19,008
BEP Revenue	82,550
Current # of Trips	1,056
BEP tariffs	78
BEP # trips per year	1,072

3.4.1.2.2 *IRR, NPV, Cash Flow and ROE*

Kisumu City : IRR, NPV, Cash Flow and ROE

Cash Flow Statement of Mechanical Emptiers – Kisumu

A. One truck operator's cash flow projection for 5 years: IRR, NPV, Cash Flow and ROE

Using the information on income statements (Table 3-75), the revenue projections (Table 3-93) for the one truck operator were generated for a period of 5 years. The results indicate that the end value of cash flows is smaller than the initial investment and is also negative.

Table 3-93 : One truck operator's Cash flow projection to 2016 - Kisumu

Income Statement	**Year 1 Actual**	**Year 2 Projected**	**Year 3 Projected**	**Year 4 Projected**	**Year 5 Projected**
	$	**$**	**$**	**$**	**$**
Revenue	14,832	17,135	19,797	22,871	26,423
Less: operating expenses	10,978	12,683	16,210	23,208	37,998
EBITDA	**3,854**	**4,452**	**3,586**	**(337)**	**(11,575)**
Less depreciation	(9,783)	(9,783)	(9,783)	(9,783)	(9,783)
EBIT	**(5,929)**	**(5,330)**	**(6,196)**	**(10,119)**	**(21,358)**
Total tax payable	(1,779)	(1,599)	(1,859)	(3,036)	(6,407)
EAITDA	**(4,150)**	**(3,731)**	**(4,337)**	**(7,083)**	**(14,950)**
Balance Sheet - year end					
Assets					
Vehicle	39,130	29,348	19,565	9,783	-
Closing cash	5,632	6,051	5,445	2,699	(5,168)
	44,763	35,399	25,010	12,482	(5,168)
Liabilities					
Owner's equity					
Opening equity	48,913	48,913	48,913	48,913	48,913
Add: annual net EAITDA	(4,150)	(3,731)	(4,337)	(7,083)	(14,950)
Net owner's equity	44,763	45,182	44,576	41,830	33,963
	44,763	45,182	44,576	41,830	33,963
Return on Equity (ROE)	**-9%**	**-8%**	**-10%**	**-17%**	**-44%**
Average annual 5 year ROE	-18%				

Based on the one truck operator's cash flow projection for 5 years (Table 3-93) the corresponding NPV estimate (Table 3-94) indicates that the rate of return falls below the discount rate of 15% p.a. This result is consistent with the negativity of the ROE over the years.

Table 3-94 : One truck operator's NPV,IRR - Kisumu

5 year analysis	
NPV @15% discount rate	**344**
Avg 5 yr monthly cash to operator	**2,826**

B. Two-truck operator's cash flow projection to 2016: IRR, NPV, Cash Flow and ROE

Using the information on income statements (Table 3-75), the revenue projections (Table 3-95) for the two truck operator were generated for a period of 5 years. The results indicate that the cash flows have improved over the one truck operator as the number of trucks has increased and this implies some form of economies of scale is attainable. Cash flows begin to improve as the number of trucks increases this implies that if well managed efficiency and subsequent economies of scale is attainable. In the projections cash flows improve each year for the next 5 years. However the end value of cash flows is smaller than the initial investment. That is end term cash is less than initial investment.

Table 3-95 : Two truck operator's Cash flow projection 5 years - Kisumu

Income Statement	**Year 1 Actual**	**Year 2 Projected**	**Year 3 Projected**	**Year 4 Projected**	**Year 5 Projected**
	$	**$**	**$**	**$**	**$**
Revenue	27,192	31,415	36,294	41,930	48,442
Less: **operating expenses**	17,911	26,432	29,645	33,358	37,647
EBITDA	**9,281**	**4,983**	**6,649**	**8,572**	**10,795**
Less: **depreciation**	(19,565)	(19,565)	(19,565)	(19,565)	(19,565)
EBIT	**(10,284)**	**(14,582)**	**(12,917)**	**(10,993)**	**(8,770)**
Total tax payable	-	-	-	-	-
EAITDA	**(10,284)**	**(14,582)**	**(12,917)**	**(10,993)**	**(8,770)**
Balance Sheet - year end					
Assets					
Vehicle	78,261	58,696	39,130	19,565	-
Closing cash	9,281	4,983	6,649	8,572	10,795
	87,542	63,679	45,779	28,138	10,795
Liabilities					
Owner's equity					

Income Statement	Year 1 Actual	Year 2 Projected	Year 3 Projected	Year 4 Projected	Year 5 Projected
Opening equity	97,826	97,826	97,826	97,826	97,826
Add annual net EAITDA	(10,284)	(14,582)	(12,917)	(10,993)	(8,770)
Net owner's equity	87,542	83,244	84,909	86,833	89,056
	87,542	83,244	84,909	86,833	89,056
Return on Equity (ROE)	**-12%**	**-18%**	**-15%**	**-13%**	**-10%**
Average annual 5 year ROE	*-13%*				

Based on the two truck operator's cash flow projection to 2016 (Table 3-95) the corresponding NPV estimate indicates (Table 3-96) that the rate of return falls below the discount rate of 15% p.a. This result is consistent with the lower end value of cashflows and the negativity of the ROE over the years.

Table 3-96 : Two Truck operator's NPV,IRR – Kisumu

5 year analysis	
NPV @15% discount rate	**601**
Avg 5 yr monthly cash to operator	**8,056**

Present value

$$PV = \frac{\pi_1}{(1+r)^1} + \frac{\pi_2}{(1+r)^2} + \cdots + \frac{\pi_n}{(1+r)^n} = \sum_{t=1}^{n} \frac{\pi_t}{(1+r)^t}$$

Value of Firm

$$Value\,of\ Firm = \sum_{t=1}^{n} \frac{\pi_t}{(1+r)^t} = \sum_{t=1}^{n} \frac{TR_t - TC_t}{(1+r)^t}$$

Where;

PV – Present Value
TR- Total Revenue
TC- Total Cost
π – Periodic cash flows
r- Rate of return
t- Time

Mombasa City : IRR, NPV, Cash Flow and ROE

A. One truck operator's cash flow projection for 5 years : IRR, NPV, Cash Flow and ROE

Using the information on income statements (Table 3-78), the revenue projections (Table 3-97) for the one truck operator were generated for a period of 5 years. This operator was unprofitable based on the income statements on both accounts of before and after charging depreciation. Therefore despite the exclusion of depreciation this operator reports adverse cash flow meaning that the operations are not only non-profitable but meeting cash obligations as they fall due is a challenge. The results indicate that the end value of cash flows is smaller than the initial investment and is also negative.

The operating expenses rise at a higher rate than the revenues. The emptier will be required to increase tariffs, cut costs or increase the number of trips as a way of increasing revenue in order to break even. The growth in trips needs to be much higher than the growth in costs for the operator to sustain profitability.

Table 3-97 : One Truck Operator Cash Flow Projection for 5 years - Mombasa

Income Statement	**Year 1 Actual**	**Year 2 Projected**	**Year 3 Projected**	**Year 4 Projected**	**Year 5 Projected**
	$	**$**	**$**	**$**	**$**
Revenue	17,608	20,343	23,502	27,152	31,368
Less: operating expenses	39,557	45,580	52,538	60,578	69,866
EBITDA	**(21,949)**	**(25,237)**	**(29,037)**	**(33,426)**	**(38,498)**
Less depreciation	(9,783)	(9,783)	(9,783)	(9,783)	(9,783)
EBIT	**(31,731)**	**(35,020)**	**(38,819)**	**(43,209)**	**(48,280)**
Total tax payable	(9,519)	(10,506)	(11,646)	(12,963)	(14,484)
EAITDA	**(22,212)**	**(24,514)**	**(27,174)**	**(30,2460**	**(33,796)**
Balance Sheet - year end					
Assets					
Vehicle	39,130	29,348	19,565	9,783	-
Closing cash	(12,429)	(14,731)	(17,391)	(20,464)	(24,014)
Liabilities					
Owner's equity					
Opening equity	48,913	48,913	48,913	48,913	48,913
Add: annual net EAITDA	(22,212)	(24,514)	(27,174)	(30,2460	(33,796)
Net owner's equity	26,701	24,399	21,739	18,667	15,117

Income Statement	**Year 1 Actual**	**Year 2 Projected**	**Year 3 Projected**	**Year 4 Projected**	**Year 5 Projected**
	26,701	24,399	21,739	18,667	15,117
Return on Equity (ROE)					
Average annual 5 year ROE	*-83%*	-100%	-125%	-162%	-224%

Based on the one truck operator's cash flow projection for 5 years (Table 3-97) the corresponding NPV estimate (Table 3-98) indicates that the rate of return falls below the discount rate of 15% p.a. This result is consistent with the negative end value of cashflows and the negativity of the ROE over the years.

Table 3-98 : One Truck Operator's NPV,IRR – Mombasa

5 year analysis	
NPV @15% discount rate	**(838.95)**
Avg 5 yr monthly cash to operator	**(17,805.73)**

Present value

$$PV = \frac{\pi_1}{(1+r)^1} + \frac{\pi_2}{(1+r)^2} + \cdots + \frac{\pi_n}{(1+r)^n} = \sum_{t=1}^{n} \frac{\pi_t}{(1+r)^t}$$

Value of Firm

$$Value\,of\ Firm = \sum_{t=1}^{n} \frac{\pi_t}{(1+r)^t} = \sum_{t=1}^{n} \frac{TR_t - TC_t}{(1+r)^t}$$

Where;
PV – Present Value
TR- Total Revenue
TC- Total Cost
π – Periodic cash flows
r- Rate of return
t- Time

B. Two-Truck Operator's Cash flow projection for 5 years : IRR, NPV, Cash Flow and ROE- Mombasa

Using the information on income statements (Table 3-78), the revenue projections (Table 3-99) for the two truck operator were generated for a period of 5 years. This operator was profitable on a cashbasis but not profitable after charging depreciation. As expected the cash flows begin to improve as the number of trucks increases. Cash flows each year are projected to improve

for the next 5 years, however operating expenses are also rising rapidly. The results indicate that the end value of cash flows is smaller than the initial investment.

Table 3-99 : Two-Truck Operator Cash flow Analysis to 2016 – Mombasa

Income Statement	**Year 1 Actual**	**Year 2 Projected**	**Year 3 Projected**	**Year 4 Projected**	**Year 5 Projected**
	$	**$**	**$**	**$**	**$**
Revenue	27,735	32,042	37,018	42,767	49,409
Less: **operating expenses**	23,309	25,338	28,837	32,880	37,551
EBITDA	**5,426**	**6,705**	**8,181**	**9,887**	**11,858**
Less: **depreciation**	(19,565)	(19,565)	(19,565)	(19,565)	(19,565)
EBIT	**(14,139)**	**(12,861)**	**(11,384)**	**(9,678)**	**(7,707)**
Total tax payable	(42,42)	(3,858)	(3,415)	(2,903)	(2312)
EAITDA	**(9,897)**	**(9,002)**	**(7,969**	**(6,775)**	**(5,395)**
Balance Sheet - year end					
Assets					
Vehicle	78,260	58,696	39,130	19,565	-
Closing cash	9,668	10,563	11,594	12,791	14,170
	87,929	69,258	50,727	32,356	14,170
Liabilities					
Owner's equity					
Opening equity	97,826	97,826	97,826	97,826	97,826
Add annual net EAITDA	(9,897)	(9,002)	(7,969)	(6,775)	(5,395)
Net owner's equity	87,929	88,824	89,857	91,052	92,431
	87,929	88,824	89,857	91,052	92,431
Return on Equity (ROE)	**-11%**	**-10%**	**-9%**	**-7%**	**-6%**
Average annual 5 year ROE	*-9%*				

Based on the two truck operator's cash flow projection for 5 years (Table 3-99) and the lower end value of cash flows than the initial investment the corresponding NPV estimate (Table 3-100) indicates that the rate of return falls below the discount rate of 15% p.a. This result is consistent with the negativity of the ROE over the years.

Table 3-100 : Two Truck operator's NPV,IRR – Mombasa

5 year analysis	
NPV @15% discount rate	**648.55**
Avg 5 yr monthly cash to operator	**11,757.65**

The operating expenses rise at a higher rate than the revenues. The emptier options include increasing tariffs, cutting costs or increasing the number of trips as a way of increasing revenue and cash flows. The growth in trips needs to be much higher than the growth in costs.

Present value

$$PV = \frac{\pi_1}{(1+r)^1} + \frac{\pi_2}{(1+r)^2} + \cdots + \frac{\pi_n}{(1+r)^n} = \sum_{t=1}^{n} \frac{\pi_t}{(1+r)^t}$$

Value of Firm

$$Value\,of\ Firm = \sum_{t=1}^{n} \frac{\pi_t}{(1+r)^t} = \sum_{t=1}^{n} \frac{TR_t - TC_t}{(1+r)^t}$$

Where;
PV – Present Value
TR- Total Revenue
TC- Total Cost
π – Periodic cash flows
r- Rate of return
t- Time

C. Four-truck operator's cash flow projection for 5 years : IRR, NPV, Cash Flow and ROE - Mombasa

Using the information on income statements (Table 3-78), the revenue projections (Table 3-101) for the four truck operator were generated for a period of 5 years. This operator was profitable on a cashbasis but not profitable after charging depreciation. As expected the cash flows begin to improve as the number of trucks increases. Cash flows each year are projected to improve for the next 5 years, however operating expenses are also rising rapidly. The results indicate that the end value of cash flows is smaller than the initial investment.

Table 3-101 : Four Truck Operator Cash FlowProjections for 5 years – Mombasa

Income Statement	**Year 1 Actual**	**Year 2 Projected**	**Year 3 Projected**	**Year 4 Projected**	**Year 5 Projected**
	$	**$**	**$**	**$**	**$**
Revenue	66,961	77,360	89,374	103,254	119,289
Less: **operating expenses**	53,461	60,663	68,983	78,596	89,701
EBITDA	**13,500**	**16,697**	**20,391**	**24,658**	**29,589**
Less: **depreciation**	(39,130)	(39,130)	(39,130)	(39,130)	(39,130)
EBIT	**(25,630)**	**(22,433)**	**(18,739)**	**(14,472)**	**(9,542)**
Total tax payable	(7,689)	(6,730)	(5,622)	(4,342)	(2,863)
EAITDA	**(17,941)**	**(15,703)**	**(13,118)**	**(10,130)**	**(6,679)**
Balance Sheet - year end					
Assets					
Vehicle	156,522	117,391	78,261	39,130	-
Closing cash	21,189	23,427	26,013	29,000	32,451
	177,711	140,819	104,274	68,131	32,451
Liabilities					
Owner's equity					
Opening equity	195,652	195,652	195,652	195,652	195,652
Add annual net EAITDA	(17,941)	(15,703)	(13,118)	(10,130)	(6,679)
Net owner's equity	177,711	179,949	182,535	185,522	188,973
	177,711	179,949	182,535	185,522	188,973
Return on Equity (ROE)	**-10%**	**-9%**	**-7%**	**-5%**	**-4%**
Average annual 5 year ROE	**-7%**				

Based on the four truck operator's cash flow projection for 5 years (Table 3-101) the corresponding NPV estimate (Table 3-102) indicates that the rate of return falls below the discount rate of 15% p.a. This result is consistent with the negativity of the ROE over the years

Table 3-102 : Four Truck operator's NPV,IRR – Mombasa

5 year analysis	
NPV @15% discount rate	**1,423**
Avg 5 yr monthly cash to operator	**26,416**

The operating expenses rise at a higher rate than the revenues. The emptier options include increasing tariffs, cutting costs or increasing the number of trips as a way of increasing revenue and cash flows.in order to break even. The growth in trips needs to be much higher than the growth in costs.

Present value

$$PV = \frac{\pi_1}{(1+r)^1} + \frac{\pi_2}{(1+r)^2} + \cdots + \frac{\pi_n}{(1+r)^n} = \sum_{t=1}^{n} \frac{\pi_t}{(1+r)^t}$$

Value of Firm

$$Value\,of\ Firm = \sum_{t=1}^{n} \frac{\pi_t}{(1+r)^t} = \sum_{t=1}^{n} \frac{TR_t - TC_t}{(1+r)^t}$$

Where;
PV – Present Value
TR- Total Revenue
TC- Total Cost
π – Periodic cash flows
r- Rate of return
t- Time

Nairobi City : IRR, NPV, Cash Flow and ROE

In analyzing the cash flow statements the purchase of trucks was assumed to have been undertaken within the year of study. Ordinarily, the cash flows for the years would otherwise be positive or much higher than the figures represented below. In that respect revenue and revenue items are projected over the next five years to ascertain the possible cash and cash equivalent positions for the business. The analysis and projections are for the top performing businesses in each truck category that is one truck, two trucks and four trucks. This approach was based on the within category analsys undertaken earlier.

A. One truck operator's cash flow projection for 5 years : IRR, NPV, Cash Flow and ROE- Nairobi

Using the information on income statements (Table 3-79), the revenue projections (Table 3-103) for the one truck operator were generated for a period of 5 years. This operator was as well as others in this category were profitable on a cashbasis and also profitable after charging depreciation. The cash flows improve in the first 2 years and then begin to decline; this is because operating expenses are rising rapidly faster than the revenues. The results indicate that the end value of cash flows is smaller than the initial investment and is also negative.

Table 3-103 : One Truck Operator Cash Flow Projections for 5 years –Nairobi

Income Statement	**Year 1 Actual**	**Year 2 Projected**	**Year 3 Projected**	**Year 4 Projected**	**Year 5 Projected**
	$	**$**	**$**	**$**	**$**
Revenue	27,893	32,724	38,392	45,042	52,843
Less: operating expenses	21,258	24,351	30,706	43,589	72,055
EBITDA	**6,635**	**8,373**	**7,687**	**1,453**	**(19,212)**
Less depreciation	(3,400)	(3,400)	(3,400)	(3,400)	(3,400)
EBIT	**3,235**	**4,973**	**4,287**	**(1,947)**	**(22,612)**
Total tax payable	1,991	2,512	2,306	436	(5,764)
EAITDA	**1,245**	**2,461**	**1,981**	**(2,383)**	**(16,848)**
Balance Sheet - year end					
Assets					
Vehicle	13,600	10,200	6,800	3,400	-
Closing cash	8,045	9,261	8,781	4,417	(10,048)
Liabilities					

Owner's equity					
Opening equity	17,000	17,000	17,000	17,000	17,000
Add: annual net EAITDA	4,645	10,506	15,887	16,904	3,456
Net owner's equity	21,645	27,506	32,887	33,904	20,456
	21,645	27,506	32,887	33,904	20,456
Return on Equity (ROE)	**21%**	**38%**	**48%**	**50%**	**17%**
Average annual 5 year ROE	*35%*				

Based on the one truck operator's cash flow projection for 5 years (Table 3-103) the corresponding NPV estimate indicates (Table 3-104) that the rate of return falls below the discount rate of 15% p.a. This result is consistent with the negative end value of cashflows and the negativity of the ROE over the years.

Table 3-104 : One Truck operator's NPV,IRR – Nairobi

5 year analysis	
NPV @15% discount rate	**(521)**
Avg 5 yr monthly cash to operator	**691**

As the operating expenses rise at a higher rate than the revenues, the emptier will be required to increase tariffs, cut costs or increase the number of trips as a way of increasing revenue in order to mitigate the arising loss position in the future. The growth in trips needs to be much higher than the growth in costs for the operator to sustain this.

Present value

$$PV = \frac{\pi_1}{(1+r)^1} + \frac{\pi_2}{(1+r)^2} + \cdots + \frac{\pi_n}{(1+r)^n} = \sum_{t=1}^{n} \frac{\pi_t}{(1+r)^t}$$

Value of Firm

$$Value\,of\ Firm = \sum_{t=1}^{n} \frac{\pi_t}{(1+r)^t} = \sum_{t=1}^{n} \frac{TR_t - TC_t}{(1+r)^t}$$

Where;
PV – Present Value
TR- Total Revenue
TC- Total Cost
π – Periodic cash flows
r- Rate of return
t- Time

B. Two truck operator's cash flow projection for 5 years : IRR, NPV, Cash Flow and ROE- Nairobi

Using the information on income statements (Table 3-81), the revenue projections (Table 3-105) for the two truck operator were generated for a period of 5 years. This operator was the only profitable one in this category as all others in this category were unprofitable. This operator was profitable on a cashbasis and also profitable after charging depreciation.

The cash flows improve in the first 2 years and then begin to decline; this is because operating expenses are rising rapidly faster than the revenues. The results indicate that the end value of cash flows is smaller than the initial investment and is also negative.

Table 3-105 : Two Truck Operator Cash Flow Projections for 5 years–Nairobi

Income Statement	Year 1 Actual	Year 2 Projected	Year 3 Projected	Year 4 Projected	Year 5 Projected
	$	$	$	$	$
Revenue	57,024	66,901	78,488	92,082	108,030
Less: **operating expenses**	36,282	41,174	50,482	67,668	103,244
EBITDA	**20,742**	**25,727**	**28,006**	**24,414**	**4,786**
Less: **depreciation**	(5,600)	(5,600)	(5,600)	(5,600)	(5,600)
EBIT	**15,142**	**20,127**	**22,406**	**18,814**	**(814)**
Total tax payable	6,223	7,718	8,402	7,324	1,436
EAITDA	**8,919**	**12,409**	**14,004**	**11,490**	**(2,250)**
Balance Sheet - year end					
Assets					
Vehicle	22,400	16,800	11,200	5,600	-
Closing cash	25,719	29,209	30,804	28,290	14,550
Liabilities					
Owner's equity					
Opening equity	28,000	28,000	28,000	28,000	28,000
Add annual net EAITDA	20,119	43,728	68,932	91,622	100,572
Net owner's equity	48,119	71,728	96,932	119,622	128,572
	48,119	71,728	96,932	119,622	128,572
Return on Equity (ROE)	**42%**	**61%**	**71%**	**77%**	**78%**
Average annual 5 year ROE	*66%*				

Based on the two truck operator's cash flow projection for 5 years (Table 3-105) the corresponding NPV estimate indicates (Table 3-106) that the rate of return falls below the discount rate of 15% p.a. This result is consistent with the negative end value of cashflows and the negativity of the ROE over the years.

Table 3-106 : Two Truck operator's NPV,IRR – Nairobi

5 year analysis	
NPV @15% discount rate	**(20)**
Avg 5 yr monthly cash to operator	**20114**

As the operating expenses rise at a higher rate than the revenues, the emptier will be required to increase tariffs, cut costs or increase the number of trips as a way of increasing revenue in order to mitigate the arising loss position in the future. The growth in trips needs to be much higher than the growth in costs for the operator to sustain profitability.

Present value

$$PV = \frac{\pi_1}{(1+r)^1} + \frac{\pi_2}{(1+r)^2} + \cdots + \frac{\pi_n}{(1+r)^n} = \sum_{t=1}^{n} \frac{\pi_t}{(1+r)^t}$$

Value of Firm

$$Value\,of\ Firm = \sum_{t=1}^{n} \frac{\pi_t}{(1+r)^t} = \sum_{t=1}^{n} \frac{TR_t - TC_t}{(1+r)^t}$$

Where;
PV – Present Value
TR- Total Revenue
TC- Total Cost
π – Periodic cash flows
r- Rate of return
t- Time

C. Four Truck operator's cash flow projection for 5 years : IRR, NPV, Cash Flow and ROE- Nairobi

Using the information on income statements (Table 3-83), the revenue projections (Table 3-107) for the four truck operator were generated for a period of 5 years. This operator was the only profitable one in this category as the other operator in this category was unprofitable. This operator was profitable both on a cashbasis and also profitable after charging depreciation.

The cash flows improve in the first 2 years and then begin to decline; this is because operating expenses are rising rapidly faster than the revenues. The results indicate that the end value of cash flows is smaller than the initial investment and is also negative.

Table 3-107 : Four Truck Operator Cash Flow Projections for 5 years – Nairobi

Income Statement	**Year 1 Actual**	**Year 2 Projected**	**Year 3 Projected**	**Year 4 Projected**	**Year 5 Projected**
	$	**$**	**$**	**$**	**$**
Revenue	128,928	151,258	177,456	208,192	244,251
Less: **operating expenses**	110,206	122,831	148,635	198,276	304,157
EBITDA	**18,722**	**28,428**	**28,821**	**9,915**	**(59,906)**
Less: **depreciation**	(30,000)	(30,000)	(30,000)	(30,000)	(30,000)
EBIT	**(11,278)**	**(1,572)**	**(1,179)**	**(20,085)**	**(89,906)**
Total tax payable	(3,383)	(472)	(354)	(6,025)	(26,972)
EAITDA	**(7,895)**	**(1,101)**	**(825)**	**(14,059)**	**(62,934)**
Balance Sheet - year end					
Assets					
Vehicle	120,000	90,000	60,000	30,000	-
Closing cash	22,105	28,899	29,175	15,941	(32,934)
Liabilities					
Owner's equity					
Opening equity	150,000	150,000	150,000	150,000	150,000
Add annual net EAITDA	(7,895)	(8,995)	(9,821)	(23,880)	(86,814)
Net owner's equity	142,105	141,005	140,179	126,120	63,186
	142,105	141,005	140,179	126,120	63,186
Return on Equity (ROE)	**-10%**	**-9%**	**-7%**	**-5%**	**-4%**
Average annual 5 year ROE	**-7%**				

Based on the four truck operator's cash flow projection for 5 years (Table 3-107) the corresponding NPV estimate indicates (Table 3-108) that the rate of return falls below the discount rate of 15% p.a. This result is consistent with the negative end value of cashflows and the negativity of the ROE over the years.

Table 3-108 : Four Truck operator's NPV,IRR – Nairobi

5 year analysis	
NPV @15% discount rate	(7,873)
Avg 5 yr monthly cash to operator	(17,363)

As the operating expenses rise at a higher rate than the revenues, the emptier will be required to increase tariffs, cut costs or increase the number of trips as a way of increasing revenue in order to mitigate the arising loss position in the future. The growth in trips needs to be much higher than the growth in costs for the operator to sustain profitability.

3.4.1.3 Sensitivity and Risks Analysis

Kisumu City

The trucks in use have an average age of 25 years, are inefficient and use old technology which is expensive. These aged trucks experience numerous breakdowns and thus slow down the possible number of trips achievable. Moreover the truck owner has no way of validating the number of trips made since clients are not issued with receipts and the dumping site which is also not properly fenced and largely unmanned therefore the truck drivers do not record the trips they make. The truck owners incur more cost trying to monitor the business. The operating environment and the equipment in use exposes the business in Kisumu to greater risk, however minor changes may be able to radically shift this unfavourable to favourable environment given the unmet demand for mechanical emptying services in Kisumu.

Mombasa City

The trucks in use by most operators are old meaning they are inefficient and use old technology which is expensive. Some operators have trucks with smaller capacity and they have better chance of increasing their revenues especially when they are dealing with large institutions since they can make numerous trips and as billings is made against trips as opposed to truck capacity. However, small sized truck owners also tend to be one or two truck owners.

In general the truck owner has no way of validating the number of trips made since all clients are not issued with receipts. For large truck owners there is a chance the the truck can exhsuat twice on a single trip and report it a single trip to the owner.

Nairobi City

The trucks in use have an average age of 25 years meaning they are inefficient and use old technology which is expensive.The presence of only one tipping point implies very long distances for the truck, and hence lowers the likelihood of more than one trip per day. Moreover poor enforcement has also reduced and impeded the demand for ME services as households engage manual emptiers or connect to storm drains.

3.4.1.4 Access to finance

Kisumu City

None of the private truck owners interviewed used loan facilities. It was also found that the truck owners operate other businesses unrelated to FSM (Table 3-109).

Table 3-109 : Access to Finance - Kisumu

What % of the private truck owners take loans?	0
What are bank interest rate and years for repayment?	N.A
Are the rest self-financing?	Yes
Do they run any other business from which they get this self-finance money?	Yes
What % of the FS emptying owners does this as their main business?	0

Mombasa City

None of the private truck owners interviewed used loan facilities. It was also found that the truck owners operate other businesses unrelated to FSM

Nairobi City

Only one of the private truck owners interviewed use loan facilities. It was also found that the truck owners operate other businesses unrelated to FSM. Access to finance remains a big challenge on three fronts.

Rate of Interest: The rates of interest on lending have remained very high in the economy over the last 20 years. This has deterred borrowing as the business would experience challenges in making payments.

Credit limits: Access to credit at micro finance institutions falls well below what is required to acquire the key asset in mechanical emptying services, namely the truck. MFI would have to

raise their credit limit but even then the MFI's would have to lend at lower interest rates than they have been in the past.

Lack of Lease financial services for the sector: Lease finance tends to be at lower rates of interest; however, since there is no equipment supplier in Kenya for specialized mechanical emptying trucks, this has not developed. Thus whereas a new truck chassis would be lease financed, the value for money of the locally fabricated mechanical emptying truck falls below the value for money of an imported specialized reconditioned emptying truck. As a consequence it may be more beneficial to offer lease finance services for reconditioned imported trucks.

3.4.1.5 Role of Public Sector in Business sustainability

FSM policy is generally lacking and as a consequence, the present framework of guiding private sector stakeholders does not lend itself to developing a sustainable industry. A number of areas are in need of public policy intervention

1. Regulation : This has to be centralized and formulated
2. Licensing: This is not coherent, the licensing regime and the whole system lacks structure
3. Industry Incentives: These are non-existent and therefore private sector operators have to pay to provide public infrastructure. For example the lack of sufficient tipping points causes long distance travel, which reduces the overall service rate of the industry.
4. Taxation: Fiscal incentives lack for this industry even which may be deserved since the service often qualifies as an essential service

3.4.1.6 Business Analysis of Wastewater Treatment Plants in the cities

None of the cities have dedicated treatment facilities for the feacal sludge collected. Only the conventional waswater treatment plants are equipped with facilities to treat fecal sludge. Unfortunately, currently all the fecal sludge collected in Nairobi and Kisumu is tipped and mixes with sewage directed to stabilization ponds while faecal sludge in Mombasa is tipped at the non-functional convential treatment plant.

All the wastewater treatmenet plants in the three cities are owned and operated by their respective city water (public) companies. WWTP receive funds from budgetary allocations from the water companies and are not autonomous neither are they expected to be financially self

sustaining. Feacal Sludge revenues for the WWTP are at the moment insignificant (section 3.4.2.1.28).

3.4.1.7 Recommendations for Sustainable business models per city

Kisumu City

Three business models proposed for Kisumu are as follows:

1. Bio-centres as social enterprises: On the whole the Bio centres have proven to be self-sustaining once capitalized and have demonstrated positive health externalities particularly at the low income household levels. There has been recorded success by the activities of Umande Trust. This model should be pursued.
2. Microfinance targeted at Sanitation services: A microfinance model and fund targeted at sanitation services would enhance access to credit to the sub-sector. This is already in place with SANA which has been operating such a scheme albeit at a micro level. This model should be pursued.
3. Treatment plants enhancement for product drying, packaging and distribution. Treated FS is more affordable than commercial fertilizers. The acceptability of treated FS re-use would be raised by increased public education, though already there is FR-re-use acceptability. Investing in modernizing FSTP to rely less on weather for the drying process would increase annual output. Kenya has wet conditions for 8 months of the year. In addition, because of the bulky nature of treated FS packaging would ease transportation and distribution to market. The large share of agriculture in the economy at 24% of GDP would offer a market for the use of treated FS. Kisumu is surrounded by large agricultural farms and therefore treated FS would be in great demand due to its low cost.

Mombasa City

Bio-centres as social enterprises: A number of sanitation blocks have been constructed as private public partnerships in the town. These have been successful. The demand for these facilities however exceeds supply and in particular to progress, these bio-centres need to undertake FS-reuse such as biogas production. This model is in place with Excloosive (section B.3.14 -b) and Umande. The existing operations should be upgraded.

Nairobi City

Three business models proposed.

1. Bio-centres as social enterprises: On the whole the Bio centres have proven to be self-sustaining once capitalized and have demonstrated positive health externalities particularly at the low income household levels. There has been recorded success by the activities of Umande Trust. This model should be pursued.
2. Microfinance targeted at Sanitation services: A microfinance model and fund targeted at sanitation services would enhance the access to credit to the sub-sector. This model should be introduced and supported.
3. Treatment plants enhancement for product drying, packaging and distribution. Treated FS is more affordable than commercial fertilizers. The acceptability of treated FS re-use would be raised by increased public education, though already there is FR-re-use acceptability. Investing in modernizing FSTP to rely less on weather for the drying process would increase annual output. Kenya has wet conditions for 8 months of the year. In addition, because of the bulky nature of treated FS packaging would ease transportation and distribution to market. The large share of agriculture in the economy at 24% of GDP would offer a market for the use of treated FS. Nairobi is surrounded by large areas engaged in farming and treated FS is by far much cheaper than commercial fertilizers.

3.4.2 Country Level (across cities)

3.4.2.1 Difference in Parameters across three cities

3.4.2.1.1 *General*

Formal financial records for the operators were difficult to obtain. Moreover, there was varying quality on operational data that would provide inference on financial performance of operators. However by cross referencing various data sources it was possible to corroborate information on key financial indicators such as tariff, wages, fuel and motor vehicle service costs. Taken together these sources of information were used to construct financial data for the operators, which were then analyzed.

3.4.2.1.2 *Income statements*

The analysis of the results obtained indicates operating consistency between the operators operating in the three cities surveyed; and there are no noticeable outlier estimates. For the case of Kisumu and Mombasa, only one operator was interviewed for each category of trucks owned and operated. In Nairobi 16 operators were interviewed. However, for purposes of the analysis, the best performing operator in Nairobi was selected and marked against comparable operators in Kisumu and Mombasa in the corresponding category of number of trucks owned. When depreciation is included in the financial estimates, most operators are found to be unprofitable. However on a cash basis the mechanical operators remain profitable.

In the absence of a proper accounting framework, the businesses represent strong cash flow, low debtors but equally thin margins in absolute terms. Under these circumstances, the existing business models may on a short term basis be self-sustaining but they may not be self-sustaining in the medium and long term. Periodic cash surpluses are consumed by intermittent but high cost of repairs as shown by the impact of depreciation on the bottom line. Alternatively, probably all businesses are profitable, but the reported number of trips per truck is understated to give the impression of low profitability. The short depreciation period also meant a very large charge on the profits, assuming a longer horizon would have provided a lesser aggressive charge on profits.

One truck operators

The broad framework of emptiers in the 3 cities is identical. Trucks are licensed on a unit basis by the national environmental agency. Each city has 2 treatment plants of either kind, conventional or stabilization ponds. Dumping in the 3 cities is centralized and as such there is only one designated tipping point in each of the 3 cities. There are more similarities than differences amongst the operators and in some instances some are branch outlets, therefore operating in more than one city. In addition, in all the cities the FSM sub sector policy framework is under developed and in urgent need of formulation. Mechanical emptying services are 100% provided by the private sector with the public sector playing varied regulatory and oversight role. The degree of oversight across the cities is generally licensing and less of enforcement. The comparison of One Truck Operators (Table 3-110) indicates several impacts including that of service tariff, size of truck, number of trips and structure of business. Among other things the tariffs across the 3 towns are different. However, the Mombasa Operator has fixed personnel costs few trips and the business is diversified, and therefore the

staff costs are absorbed by different departments. Apportioning the costs of the emptying business would most likely indicate it to be a profitable segment on its own account. The loss position of the Kisumu operator is most likely explained by the lower tariff, number of trips and the high depreciation charge.

Table 3-110 : Condensed Income Statement - One Truck Operators

Condensed Income Statement	**Kisumu**	**Mombasa**	**Nairobi**
	$	**$**	**$**
Revenue	14,832.00	17,608.00	27,893.25
Total Revenue	**14,832.00**	**17,608.00**	**27,893.25**
Operating Expenses			
Fixed Expenses	3,084.83	6,817.39	5,730.50
Gross Profit	**11,747.17**	**10,790.61**	**22,162.75**
Variable Expenses	17,295.65	42,195.65	15,527.50
Operating Profit/loss Before Dep & Tax	**4,234.13**	**(21,622.43)**	**10,035.25**
Depreciation	9,782.61	9,782.61	3,400.00
P/ loss After Depreciation	**(5,548.48)**	**(31,405.04)**	**6,635.25**
Tax			1,990.58
Profit After Tax & Dep	**(5,548.48)**	**(31,405.04)**	**4,644.68**
# Trips per Annum	**288**	**142**	**347**
Average Tariff(USD)	**52**	**124**	**80**
Vehicle capacity M^3	**10**	**9**	**10**

Two truck operator

The comparison of two truck operators across the three cities reveals the variation in operating costs (Table 3-111). What is notable is that only the operator in Nairobi is profitable after charging depreciation, which is also considerably lower.

Table 3-111 : Condensed Income Statement - Two Truck Operators

Condensed Income Statement	**Kisumu US$**	**Mombasa US$**	**Nairobi US$**
Revenue	27,192.00	27,735.00	57,024.00
Total Revenue	**27,192.00**	**27,735.00**	**57,024.00**
Operating Expenses			

Fixed Expenses	10,943.52	6,641.30	14,181.52
Gross Profit	**16,248.48**	**21,093.70**	**42,842.48**
Variable Expenses	25,304.35	27,978.26	19,856.00
Operating Profit/loss Before Dep & Tax	**10,509.35**	**12,680.65**	**28,586.48**
Depreciation	19,565.22	19,565.22	5,600.00
P/loss After Depreciation	**(9,055.87)**	**(6,884.57)**	**22,986.48**
Tax			6,895.94
Profit after tax	**(9,055.87)**	**(6,884.57)**	**16,090.54**
# Trips per Annum	**528**	**258**	**528**
Average Tariff(USD)	**52**	**108**	**108**
Vehicle capacity M^3 Truck 1	**6**	**5.6**	**10**
Truck 2	**8**	**5.6**	**10**

Four Truck operators

Generally 4 truck operators are profitable and exhibit economies of scale, but more likely supported by more trips. In addition operators of larger fleet tended to have also large capacity vehicles and therefore were able to charge higher service tariffs. There were no 4 truck operators in Kisumu (Table 3-112).

Table 3-112 Condensed Income Statement - Four Truck Operators

Condensed Income Statement	Kisumu US$	Mombasa US$	Nairobi US$
Revenue		128,928.00	66,961.11
Total Revenue		**128,928.00**	**66,961.11**
Operating Expenses			
Fixed Expenses		23,086.00	24,393.48
Gross Profit		**105,842.00**	**42,567.63**
Variable Expenses		87,120.00	54,013.04
Operating Profit/loss Before Dep & Tax		**48,722.00**	**81,698.07**
Depreciation		30,000.00	39,130.43

P/loss After Depreciation		**18,722.00**	**42,567.63**
Tax		5,616.60	12,770.29
Profit after tax		**13,105.40**	**29,797.34**
# Trips per Annum		**326**	**1,632**
Average Tariff(USD)		**205**	**79**
Vehicle capacity M^3 Truck 1 T		**22**	**10**
Truck 2		**22**	**10**
Truck 3		**20**	**20**
Truck 4		**18**	**20**

3.4.2.1.3 *Cash Flow Statements for Mechanical Emptiers - Case of Kenya (Three Cities)*

One truck operator's cash flow statement

Cash flow is important because it underlies the ability of a business to meet its day to day operations. In the emptying business, there are few debtors and most sales are collected immediately after service. Single truck operators have positive cash flows, though the Kisumu and Mombasa operators are unprofitable (Table 3-113). The combination of losses and positive cash flow imply there are numerous occasions of deficit financing especially during periods of vehicle repairs, when the owners have to obtain debt.

Table 3-113 : One Truck Operators Cash Flow Statement

Cash flow Statement	**Kisumu US$**	**Mombasa US$**	**Nairobi US$**
Investment Cash flow	(48,913.04)	(48,913.04)	(17,000.00)
	-	-	
	-	-	
Cash flow from operation	-	-	
Net Profit After Tax &Depreciation	(5,548.48)	(31,405.04)	4,644.68
Add Back :	-	-	
Depreciation	9,782.61	9,782.61	3,400.00
	-	-	
Net Cash flow from Operation	4,234.13	(21,622.43)	8,044.68
Net Cash flow	(44,678.91)	(70,535.48)	(8,955.33)

Line items to calculate taxation			
Truck Costs	48,913.04	48,913.04	17,000.00
Depreciation 20%* cost	9,782.61	9,782.61	3,400.00
Book value of vehicle at year end	**39,130.43**	**39,130.43**	**13,600.00**
# Trips per Annum	**288**	**142**	**347**
Average Tariff(USD)	**52**	**124**	**80**
Vehicle capacity M^3	**10**	**9**	**10**

Two trucks operators cash flow statement

The high depreciation charges undermine profitability. The financial performance and cash flow position of a single truck owner and a two truck owner is somewhat identical (Table 3-114). This may stem from the nature of the emptying operations, where single truck owners may be unable to secure large emptying contracts and rely more on small volume household customers who provide irregular demand for services.

Table 3-114 : Two Trucks Operators Cash Flow Statement

Cash flow Statement	**Kisumu US$**	**Mombasa US$**	**Nairobi US$**
Investment Cash flow	(97,826.09)	(97,826.09)	(28,000.00)
Cash flow from operation			
Net Profit After Tax &Depreciation	(9,055.87)	(6,884.57)	16,090.54
Add Back :			
Depreciation	19,565.22	19,565.22	5,600.00
Net Cash flow from Operation	10,509.35	12,680.65	21,690.54
Net Cash flow	(87,316.74)	(85,145.43)	(6,309.46)
Line items to calculate taxation			
Truck Costs	97,826.09	97,826.09	28,000.00
Depreciation 20%* cost	19,565.22	19,565.22	5,600.00
Book value of vehicle at year end	**78,260.87**	**78,260.87**	**22,400.00**
# Trips per Annum	**528**	**258**	**528**
Average Tariff(USD)	**52**	**108**	**108**
Vehicle capacity M^3 Truck 1	**6**	**5.6**	**10**
Truck 2	**8**	**5.6**	**10**

Four trucks operator cash flow statement

The 4 truck operators have strong positive cash flows (Table 3-115). In the absence of revenue leakages, the larger operators can easily leapfrog their business size buy financing the purchase of more trucks and enhance the economies of scale of their operations.

Table 3-115 : Four trucks operator cash flow statement

Cash flow Statement	**Mombasa $**	**Nairobi $**
Investment Cash flow	(195,652.17)	(150,000.00)
	-	-
	-	-
Cash flow from operation	-	-
Net Profit After Tax &Depreciation	29,797.34	13,105.40
Add Back :	-	-
Depreciation	39,130.43	30,000.00
	-	-
Net Cash flow from Operation	68,927.78	43,105.40
Net Cash flow	(126,724.40)	(106,894.60)
Line items to calculate taxation		
Truck Costs	195,652.17	150,000.00
Depreciation 20%* cost	39,130.43	30,000.00
Book value of vehicle at year end	**156,521.74**	**120,000.00**
# Trips per Annum	**326**	**1,632**
Average Tariff(USD)	**205**	**79**
Vehicle capacity M^3 Truck 1	**22**	**10**
Truck 2	**22**	**10**
Truck 3	**20**	**20**
Truck 4	**18**	**20**

Given the reported number of trips by the operators accounting profit is possible for most operators if the depreciation charge is omitted. Thus if the depreciation charge is viewed as a proxy of loan repayment, then the businesses would be unable to support debt servicing, at the reported tariffs and number of trips.

Negative cash flows because of the depreciation charge unmask the real profits of the business and indicate the nature of the business. An increase in the tariff (fees) and an increase in the number of trips offer an appreciable increase in revenues which would offers far much higher income relative to costs for the operator. An increase in number of trips would easily offset the corresponding increase in costs.

Data on number of trips was difficult to obtain. As a result, one reason for the apparent underperformance by the operators would be explained by underreporting of the number of trips. Data obtained from a dumping site registry showed that some operators were able to achieve more than 40 trips per month on a single truck. This data could not be validated for being applicable to all operators.

3.4.2.1.4 *Overview of Existing Business models*

Operating environment

There are 4 business models in place. These include

1. Manual emptiers
2. Mechanical emptiers
3. Bio-centers and aggregators
4. FS processors

Fecal sludge management business can be considered a growing sub sector, particularly because of the increasing number of un-sewered households in urban populations. The need for service providers to offer reliable extraction and disposal of FS and other solid waste is as such to be anticipated.

Manual and Mechanical Operators

The business models here often combine extraction, transportation and disposal of FS. A number of operators cited having identified the need for such services in the society as the reason they chose to start their businesses. Overtime FSM in the area of manual and mechanical emptying has become very competitive and though tariffs remain high in most areas.

Bio-centres and Aggregators

This business model combines provision of sanitation services and re-use of treated FS. Pricing for use of sanitation facilities is aimed at enhancing access over financial return. However the sale of treated FS in the re-use option particularly as biogas aims at providing a sustainable and viable financial return. Bio-centres also operate as micro commercial centres, with rental offices, meeting rooms and cyber shops for internet access.

FS Processors

This business model combines disposal sites, treatment plants and production of treated FS for re-use. The common treated FS for re-use takes the form of solid and liquid fertilizers. There is a general underdevelopment of the FS processors business model. In the cities studied all the Utilities were found to operate FS processors limited only to FS treatment.

3.4.2.1.5 *Ownership Structure, Business Financing*

Most of the businesses can be categorized into three main broad categories in terms of their ownership structures; namely sole proprietorships, partnerships and limited liability companies (corporations). The decision to assume a certain business model is largely influenced by the capital intensity of the business particularly since start-up capital is a barrier to entry. Most of the manual and mechanical emptier businesses are sole proprietorships or partnerships (Table 3-116).

Table 3-116 : Business Ownership Structures

Mode of operations	Common business Type
Manual Emptiers	Informal and not registered, Sole proprietors,
Mechanical Emptiers	Sole proprietors, partnerships and limited liability companies
Bio-Digesters & Aggregators	Limited liability companies and NGO set ups
FS Processors	Utility corporations set up as Limited liability companies partially owned by the government.

In most instances startup capital is from personal savings and borrowings from friends and relatives. Bank credit is often accessed for expansion or fleet replacement purposes when the entrepreneur has developed sufficient track record of operations. In the case of bank credit, the vehicle log book acts as the collateral for the loan facility.

For the case of partnerships, in the mechanical emptier business, the partners tended to be family members and predominantly husband and wife. In the case of limited liability set ups, the shareholders were found to be predominantly relatives and for all survey cases these were family owned businesses.

In both cases of the sole proprietor or the partnership the entrepreneurs retain the right of management of the business and will often be the one (s) to formulate and implement the businesses' strategies.

In Kenya few of these mechanical emptying businesses will take the form of a corporate body during inception due to the complexities of forming and registering a limited liability company. In addition to the unfamiliarity with typical corporate structure, the legal obligations tend to be overwhelming and requiring formal frameworks of auditors, lawyers and legal company representatives. Only after years of operations, and having been able to mobilize adequate resources, are entrepreneurs willing to consider transforming their businesses into a limited company with more elaborate corporate structures. This transformation is however nudged by regulators, bankers or potential partners who then provide owners with an opportunity to expand their operations.

3.4.2.1.6 *Economic Viability, Revenue and Profit Drivers*

Economic viability of the mechanical emptying business depends on the level of demand for the service, use of the right equipment and appropriate scale. The appropriate equipment include custom made trucks to allow for suction and disposal of fecal substance, proper car parking facility, garage and an ideally located disposal point. It is also important that enforcement takes place to combat malpractice etc.

In the past, truck fabrication has been taking place, but more recently operators prefer to buy reconditioned custom made trucks as these are found to be more durable and have lower maintenance costs. A locally fabricated truck based on a second hand chassis costs USD 20,000 whereas a reconditioned custom made truck costs USD 48,000. Industry malpractice such as illegal dumping, disposal into storm drains and the presence of manual emptiers undermines the demand for mechanical emptying of FS.

3.4.2.1.7 *Value chain Structure*

Fecal sludge management process starts from the households and terminates at a dumping site, FSTP or as re-usable material. Often this process will go through a series of value addition stages. There are three main value chain structures;

1	Households	→	On-site	→	Extraction	→	Dumpsite					
2	Households	→	On-site	→	Extraction	→	Bio-centre	→	Re-use	→	Extraction	→	Dumpsite
3	Households	→	On-site	→	Extraction	→	FSTP	→	Re-use				

3.4.2.1.8 *Service delivery models*

Overview of FSM service delivery models

There are four service delivery models:

- Utility companies; these provide:
  - Connection to sewer
  - Sewer infrastructure
  - Mechanical emptying at a lower fee
- Local Authorities; these provide:
  - sewer infrastructure
  - Public toilets and public toilet infrastructure
  - Mechanical emptying at a lower fee (not operational)
- Private emptiers; these provide:
  - Mechanical emptying services
  - Manual emptying services
  - Pay for use toilets often under concession or public private partnership with local authority
  - FS treatment in collection aggregation bio centre facilities
  - FS re-use in bio-centres
- NGOs; these provide:
  - Pay for use toilets often under concession or Public private partnership with local authority
  - FS re-use in Bio-centres for onsite cooking
  - FS-re-use through delivery of bio-gas by pipe infrastructure to homes

- FS-evacuation through disposable bags
- FS-sanitation services through household pit latrines

Overview of SWM service delivery models

There are three service delivery models:

- Local authorities; these provide:
  - dumping site
  - regulatory enforcement
  - Licenses-environmental restoration – greening
- Private operators; these provide:
  - Garbage collection
  - Garbage disposal to dump-site
  - Solid waste processing
  - Solid waste re-use applications
- NGOs; these provide:
  - - Solid waste re-use- energy
  - Environmental restoration
  - Solid waste re-use - plastic poles
  - Solid waste re-use in fertilizer processing
  - Environmental restoration- afforestation

Comparison of FSM and SWM service delivery models

SWM and FSM are complementary and necessary services in urban areas. Policies have hitherto been more progressive in SWM than FSM. However, reforms to FSM are inevitable if urban populations are to live in healthier environments. FSM as a sub-sector has however a different technology matrix from SWM given the nature of FS and the socio-cultural interpretation of FSM. In this regard there is opportunity to develop the progressive trajectory for the delivery of FSM. The role of various stakeholders is common and necessary in both FSM and SWM as indicated in the comparative summary below (

Table 3-117)

Table 3-117 : Comparison of FSM and SWM service delivery models

Fecal sludge management	Solid waste management
There are four service delivery models; • Utility companies - these provide connection to sewer ➢ Sewer infrastructure • Local Authorities – these provide sewer infrastructure ➢ Public toilets and public toilet infrastructure ➢ Mechanical emptying at a lower fee (not operational) • Private emptiers – mechanical emptying services ➢ Manual emptying services ➢ Pay for use toilets often under concession or Public private partnership with local authority ➢ FS treatment in collection aggregation bio centre facilities ➢ FS re-use in bio-centres • NGOs - Pay for use toilets often under concession or Public private partnership with local authority ➢ FS re-use in Bio-centres for onsite cooking	• Local authorities- provide dumping site ➢ regulatory enforcement ➢ Licenses-environmental restoration – greening • Private operators- Garbage collection ➢ Garbage disposal to dump-site ➢ Solid waste processing ➢ Solid waste re-use applications • NGOs - Solid waste re-use-energy ➢ Environmental restoration ➢ Solid waste re-use - plastic poles ➢ Solid waste re-use in fertilizer processing ➢ Environmental restoration-afforestation

3.4.2.1.9 *Flow of Money Chart for FSM Transactions*

The service channels in FSM showed different financial transaction opportunities. The more immediate being clients (Institutional/individuals) paying for FS management services to emptiers (Figure 3-26). However, underlying this is the indirect payment to the FSTP/WWTP through licensing by the utility company which manages the FSTP/WWTP. More directly the FSTP/WWTP receives payments for the sale of treated FS to end users.

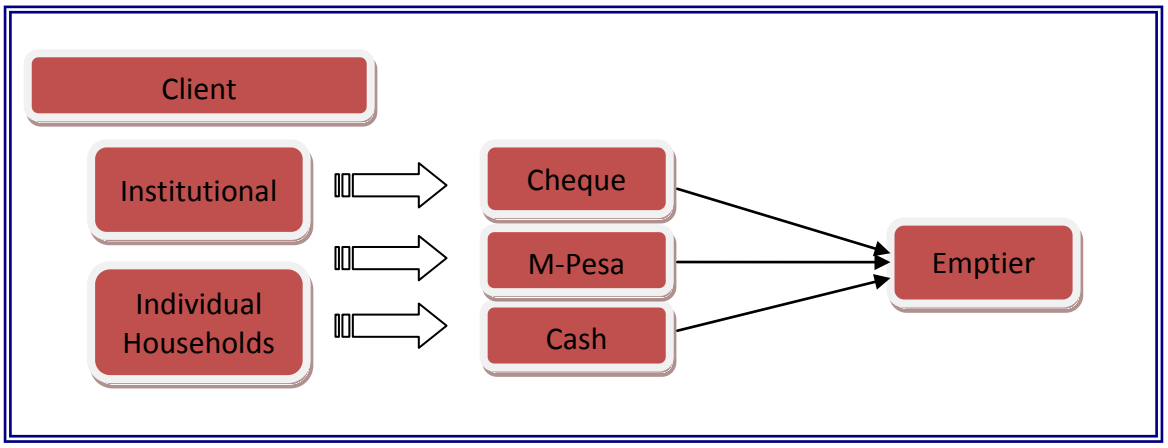


Figure 3-26 : Flow of Money Chart for FSM Transactions

3.4.2.1.10 *Tariffs and Fees for FSM Services*

Table 3-118 summarizes financial transaction data for FSM services. The average tariffs in the three cities are incomparable as the trucks are of different capacities. In Kisumu there is no dumping fee since it is already included in the business permit, in Mombasa, operators are required to have three licenses, that is a business permit renewable annually, Environmental license and a dumping permit charged on a per truck basis, while in Nairobi operators are required to have four licenses; business permit, environmental license charged on a per truck basis and NCWSCO licensing fee charged on a truck basis and a dumping fees of USD 2.00 per trip. The treated sludge re-sale price is fixed by the utility company which operates the treatment plant. However at present there is no regular sale of sludge at any of the WTP in the three cities studied. Moreover the WWTP where FS is dumped in Nairobi and Kisumu comprises of stabilization ponds which in effect cannot undertake any FS waste treatment.

Table 3-118 : Comparison of Tariffs and Fees for FSM Services

Parameter	Kisumu		Mombasa			Nairobi		
	One truck	Two trucks	One truck	Two trucks	Four trucks	One truck	Two trucks	Four trucks
Average Tariffs	52	52	124	107	205	81	108	79
Maximum Tariff(long - distance)						100	120	100
Minimum Tariff - (Short-Distance)						35	80	30
Number of trips	288	528	142	258	326	347	528	1632
Total Cost of trucks	48,913	48,913	48,913	48,913	48,913	17,000	28,000	150,000
Dumping per truck	-		10.87			2.17		
Environmental License - per truck	33		54			50		
Business Permit-for whole business	237		184.78			102		
FS License-per month per truck	36		-			50		

3.4.2.1.11 *FS Emptying Business Owners' Profile*

Following a landscape review of the operators, it was decided to interview a number of the mechanical truck operators operating in all three cities. Information from one operator per every operating capacity was used to develop the emptier profile for purposes of comparison between cities.

3.4.2.1.12 *FSM Emptying Practices and Technologies Used: Manual and Mechanical*

The methods of fecal sludge emptying were as determined from the HH survey (Table 3-119). The results indicate that in all the three cities, most households with on-site sanitation facilities use mechanical exhausters as the main mode of fecal extraction.

Table 3-119 : Methods of Emptying Fecal Sludge in the Three Cities

	Nairobi		Mombasa		Kisumu	
	Mechanical	**Manual**	**Mechanical**	**Manual**	**Mechanical**	**Manual**
% of Method of Emptying by HH with on-site sanitation	52%	48%	7%	93%	25%	75%
% of Share of Volume of FS emptied by method	32%	68%	10%	90%	2%	98%
% of the HH with on-site sanitation (pits) in the city emptied	38%	62%	7%	93%	17%	83%
% of the HH with on-site sanitation (septic tanks) in the city emptied	71%	29%	8%	92%	53%	47%
% of the HH with on-site sanitation (cesspool) in the city emptied	84%	16%	8%	92%	87%	13%
Total Volume in m^3 of FS emptied (manual + mechanical)	929,286		289,908		272,789	

As the HH survey revealed, manual emptying included: closing the pit when full and digging another one, burying the pit, directing the sludge into existing drainage channels or directing liquid FS into farms, closing the pit when full and reusing it after some time when the sludge has reduced.

The operations of mechanical operators are insufficient to meet the existing demand of emptying services, though neither is the effective demand sufficient to cause the operators to operate at larger capacities. This sluggish effective demand for mechanical emptiers may be explained by three reasons.

1. Price and affordability: - many HH opt for manual emptying as mechanical services are unaffordable
2. Illegal dumping: - it was common to observe emptying channels constructed connecting SP or CP to storm drains
3. Weak enforcement and corruption: Enforcement is generally weak creating room for illegal connections of ST and CS to storm drains.

There are 43 mechanical FS services businesses operating in the cities that among them operate 74 trucks.

Table 3-120 provides data on these mechanical operators.

Table 3-120 : Data on Mechanical Operators in Cities

	Kisumu	Mombasa	Nairobi
# of private mechanical businesses in city	3	14	26
# of trucks run by private businesses	4	11	60
# of trucks owned by utilities	0	0	4
What are utility trucks used for (HH? Govt. institutions use, sewer cleaning?			
# of private businesses that are small (1 truck)	1	3	8
# of pvt businesses that are medium (2-5 trucks)	2	3	18
# of pvt businesses that are large (>5 trucks)	0	0	0
What are the capacities of private trucks (m^3)	10	10	8
What are capacities of Utility trucks (m^3)	0	0	10
Price for new truck (10 m^3 capacity) USD-2nd hand import	48,000	48,000	48,000
Price for USED truck (10 m^3 capacity) USD-fabricated	20,000	20,000	20,000

Based on the survey a number of operators run the FS emptying service as part of existing businesses, however, the market leaders in each city were observed to be solely focused on mechanical FS emptying as the core business.

The vast majority of trucks currently in use in all the cities are old and fairly unreliable, and experiencing frequent breakdowns. In the last 6 months however, new trucks into the industry have been procured in departure from past practice. In the past, mechanical emptiers preferred to purchase old trucks and thereafter fabricate the ferrying tanks as well as fit in the needed pumps. However, more recently, the new tanks in two of the three cities have been second hand reconditioned specialized exhauster trucks. This new trend not to attempt local fabrication appears to be informed by experience, economy and maintenance costs and suitability of the specialized trucks. Across the 3 cities there are other challenges experienced by the emptiers besides those associated with trucks and these include the following:

3.4.2.1.13 *Challenges Faced by Mechanical Operators*

The FSM sub sector is under developed and general policy lags that of SWM. As a consequence FSM service providers do face policy as well business challenges which include some of the following:

- Long distance to discharge point
- Difficult to extract latrines due to disposal of solid waste into the latrines
- Poor roads infrastructure
- Extortion , penalties , expensive, permits, bribes by the local authorities
- High fuel prices
- Limited sources of capital

3.4.2.1.14 *Trucks*

The trucks in use by some operators are old and delicate, while others are new with much higher capacity (Figure 3-27).

Figure 3-27 Trucks used by Mechanical Operators

3.4.2.1.15 *FS Management: Mechanical Operators*

The cities have a total of 43 mechanical operators who own a total of 74 trucks; in Kisumu and Mombasa, they operate from diverse areas and within the town but do not have a designated parking area, whereas in Nairobi most reported having designated parking area under the management of the City Council.

The operator's businesses are sole proprietorships, partnerships and corporate bodies. The majority of mechanical emptying operators do not have formal offices, and clients generally find them by visiting the common parking area or by stopping the trucks on the road whenever they see them or calling them on the telephone numbers usually displayed on the trucks. The ownership of the business is predominantly male.

3.4.2.1.16 *Mechanical Operators' Employees*

In general a truck has two employees to it, which includes a driver and a plumber cum turn boy. Some of the owners engage their employees on casual employment terms based mainly on the number of trips, while other had them on permanent employment. The businesses can be classified further as informal or formal.

Informal businesses do not have central offices or designated area of operation and lack an organizational structure. But, on the other hand, formal businesses have a central office and a defined organizational structure; they have in place fully fledged sales and marketing departments which are tasked with seeking business opportunities. These sales and marketing departments where they exist are often managed by ladies and the operators are in diversified operations not exclusively FS emptying.

3.4.2.1.17 *Mechanical Operator Licensing*

All operators are required to have 3 or 4 licenses which include:

1. Trading license obtained from the City Council Authority but issued as a business license. This is renewed annually.

   Environmental license issued by the national environmental office located in Nairobi and issued on a per truck basis. This is renewed annually.

2. Tipping permit and fee licensing issued by the utility firm. This permit is issued on a dumping trip basis. This applies only to Nairobi and Mombasa.

3. FS Operator license which is on a truck basis and issues annually by the Utility Company. This applies to Kisumu and Nairobi.

3.4.2.1.18 *Operations of Mechanical Emptiers*

In general mechanical operators make an assessment of the required de-sludging and then quote a fee. The fees are fixed per trip but in other instances the fee varies depending on the size of the truck and the distance covered. The business practice is payment after service. The fee is usually agreed in advance. The client pays the truck driver or the owner through mobile money once the sludge has been loaded into the truck. Some operators issue receipts while others do not. For commercial clients receipts are issued because the service is taxable (vatable) and this tax can be claimed back.

In the case of Nairobi operators pay a sum of USD 2.00 as the tipping fee per trip to the Utility Company, In Mombasa operators pay a per trip dumping fee of USD 10.87 while in Kisumu there is no dumping fee charged. In Nairobi and Mombasa when dumping the sludge at the FSTP plant the truck is required to register itself and surrender the permit and receipt of fee payment. Truck owners generally use the dumping permits to reconcile the number of trips per day with number of customers served. However, use of the mobile phone is extensive as a way of tracking the movement of the truck.

Most of the truck owners do not have a central area of operation, but, operated from different locations. At night the truck owners have designated parking lots for their trucks but these are not exclusive. Some park by the road side, while others park at the nearest gas station.

The levels of organization for the operators are varied. While some are sole proprietors or partnerships or corporate bodies with the owner operating the truck, others have an elaborate structure comprising of an operations manager, accountant, drivers, and plumbing assistants.

Fueling of trucks is undertaken by the truck crew and is based on collections from clients. However, for all firms, the daily collections are remitted net of fuel amounts to begin operations the following day which ranges from USD 25 to 30 per truck for the first trip of the day.

Trips and customers

The number of trips per day reported to the truck owner may not tally actual trips made by the crew to the dumping site. However the variation may be small where there is dumping fee and

receipting system by the FSTP operator. What is likely to be very varied is the amount the client pays to the truck crew and what they report to the owner especially where there are no receipts issued and the truck crew is responsible for revenue collection. With the presence of mobile based payments-M-pesa- some operators forbid their truck crew from handling any payments and require customers to pay directly to the truck owner. A number of reasons may exist for lack of receipting in the industry. Foremost receipts are only absolutely necessary for

1. Expense claims process-where the customer may have service paid for him by his employer or landlord.
2. Where the customer maintains book keeping records such as a corporate client-hotel, factory etc.
3. Where the customer makes a VAT return and therefore the service VAT incurred is INPUT TAX and is useful for offsetting purposes

3.4.2.1.19 *FS Tipping/Dumping points*

In Nairobi, all trucks tip at Njiru tipping point. In Kisumu trucks tip at Nyalenda while in Mombasa it is at Changamwe. In Kisumu and Nairobi the maximum number of trucks that can tip at a given time is four, while in Mombasa only two trucks can tip at a given time. Across the cities surveyed most trucks have a capacity of between 6,000 – 22,000 litres.

Figure 3-28 show a typical tipping scenario and one of the largest trucks (green truck) in Nairobi which has a capacity of 18,000 litres.

Figure 3-28 : Nairobi FS Tipping Point

Across the cities surveyed there is only one designated tipping site for FS and the use of remote transfer points for mechanical emptiers is prohibited. All tipping points except that of Kisumu are manned by security guards on a 24 hour basis and dumping takes place between Monday to Saturday and the gates are open between 0600 to 1800hrs. At all dumping sites, the trucks discharge to a man-hole which is connected by sewer line to the WWTP. In Mombasa the tipping point is not well managed thus, not all trucks tip to the man hole. The drum trucks pour the FS onto the grounds. Arising out of this, the Mombasa WWTP facility now under rehabilitation is developing a special tipping point for the drum type of trucks.

3.4.2.1.20 *Number of Trucks for FS operations*

There are 74 trucks operating in the 3 cities while there 43 registered operators. Unlike in Kisumu and Nairobi there are more operators in Mombasa than the number of trucks. This is because some of the operators are “brokers” who hire the trucks periodically from the mainstream operators-truck owners- to service clients.

Of the trucks surveyed, the 3 found in Mombasa use a unique combination of technologies where 200 litre drums are placed at the back of the truck and a water pump or manual emptiers are used to fill these drums. These 3 trucks two which belong to one operator and one for another operator have difficulties emptying sludge at the manhole provided for dumping at WWTP. Part of the rehabilitation includes designing a receiving bay to act as a dump location for these trucks. Across the three cities the capacity of trucks varies from 6,000 litres to 22,000 litres. Figure 3-29 shows one of the largest trucks in terms of capacity.

The drum combination trucks found in Mombasa have a lower capacity of 5,600 litres and 7,200 litres. However, all trucks across the cities charge on a per trip basis and sometimes the fee is higher depending on the distance to the dumping site. The longest distance is in Nairobi which is 50 km comprising of from client to dumpsite to parking bay, while the shortest distance is in Mombasa which is 4 kilometers. Most trips have an average distance of 8 km in Kisumu and Mombasa.

Figure 3-29 : One of the Largest Trucks in Mombasa -22,000 litres

3.4.2.1.21 *Number of Trips per Day*

Across the cities the number of trips per day varies. In the case of Nairobi there are least 4 trips for every three days, which translates to 8 trips for a week of six days and in Mombasa 3 trips for every three days, that is 6 trips per week and at least one trip per day for the operators in Kisumu where two of the 3 operators reported at least 1 trip per day every day on a 22 working day cycle while the other reported a trip every two days. There are reports of manual emptying taking place and illegal dumping and connection of septic tanks to the storm drain in Nairobi and Mombasa. The operators using drum-trucks-in Mombasa work closely with manual emptiers. Manual emptiers in Mombasa reported that only 50% of their emptying is transported by trucks. The total dumping by drum trucks in a year is estimated at 180. This means that every 2 days there is manual emptying taking place in Mombasa with the FS being either dumped into the storm drain or being buried into the ground.

3.4.2.1.22 *Fuel Consumption and Expenditure*

Figure 3-30 shows a more advanced pump technology. The pump technologies take about 30minutes to fill a 20,000 litre's tank. The suction process consumes between 1 and 1.5 litres of fuel. This is the pump system of the vehicle. It operates with its own generator. This system is more fuel efficient and operationally safer. This pump system is found in the imported second hand specialized exhauster trucks, which are the vehicle of choice for new buys by operators.

Figure 3-30 : Pump Technology for Exhauster Trucks

In the alternate models, the pump system runs on the engine of the vehicle, during operations the driver has to "rev" the vehicle to drive the pump system. Figure 3-31 shows how such pump technology looks like.

Figure 3-31 : Alternative Pump Technology for Exhauster Trucks

Therefore the level of fuel consumption is higher in this pump model compared to the advance pumping system. The pump is connected to the engine via a pulley system-fan belt at RHS of pump. This is driven by a central shaft, which the driver moves by pressing the pedal while the vehicle is not in gear. The vehicle is reconfigured to switch to this mode during pump operation. This is the most common pump installation technique for mechanical operators in the three cities.

These pumps can be mounted in different positions on the chassis of the vehicles. Most of them have been mounted on the sides near the battery with others on the top, below and even at the rear.

3.4.2.1.23 *Operations Audit and Supervision*

The dumping permit system present at the WWTP in Nairobi and Mombasa provides an audit mechanism for the truck owners to monitor the number of trips per truck per day. In the absence of this, it would be difficult to confirm actual trips as most trucks have defective odometers. Some of the truck owners have organizational structures that allow them to conduct random inspections on the movement of the trucks. The approach may involve; calling the truck driver and requesting for the truck location, then hire out a small taxi-tuk tuk- (as is the case in Mombasa) to drive to the location to confirm. In Nairobi on a random basis, owners ride in public passenger vehicles (matatu) tracking their trucks. Given the inexpensive fares charged by these tuk-tuks or matatu, management personnel in these firms are able carry out regular checks on the movement of trucks. In other instances the operator management personnel locate themselves along a route and place a call to the truck crew when they are passing by and seek confirmation of their location. This takes places on a regular basis in the course of the day. A summary of the operations and operator challenges are presented in Table 3-121.

Table 3-121 : Summary of Operations and Operator Challenges

Kisumu	Marketing	Active operations and marketing manager, word of mouth and established reputation
	Supervision	Operations manager actively supervises the truck and most transactions are formally recorded
	Challenge	Unfair practices
	Challenge	Manual emptying still undertaken with complicity of the officials
Mombasa	Marketing	Collaborates with many manual emptiers and pays a commission for finding the work
	Supervision	Owner also acts as a truck driver, and negotiates all contracts directly
	Challenge	Harassment by city council officials
	Challenge	Dumping site is not well suited for the drum truck technology
Nairobi	Marketing	Word of mouth, billboards, posters on truck and an active marketing function by the branch manager
	Supervision	All client activities are centralized at the office
	Challenge	Dumping Permit processing can be made better
	Challenge	Manual emptiers are very active, fuel costs are high

3.4.2.1.24 *Marketing*

Clients Receipting and Payments

Domestic clients generally do not require receipts and thus revenue accounting is mostly dependent on the truck crew. Commercial clients on the other hand (restaurants, landlords and factories) do require receipts for the FS services. Most commercial clients prefer to make cheque payments as opposed to cash. Domestic clients on the other hand pay in cash. Payment by mobile money-in particular M-pesa is very common and increasing in use. This is because it is convenient, safer and more effective in remitting the money. In the past, when M-pesa was not available, truck owners would have to visit the client premises, obtain the money before instructing the truck to commence the trip to the extraction site. This no longer applies. However, with mobile payments such as M-pesa, most truck owners do not allow their truck crew to handle payments and require that the client pays directly by M-pesa to the owner.

Credit services

All operators do offer credit services, but this is often to the commercial clients. Domestic clients only known to the business proprietor receive credit while all others pay upon service delivery. The operators' primary reason for extending credit is to maintain the business relationship as opposed to price cutting.

Payment systems

Three payment systems are observed in the industry, cash, mobile phone based systems and cheques. Domestic clients tend to pay in cash or by mobile phone system. Commercial operators pay either in cash or by cheque.

3.4.2.1.25 *Hire of Third Party Trucks to Provide FS Services*

There are cases where operators who do not own trucks secure "exhausting contracts" then hire truck from a third party to service a client. This usually occurs at two levels. The first case is where the operators who do not own any trucks-brokers- but are able to secure "exhausting contracts" from households and commercial entities engage a lessor contractor who negotiates varied pricing. In the second instance, some operators when overwhelmed by emptying contracts prefer to hire the trucks of their industry colleagues in order to service the clients. In this second instance the pricing system is commission based. Across the three cities, hire of trucks by brokers was most predominant in Mombasa and to a renter extent in Nairobi. These

brokers often obtain exhausting contracts through the tender process which is the predominant procurement approach by many large commercial, public and non-governmental institutions. In Mombasa, this prevalence is because many commercial installations are outside the functioning sewer system.

3.4.2.1.26 *Collaboration of Drum Trucks with Manual Emptiers*

The Drum truck operators in Mombasa were noted to have strong collaboration with manual emptiers .This is because the drum-trucks are more affordable and mostly in use where conventional trucks may not be able to access. Drum trucks in Mombasa are also used for solid waste transport services. In Kisumu one operator was noted to work closely with manual emptiers. In Nairobi like in Kisumu, manual and mechanical operators collaborate in instances where the client would like to have the FS transported by truck but the sanitation facility is inaccessible by a mechanical emptier. This was found to be the case for bio-centres and certain public toilet facilities. One of the promoter institutions of bio-centres is investing in the development of a manual FS pump to be used by the manual operators as a way of improving hygiene standards in the manual emptying service. Moreover in Nairobi, many of the bio-centres and FS aggregator sites are inaccessible by conventional trucks and therefore there is use of manual emptiers. Figure 3-32 below shows a drum truck used in Mombasa.

Figure 3-32 : Drum Truck in Mombasa

3.4.2.1.27 *Overview of all WWTP, FSTP or dumping sites*

Only the conventional WWTPs in Mombasa can treat FS for re-use. The fecal sludge from the designated tipping points in Nairobi and Kisumu mixes up with sewage and ends up in wastewater stabilization ponds (Table 3-122).

Table 3-122 : Data on Wastewater Treatment Plant in Nairobi, Kisumu and Mombasa

	Nairobi	Mombasa	Kisumu
What is the official dumping site for city? (WWTP, FSTP, wetlands, landfill, official open land, or nothing?	Ruai	Changamwe	Nyalenda (Stabilization Pond)
What is the m3 capacity of this treatment facility?		17,000	2,000
Where is it located? (Center of city, edge of city, outside city..?)	Edge of the city	Edge of the city	Edge of the city
What is the dumping fee truckers have to pay? USD (Per Truck)	2.17	10.87	-
Is this payment per trip or per month or m3 or?	Per Trip	Per Trip	N.A.

3.4.2.1.28 *FS End Re-Use in the three cities Kisumu, Mombasa and Nairobi*

FS re-use in all the cities is acceptable among the local residents. FS End re-use occurs at two levels one-Macro FS re-use undertaken by FSTP's and second Micro FS re-use undertaken by small FS processors including bio-centres.

Macro FS re-use by FSTP's

FSTPs in the 3 cities have generally underperformed; consequently there are marginal sales of treated FS. However, across the three towns, the management of the FSTP's would like to carry out public sensitization and awareness campaigns to increase the acceptability of treated FS particularly in agroforestry. Treated FS in Kisumu sells at USD 1.25 per tonne when available. Treated FS sell at USD1.45 per tonne in Nairobi and is often unavailable. There have not been any treated FS sales in Mombasa over the last 12 months. The main challenges with sales of treated FS are logistical given that the product is bulky and not packaged. Logistical problems therefore arise in the transportation and distribution process.

Micro FS re-use by Bio-centres

Micro FS re-use takes place under a framework referred to as bio-centres (Figure 3-33). Bio-centres are public sanitation –toilet and bathroom-facilities operated on a pay for use basis. Bio-centres are located more often than not in high density settlements –slums- and provide access to superior sanitation services for residents. More than 100 bio centres exist in the 3 cities studied. Amongst the bio-centres, FS-re-use takes place through the generation of biogas which is used for cooking purposes within cooking facilities present at these centres. The cooking facilities are more cost-effective on a fuel basis for the households as well as much more friendly to the users vis a vis the alternatives of wood fuel and kerosene. The daily biogas output of a standard bio-centre is 12 cubic meters of gas.

Figure 3-33 : Construction of Bio- center; Kisumu (left); Stara Bio-centre; Nairobi

3.4.2.1.29 *Market Demand and supply analysis*

The survey was conducted across the cities revealing the following varied statistics on households, sanitation facilities distribution and mode of emptying (Table 3-123).

Table 3-123 : Statistics on Households, Sanitation Facilities and Mode of Emptying

	Cities		
FS Collection Calculations	**Nairobi**	**Mombasa**	**Kisumu**
Number of households in the city	985,016	140,535	148,494
% of the city HH with On-site sanitation	51%	82%	84%
Number of the city HH with On-site sanitation	502,839	115,228	124,830
% HH with Onsite sanitation in the city			
Pits	66%	54%	80%
Septic tanks	13%	21%	17%
OTHER (i.e. cesspools, holding tanks)	21%	25%	2%
# of HH with on-site sanitation			
Pits	331,874	62,223	99,864
Septic tanks	65,369	24,198	21,720
OTHER (i.e. cesspools, holding tanks)	105,596	28,807	2,871
	502,839	**115,228**	**124,456**
% of HH with O-S in the city using Mec. Emp			
Pits	38%	7%	17%
Septic tanks	71%	8%	53%
OTHER (i.e. cesspools, holding tanks)	84%	8%	87%
% of HH with O-S in the city using Man. Emp			
Pits	62%	93%	83%
Septic tanks	29%	92%	47%
OTHER (i.e. cesspools, holding tanks)	16%	92%	13%
% of HH with On-site sanitation using			
Mec Emp	52%	7%	25%
Man Emp	48%	93%	75%
	100%	**100%**	**100%**
# of HH with O-S using Mec Emp			
Pits	126,112	4,356	16,977
Septic tanks	46,412	1,936	11,512
OTHER (i.e. cesspools, holding tanks)	88,701	2,305	2,498
	261,225	**8,596**	**30,987**
# of HH with O-S using Man Emp			
Pits	205,762	57,868	82,887
Septic tanks	18,957	22,262	10,209
OTHER (i.e. cesspools, holding tanks)	16,895	26,502	373

	241,614	**106,632**	**93,469**
Other			
Typical volume of the septic tank (SV)	5	5	5
Typical volume of the pits (PV)	3	3	3
Typical volume of the Cesspool (CV)	5	5	5
Fecal sludge ratio on pits	0.6	0.6	0.6
Fecal sludge ratio on septic tanks	1	1	1
Number of Users	6	6	6
Number of trucks	60	11	4
Capacity of trucks	12	16.4	7.5
Number of trips per year	416	156	208
Trips per year			
*Nairobi- 4 trips for every 3 days for 6 days			
*Mombasa- 3 trips for every 3 days for 6 days			
*1 trip everyday for 6 days			

3.4.2.1.30 *City demand and supply analysis*

Nairobi

The annual demand for FS management services is estimated at 4,604,701 m^3 and the mechanical supply for those services is estimated to cater for only 299,520 m^3 at present representing 10% service delivery rate (Table 3-124). On the other hand, the manual supply has an annual demand of approximately 1,808,010 m^3 which represents about 35% service delivery rate.

Table 3-124 : Nairobi City FS Demand and Supply Data

	Pit latrines (PL)				Septic Tanks (ST)				Cess pools (CP)				Total FS Volume
Emptying frequency	%	# of HH	PL	V Pit (2.6 M^3)	%	# of HH	ST (5 M^3)	V ST	%	# of HH	CP(5 M^3)	V CP	
Mechanical P1 me													
Two times/ yr	32%	39,935	79,871	207,664	42%	19,580	39,160	195,801	26%	22,728	45,455	227,276	630,741
Once/yr	16%	19,968	19,968	51,916	16%	7,614	7,614	38,072	10%	8,523	8,523	42,614	132,603
After 2-4 years	6%	7,357	1,839	4,782	4%	1,813	453	2,266	5%	4,419	1,105	5,524	12,572
Once every three months	47%	58,852	235,409	612,064	38%	17,405	69,618	348,090	60%	53,031	212,124	1,060,622	2,020,776
Number of HH emptied P me M^3	***100%***	***126,112***	***337,087***	***876,426***	***100%***	***46,412***	***116,846***	***584,230***	***100%***	***88,701***	***267,207***	***1,336,036***	***2,796,692***
Manual P1 Ma													
Two times/ yr	37%	76,391	152,781	397,231	50%	9,479	18,957	94,785	60%	10,137	20,274	101,372	593,389
Once/yr	7%	13,553	13,553	35,238	38%	7,109	7,109	35,544	0%				70,783
After 2-4 years	4%	7,393	1,848	4,805	13%	2,370	592	2,962	40%	6,758	1,690	8,448	16,215
Once every three months	53%	108,425	433,701	1,127,624	0%				0%				1,127,624
Number HH emptied P ma M^3	***100%***	***205,762***	***601,884***	***1,564,898***	***100%***	***18,957***	***26,658***	***133,292***	***100%***	***16,895***	***21,964***	***109,820***	***1,808,010***
TOTAL (Me and Ma)		**331,874**	**938,971**	**2,441,324**		**65,369**	**143,504**	**717,521**		**105,596**	**289,171**	**1,445,856**	**4,604,701**

Market Demand and Supply M^3	% (D)	Demand M^3	% (S)	Supply M^3	% (D/S)	Excess D/S M3	Service Delivery
Volume of FS emptied Mech M^3	61%	2,796,692	32%	299,520	68%	2,497,172	11%
Volume of FS emptied Man M^3	39%	1,808,010	68%	629,766	32%	1,178,244	35%
Total Volume FS Produced M^3	**100%**	**4,604,701**	**100%**	**929,286**	**100%**	**3,675,416**	**20%**

The capacity to cater for more demand exists in the current operating environment both for mechanical and manual operators, however due to the hazardous nature of manual FS extraction; mechanical extraction if well developed as a service may experience the needed growth to meet the excess demand. There is a huge potential for the operators to operate above their current averages, although it may not exceed 6 times their current number of trips given the infrastructural limitations, vehicle capacities and number of vehicles currently in operation. As such the gap for mechanical emptiers to meet current demand is approximately 2,497,172 m^3 which demands for more trucks to the business and additional tipping destinations preferably well managed transfer points that reduce travel distances.

Mombasa

The annual demand for FS management services is estimated at 853,341 m^3 and the mechanical supply for those services is estimated to cater for 28,142 m^3 representing 3% service delivery rate and 261,766 m^3 in manual extraction supply, representing 30% service delivery rate (Table 3-125). From the study it was established that a substantial number of households do not use the mechanical services but opt for manual services. These households was estimated to produce a total of 50,930 m^3 annually in FS, however the mechanical supply was estimated at

28,142 $m^{3,}$. This implies that the operators operated with underemployed capacity and in some cases had to make trips to the dumping site with half-filled tanks. On the other hand, the manual supply has an annual demand of approximately 802,411 m^3 and a corresponding 261,766 m^3 annual supply from manual operators which represents about 33% service delivery rate.

The capacity to cater for more demand exists in the current operating environment both for mechanical and manual operators, however since there is excess supply for manual extraction there is need to seal the leakages into the manual extraction due to the hazardous nature of manual FS extraction; mechanical extraction if well developed as a service may experience the needed growth to meet the excess demand.

Table 3-125 : Mombasa City FS Demand and Supply Data

	Pit latrines (PL)				Septic Tanks (ST)				Cess pools (CP)				Total FS Volume
Emptying frequency	**%**	**# of HH**	**PL**	**V Pit (2.6 M^3)**	**%**	**# of HH**	**ST (5 M^3)**	**V ST**	**%**	**# of HH**	**CP(5 M^3)**	**V CP**	
Mechanical P1 me													
Two times/ yr	34%	1,493	2,987	7,765	46%	893	1,787	8,935	43%	988	1,975	9,877	34%
Once/yr	17%	747	747	1,941	23%	447	447	2,234	21%	494	494	2,469	17%
After 2-4 years	14%	622	156	404	31%	596	149	745	36%	823	206	1,029	14%
Once every three months	34%	1,493	5,973	15,531	0%				0%				34%
Number of HH emptied P me M^3	***100%***	***4,356***	***9,862***	***25,642***	***100%***	***1,936***	***2,383***	***11,913***	***100%***	***2,305***	***2,675***	***13,375***	***100%***
Manual P1 Ma													
Two times/ yr	23%	13,354	26,708	69,441	53%	11,873	23,746	118,731	44%	11,739	23,479	117,393	23%
Once/yr	16%	9,348	9,348	24,304	33%	7,421	7,421	37,103	22%	5,870	5,870	29,348	16%
After 2-4 years	24%	13,799	3,450	8,969	13%	2,968	742	3,710	1%	356	89	445	24%
Once every three months	37%	21,366	85,466	222,211	0%				32%	8,538	34,151	170,754	37%
Number HH emptied P ma M^3	***100%***	***57,868***	***124,972***	***324,926***	***100%***	***22,262***	***31,909***	***159,545***	***100%***	***26,502***	***63,588***	***317,940***	***100%***
TOTAL (Me and Ma)		**62,223**	**134,834**	**350,568**		**24,198**	**34,291**	**171,457**		**28,807**	**66,263**	**331,315**	

Market Demand and Supply M^3	**% (D)**	**Demand M^3**	**% (S)**	**Supply M^3**	**% (D/S)**	**Excess D/S M3**	**Service Delivery**
Volume of FS emptied Mech M^3	6%	50,930	10%	28,142	4%	22,787	55%
Volume of FS emptied Man M^3	94%	802,411	90%	261,766	96%	540,645	33%
Total Volume FS Produced M^3	100%	853,341	100%	289,908	100%	563,433	34%

***NB: SF –Sanitation facility**

To effectively meet the market demand, the operators will have to increase their popularity and penetration into the manual demand and convert that to mechanical extraction. There is a huge potential for the operators to operate above average, although it may not exceed 6 times their current number of trips given the infrastructural limitations, vehicle capacities and number of vehicles currently in operation. As such the gap for mechanical emptiers to meet current

demand is approximately 22,787 m^3 which demands for more trucks to the business and additional tipping destinations preferably well managed transfer points.

Kisumu

The city has three mechanical operators operating a total of four trucks among them. It has an estimated annual demand for FS management services of 691,903 m^3 and the mechanical supply for those services is estimated to cater for only 6,240 m^3 at present representing a 1% service delivery rate. On the other hand, the manual supply has an annual demand of approximately 508,431 m^3 and a corresponding 266,549 m^3 annual supply from manual operators which represents about 35% service delivery rate (Table 3-126). The capacity to cater for more demand exists in the current operating environment both for mechanical and manual operators.

Table 3-126 : Kisumu City FS Demand and Supply Data

	Pit latrines (PL)				Septic Tanks (ST)				Cess pools (CP)				Total FS Volume
Emptying frequency	%	# of HH	PL	V Pit (2.6 M^3)	%	# of HH	ST (5 M^3)	V ST	%	# of HH	CP(5 M^3)	V CP	
Mechanical P1 me													
Two times/ yr	48%	8,225	16,450	42,769	14%	1,625	3,250	16,252	0%				59,021
Once/yr	15%	2,531	2,531	6,580	56%	6,501	6,501	32,504	69%	1,729	1,729	8,646	47,730
After 2-4 years	14%	2,425	606	1,576	15%	1,761	440	2,201	31%	769	192	961	4,738
Once every three months	22%	3,796	15,184	39,479	14%	1,625	6,501	32,504	0%				71,983
Number of HH emptied P me M^3	***100%***	***16,977***	***34,771***	***90,405***	***100%***	***11,512***	***16,692***	***83,461***	***100%***	***2,498***	***1,921***	***9,607***	***183,472***
Manual P1 Ma													
Two times/ yr	49%	40,747	81,494	211,885	37%	8,220	7,539	37,693	0%				249,578
Once/yr	27%	22,463	22,463	58,404	18%	1,885	1,885	9,423	100%	373			67,827
After 2-4 years	11%	9,229	2,307	5,999	8%	785	196	982	0%				6,980
Once every three months	13%	10,448	41,792	108,659	37%	3,769	15,077	75,387	0%				184,045
Number HH emptied P ma M^3	***100%***	***82,887***	***148,056***	***384,946***	***100%***	***14,659***	***24,697***	***123,485***	***100%***	***373***			***508,431***
TOTAL (Me and Ma)		**99,864**	**182,827**	**475,351**		**26,171**	**41,389**	**206,945**		**2,871**	**1,921**	**9,607**	**691,903**

Market Demand and Supply M^3	% (D)	Demand M^3	% (S)	Supply M^3	% (D/S)	Excess D/S M3	Service Delivery
Volume of FS emptied Mech M^3	27%	183,472	2%	6,240	42%	177,232	3%
Volume of FS emptied Man M^3	73%	508,431	98%	266,549	58%	241,882	52%
Total Volume FS Produced M^3	**100%**	**691,903**	**100%**	**272,789**	**100%**	**419,114**	**39%**

***NB: SF –Sanitation facility**

3.4.2.1.31 *Operational Analysis*

One truck operators

Two operators, in Kisumu and Nairobi have greater operational efficiency as shown by their gross margins of 79 % each compared with the Mombasa operator (Table 3-127). Considering that all the operators have the same number of trucks, Kisumu operator can be concluded to be

more efficient since he is able to retain a greater portion of his revenue despite the revenue being lower than for Nairobi and Mombasa operators.

Table 3-127 : Operational Analysis of One Truck Operators

One Truck Operators	KISUMU	MOMBASA	NAIROBI
	USD	USD	USD
Gross Margin	79%	61%	79%
Net Profit/loss Margin	29%	-123%	36%
Contribution Margin	(2,463.65)	(24,587.65)	12,365.75
Contribution margin Per Truck	(2,463.65)	(24,587.65)	12,365.75
Contribution margin per trip	(8.55)	(173.15)	35.69
Revenue per Trip	51.50	124.00	80.50
Revenue Per Truck	14,832.00	17,608.00	27,893.25
Trip Per Truck	288	142	347
Fixed Cost per trip	10.71	48.01	16.54
Fixed Cost Per Truck	3,084.83	6,817.39	5,730.50
Variable Cost Per trip	60.05	297.15	44.81
Variable cost per Truck	17,295.65	42,195.65	15,527.50
Number of Trucks	1	1	1
Number of Trips	288	142	347
Distance Covered in KM	2,304	1,207	9,356

Two Trucks Operators

The operating margins are within trend (Table 3-128). The variation that leads to a negative position of the Mombasa two truck operators may be on account of the cost of the trucks and the resulting amount of depreciation charge.

Table 3-128 : Operational Analysis of Two Truck Operators

Two Truck Operators	KISUMU	MOMBASA	NAIROBI
	USD	USD	USD
Gross Margin	60%	76%	75%
Net Profit/loss Margin	39%	46%	50%
Contribution Margin	1,887.65	(243.26)	37,168.00
Contribution margin Per Truck	943.83	(121.63)	18,584.00
Contribution margin per trip	6.55	(0.94)	70.39
Revenue per Trip	94.42	107.50	108.00
Revenue Per Truck	13,596.00	13,867.50	28,512.00
Trip Per Truck	144	129	264
Fixed Cost per trip	38.00	25.74	26.86
Fixed Cost Per Truck	5,471.76	3,320.65	7,090.76
Variable Cost Per trip	87.86	108.44	37.61
Variable cost per Truck	12,652.17	13,989.13	9,928.00
Number of Trucks	2	2	2
Number of Trips	258	528	288
Distance Covered in KM	2,193	14,256	4,224

Four Truck Operators

Four truck operators are consistently profitable in the two cities. Equally these large fleet operators appear to prefer larger capacity vehicles.

Table 3-129 : Operational Analysis of Four Truck Operators

Two Truck Operators	KISUMU	MOMBASA	NAIROBI
	USD	USD	USD
Gross Margin		82%	64%
Net Profit/loss Margin		38%	122%
Contribution Margin		41,808.00	12,948.07
Contribution margin Per Truck		10,452.00	3,237.02
Contribution margin per trip		25.62	39.72

Revenue per Trip		79.00	205.40
Revenue Per Truck		32,232.00	16,740.28
Trip Per Truck		408	81.5
Fixed Cost per trip		14.15	74.83
Fixed Cost Per Truck		5,771.50	6,098.37
Variable Cost Per trip		53.38	165.68
Variable cost per Truck		21,780.00	13,503.26
Number of Trucks		4	4
Number of Trips		1632	326
Distance Covered in KM		14,029	2,771

Break Even Analysis

Sales Revenue – Variable Cost = Contribution Margin

Therefore: - Contribution Margin – Fixed Cost =Operating Income or loss

The comparative table (Table 3-130) on the operators indicates that economies of scale do not necessarily set in with the number of trucks owned and operated. This could be for a number of factors such as number of truck breakdowns, the pattern of demand and variability of truck capacities. In addition the operators have different models in the nature of employment of their personnel. As the industry is unregulated, it is unclear what the optimal number of trucks would be, and what level of service demand would be needed to ensure operational sustainability.

Table 3-130 : Operations Data Comparison of One, Two and Four Truck Mechanical Operators

	KISUMU, MOMBASA AND NAIROBI		
Macroeconomic & business size data	**ONE TRUCK OPERATOR**	**TWO TRUCKS OPERATOR**	**FOUR TRUCKs OPERATOR**
Inflation (CPI)	17%	17%	17%
Any other inflation index	0%	0%	0%
Number of trucks	1	2	4
Number of drivers	1	2	4
Number of turn	2	2	2

boys per Truck								
Other Parameters	**KSM**	**MSA**	**NBO**	**KSM**	**MSA**	**NBO**	**KSM MSA**	**NRB**
Distance covered per year (Km)	2,304	1,207	9,356	4,224	2,193	14,256	2,771	14,029
Number of trips per annum	288	142	347	288	258	528	326	1632
Fuel consumption	3,130.43	1,543.48	8,662.50	5,739.13	2,804.35	13,200.00	3,543.48	40,800.00
Tariffs	51.50	124.00	80.50	94.42	107.50	108.00	205.40	79.00

Operator BEP analysis

For both Mombasa and Kisumu one truck operators, their businesses have negative contribution margins which imply that they are making losses. In each case, to break even, operators have two options; they can either increase the number of trips one makes per year to 396 from 288 or increase the tariff charge per trip to $ 70.77 for the same number of trips they need to make per year (Table 3-131). While for the second operator in Mombasa, they need to increase his number of trips to 395 per year from 142 or double the tariff charge per trip to USD 345 for the same number of trips.

Table 3-131 : Mechanical Operators BEP Analysis – Kisumu, Mombasa and Nairobi

	One truck Operators			**Two trucks operators**			**Four trucks operators**	
	Kisumu	**Mombasa**	**Nairobi**	**Kisumu**	**Mombasa**	**Nairobi**	**Mombasa**	**Nairobi**
Revenue	14,832.00	17,608.00	27,893.25	27,192.00	27,735.00	57,024.00	66,961.11	128,928.0
Fixed Expenses	3,084.83	6,817.39	5,730.50	10,943.52	6,641.30	14,181.52	24,393.48	23,086.00
Variable Expenses	17,295.65	42,195.65	15,527.50	25,304.35	27,978.26	19,856.00	54,013.04	87,120.00
Gross margin	79%	61%	79%	60%	76%	75%	64%	82%
Net gain/loss	29%	-123%	36%	39%	46%	50%	122%	38%
Contr-Margin MaMaMargin	(2,463.65)	(24,587.65)	12,365.75	1,887.65	(243.26)	37,168.00	12,948.07	41,808.00
CM per truck	(2,463.65)	(24,587.65)	12,365.75	943.83	(121.63)	18,584.00	3,237.02	10,452.00
CM per trip	(8.55)	(173.15)	35.69	6.55	(0.94)	70.39	39.72	25.62
Revenue per Trip	51.50	124.00	80.50	94.42	107.50	108.00	205.40	79.00
Revenue Per Truck	14,832.00	17,608.00	27,893.25	13,596.00	13,867.50	28,512.00	16,740.28	32,232.00

Trip Per Truck	288	142	347	144	129	264	81.5	408
Fixed Cost per trip	10.71	48.01	16.54	38.00	25.74	26.86	74.83	14.15
Fixed Cost Per Truck	3,084.83	6,817.39	5,730.50	5,471.76	3,320.65	7,090.76	6,098.37	5,771.50
Variable Cost Per trip	60.05	297.15	44.81	87.86	108.44	37.61	165.68	53.38
Variable cost per Truck	17,295.65	42,195.65	15,527.50	12,652.17	13,989.13	9,928.00	13,503.26	21,780.00
Number of Trucks	1	1	1	2	2	2	4	4
Number of Trips	288	142	347	288	258	528	326	1632
Distance Covered in KM	2,304	1,207	9,356	4,224	2,193	14,256	2,771	14,029
BEP Revenue	20,380.48	49,013.04	21,258.00	36,247.87	34,619.56	34,037.52	78,406.52	110,206.00
BEP #Trips per truck	396	395	264	192	161	158	95	349
BEP Tariff	70.77	345.16	61.26	125.86	134.18	64.47	240.51	67.53
Price variance	37%	178%	-24%	33%	25%	-40%	17%	-15%

The price variance in order to break even and become profitable is 37% and 178% respectively. Due to the price sensitivity nature of this kind of business and the high level of competition increasing the tariff may be difficult due to clientele flight to cheaper service providers. It is also very likely that the number of trips reported is far below the actual trips by the operators.

In the case of two truck operators only Mombasa operator yields a negative contribution margin. For this operator to break even they need to increase the number of trips per truck to 161 per year from the current 129 trips or increase the charges to USD 134 from 108 charged currently.

Sensitivity and risk analysis

The trucks in use have an average age of 25 years meaning they are inefficient and use old technology which is expensive. Some operators have trucks with smaller capacity and they have better chance of increasing their revenues especially when they are dealing with large institutions since they can make numerous trips and billings is made against trips as opposed to truck capacity.

The truck owner has in many cases no way of validating the number of trips made since clients are not issued with receipts. The dumping sites are not properly controlled and largely truck

drivers do not record the trips they make. The truck owners incur more cost trying to monitor the business.

3.4.2.2 Sustainable Business Models across the Common Parameters

Micro-Finance Fund Model

In most urban areas especially low income areas such as the informal settlements, the challenges of managing fecal sludge are enormous. This is compounded by the fact that most slum areas are inaccessible and lack basic social amenities, while those available are in deplorable conditions.

To address the challenges of fecal sludge management, there is need to empower FSM service providers by offering low cost targeted credit, which they may then use to acquire tools, machines and equipment essential for the effective delivery of their services.

Reasons for establishment of a micro-finance fund include:

1. **High cost of Credit:** Unfortunately, commercial bank offer credit at high interest rate which makes it unviable for many borrowers as the servicing costs are too high.
2. **Small loan size:** In addition high rates of interest imply a very low maximum loan account. For many service providers large loans are necessary for these operators to transition from micro to small and then to medium sized enterprises. Accessing credit at high interest rates always exerts too much pressure on the business cash flow since the loan must be serviced.
3. **Unfamiliarity with FSM:** Many commercial banks are unfamiliar with the FSM sub sector and do not have appropriate credit facilities available to such borrowers.
4. **MFI's operate small loan sizes:** Existing MFI's have very low credit limits which are not suited for the required lump sums by industry operators.

To overcome these challenges a specialty funded micro-finance fund would be established to augment an existing one operated by SANA. SANA which has been operating such a microfinance model and fund targeted at sanitation services that has enhanced the access to credit to the sub-sector scheme albeit at a micro capitalization level relative to the demand for funding.

SANA is a specialist water and sanitation sector NGO, implementing projects in Nyanza – in both urban and rural areas of the province. Through its commercial arm – SANA Holdings Ltd, the

NGO is currently offering credit to 7 water and sanitation associations in Nyanza, enabling some 35,000 people to access safe water supplies and sanitation.

The Study Team found the SANA Credit for Water and Sanitation model quite an interesting initiative – which could fittingly be replicated in the FSM system. Here below is highlighted the main features of the SANA Model.

1. Previous sanitation initiatives – mainly through donor grants, have failed to improve access to sanitation by the majority of the population, mainly because of hijacking by the rich and unsustainability of installed facilities.
2. Sanitation has in the past been accorded a rather low priority – vis-à-vis water – resulting in sanitation being denied access to adequate investment finance.
3. Hence, the main objective of sanitation loans is to enable for the establishment of a revolving loan fund pool – exclusively dedicated to sanitation development: at the household level and public places – in low income areas.
4. The target beneficiaries are women groups and self-help groups (50% must be women) – with a membership of 10-30 people. Whilst the group acts as the main security for the loans disbursed, individual members are expected to save monthly into the collective pool and service disbursed loans.
5. After servicing sanitation loans, members can venture into other related income generating activities, e.g. solid waste management (and hence possibility exists here for FSM?)

Bio-Centre Model

Throughout the developing world many of the urban poor depend on informal, private small-scale providers for sanitation services. These entrepreneurs receive no government resources but survive by offering services that the consumers want and are willing to pay for. Small Scale Providers (SSPs) mostly provide manual emptying services to the slum dwellers since mechanical emptiers cannot access the slums due to overcrowding and lack of infrastructure. SSPs were thought to offer only temporary, short-term solutions to the increasing and unmet demand for sanitation services and were often ignored by government policy makers and donors. But there is growing recognition that a meaningful response to the needs of low-income and informal areas must involve partnerships between small entrepreneurs and formal utilities.

One of the reasons for this change in attitude is the persistent failure by municipalities and public utilities to meet service demands in slum settlements that develop on the outskirts of cities and towns. This gap can be filled by SSPs who have shown remarkable resourcefulness in finding simple, but effective, solutions often under the most adverse operating conditions.

The high population density, unplanned and crowded housing, and lack of infrastructure have resulted in poor provision of environmental and social services in most slums areas. Furthermore most slums areas are inaccessible to vehicles, drainage channels on the sides of the roads are often blocked, pit latrines overflow (especially in the rainy season) and heaps of uncollected garbage is everywhere. Taking all these factors into consideration the construction of a bio-centre would offer an opportunity to provide sanitation facilities while addressing the issue of fecal management.

A bio-centre is a bio sanitation unit that provides secure and adequate access to sanitation and income generation by converting human waste (fecal sludge) into biogas and fertilizer (liquid and solid). Bio centres contain sanitation facilities such as showers and toilets and are mostly located in slums areas where access to sanitation is low or non existence. The households that are served by the bio-centre pay a small fee of about USD 5 cents (Kshs. 5) to access it.

The bio-centre also contains a digester which is used to process fecal sludge to produce biogas and fertilizer. The biogas is used for cooking. The major advantage of using biogas over kerosene is reduction of health complications like respiratory problems caused by use of kerosene while reducing gases emitted to the environment.

Reasons for establishment of Bio-Centres include:

- **Positive Impact on Health**: The location of bio-centre in a slum area has the highest impact on hygiene and health; it offers an alternative and better access to sanitation. Sanitation facilities in slums are close to non existent, even the few available are in dilapidated conditions. One latrine is often used by several households or even several plots (a plot refers to a group of rooms either belonging to the same owner or placed side by side), which means up to 150 people may be sharing a single latrine. In many cases the latrines lack privacy and security, are unhygienic and in poor condition with gaping holes in the walls, broken doors and filled pits.

Where neither private nor public latrines are available, many residents have had to resort to using plastic bags that are then dumped in alleys and ditches – a practice called "flying toilets". In the already overcrowded slums, lack of adequate water supply, solid waste management, excreta disposal, drainage and wastewater management impact severely on public health. Most of the widespread diseases in these slum areas are linked directly to inadequate water and sanitation provision (diarrhoea, skin diseases, typhoid, tuberculosis, malaria).

- **Cultural Acceptance :** The concept of bio-centre has a cultural acceptance in that the sanitation facilities are located outside households like in majority of rural areas.
- **Income and Employment generating and economically self sustaining :** The centre also offer a source of employment to the community through the construction and management of such centres. There is considerable expertise in selecting an ideal site of a bio centre and construction of one as is undertaken by Umande Trust in Kenya. Funding the construction of bio centres therefore has multiple benefits to the community most of all economic, health and social.

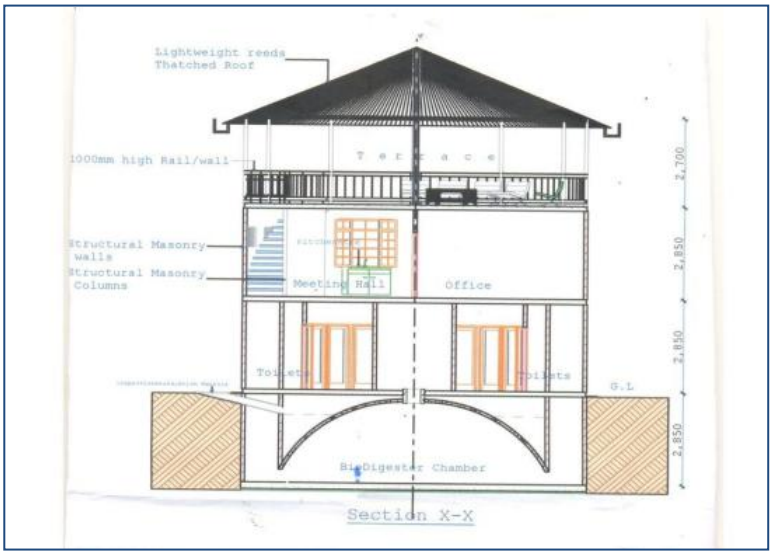
Umande Trust

Umande is a rights-based agency supporting community-based initiatives in Kenya. It currently has operations in Nairobi (where its head office is located), Kisumu and Embu town. It's main focus area of operation is water and sanitation: financing investment and eco-friendly technologies.

In Kisumu, it has operations in 4 slums of Bandani, Obunga, Manyatta and Nyalenda – where it has financed community members' sanitation facilities through its Sanitation Development Fund (SANDEF). Umande's flagship initiative however is the Bio-Sanitation Center of which at the national level Umande operates more than 48 bio-centres.

- Design

The bio centre pre construction process starts with a design of a bio digester a shown in Figure 3-34.



Courtesy: Umande Trust

Figure 3-34 : Bio Centre Construction

After the completing the design of the centre, the site is selected and the work of constructing it begin with excavation and laying of the foundation as shown in Figure 3-35.

Courtesy: Umande Trust

Figure 3-35 : Excavation and Laying of Foundation for Bio-Centre

The dome and super structure are also constructed as shown below in Figure 3-36.

Courtesy: Umande Trust

Figure 3-36 : The dome and super structure of a Bio-centre

A complete bio-centre is shown in Figure 3-37.

Figure 3-37 : Complete Bio-Centre

- Location

The location of a bio-centre should be in low income areas with low access to sanitation facilities. One bio-centre can serve households within a radius of up to sixty metres. Such a facility would have a huge impact in provision of sanitation facilities to many households given the nature of congestion in slums.

- The Treatment Process and Value Addition

The fecal sludge is treated in the digester to produce biogas and organic fertilizer. A digester operates as shown in Figure 3-38. The biogas is piped to household who use is as a source of energy.

➢ Implications

- Social Implications

The bio-centre offers an opportunity to provide basic social amenities like toilets to many households since one bio-centre can serve households within the radius of up to sixty metres. As existing amenities are often in deplorable conditions in slum areas, construction of a bio-centre would enhance the human dignity of households living there.

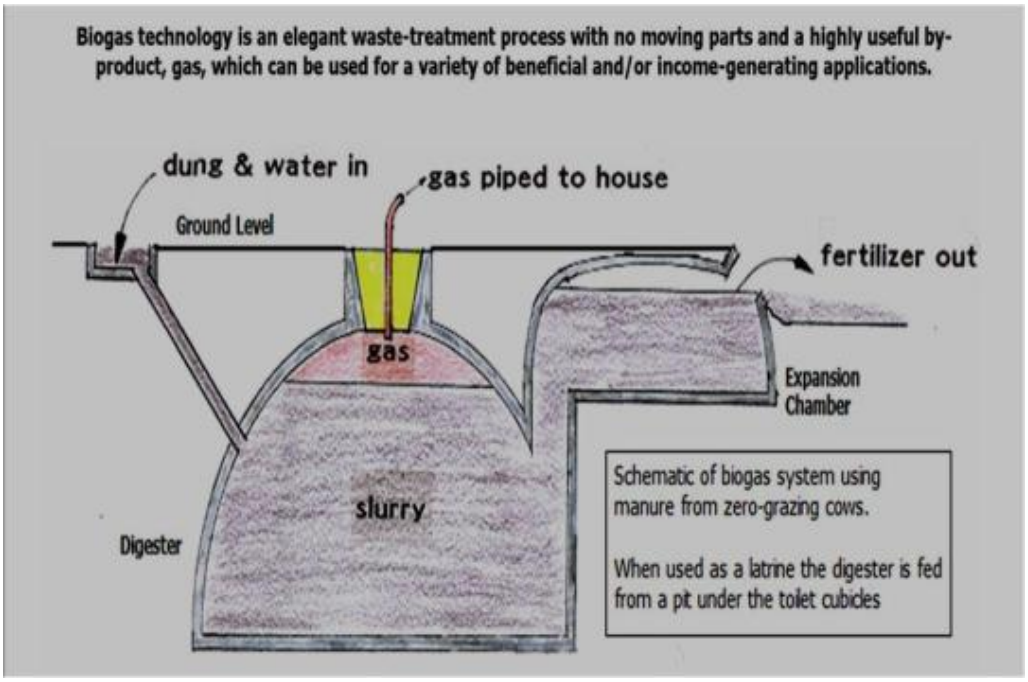


Figure 3-38 : Schematic of Feacal Sludge Digester

- Financial Implication

  Construction of bio-centre offers employment opportunities to communities residing where it is located. A community can be empowered by allowing them to run the centre's thus earning a source of income. The biogas is a cheap source of green energy meaning it will reduce expenses incurred by household purchasing kerosene which is expensive since it is dependent on international crude oil prices.

The use of biogas also reduces medical expenses incurred by household who use kerosene since it has a negative effect on their respiratory systems. The biogas can also be supplied to middle income households who live nearby at a much higher price. The production of organic fertilizer would also increase the income earned by the community making the venture viable in the long term.

FS Treatment Plant Model

Across the three cities two broad types of treatment plants/dumping sites are known to exist, one-conventional type and two stabilization pond type. The conventional type includes is ideal for treating FS for re-use especially where quality control standards are to apply to mitigate the poor processing of heavy metals. However the production of treated FS is very low and the availability is also irregular.

Therefore investing in enhancing Treatment plants would increase production. The enhancement would be for product drying, packaging and distribution. Treated FS is more affordable than commercial fertilizers. The acceptability of treated FS re-use would be raised by increased public education, though already there is FR-re-use acceptability. Investing in modernizing FSTP to rely less on weather for the drying process would increase annual output. Kenya has wet conditions for 8 months of the year. In addition, because of the bulky nature of treated FS packaging would ease transportation and distribution to market. The large share of agriculture in the economy at 24% of GDP would offer a market for the use of treated FS.

In the conventional type, there is use of mechanical aeration, filtration and discharge in treatment of fecal sludge. At the inlet the fecal sludge is filtered for solids and metals before being released into a tank where it is stirred for effective concentration. The fecal sludge is then moved to filtration tank and then to sedimentation tank which has a filter of rocks and sands for separation of solid and liquid. Wastewater treatment standards are included in the design such as a BOD of 560 mg/l or a design of BOD/SS effluent standard of 20/30. The processed fecal sludge which is transforming to organic fertilizer is left to dry naturally in the drying beds. In the drying beds further use of use of ultra violets rays from sunlight to kill micro organisms in the fecal sludge improves quality control in the processing. The challenge in Kenya is the need to hasten the drying process, packaging of the treated FS and distribution of the final product.

Treated FS-re use is acceptable in Kenya. The present processes are slow as the sludge is pumped to the drying beds which depend on the weather to complete the process Figure 3-39.

The beds have under drains which drain excess wastewater back to the treatment plant.

Figure 3-39: First sludge drying bed at Kariobangi Treatment Plant

Drying of the treated sludge depends on weather conditions. It takes an average of two (2) weeks for complete drying of the treated sludge. Kenya generally has 8 wet months in a year, therefore only availing drying opportunities for 20 out of 52 weeks. Moreover as the 20 weeks are grouped in two clusters of 8 weeks (January and February) and 12 weeks (August, September and October), there is variation in production. The ideal is to ensure production through out March, April, May, June and July through industrial drying. In addition to strengthen the market supply of the product storage of the dried sludge would be needed to hold stock ready for distribution.

Figure 3-40 shows portions of already dried sludge ready to be sold. Currently none of the treatment parts in the country has storage facilities for dried sludge since the plants are being operated below capacity. Thus it is sold directly to farmers.

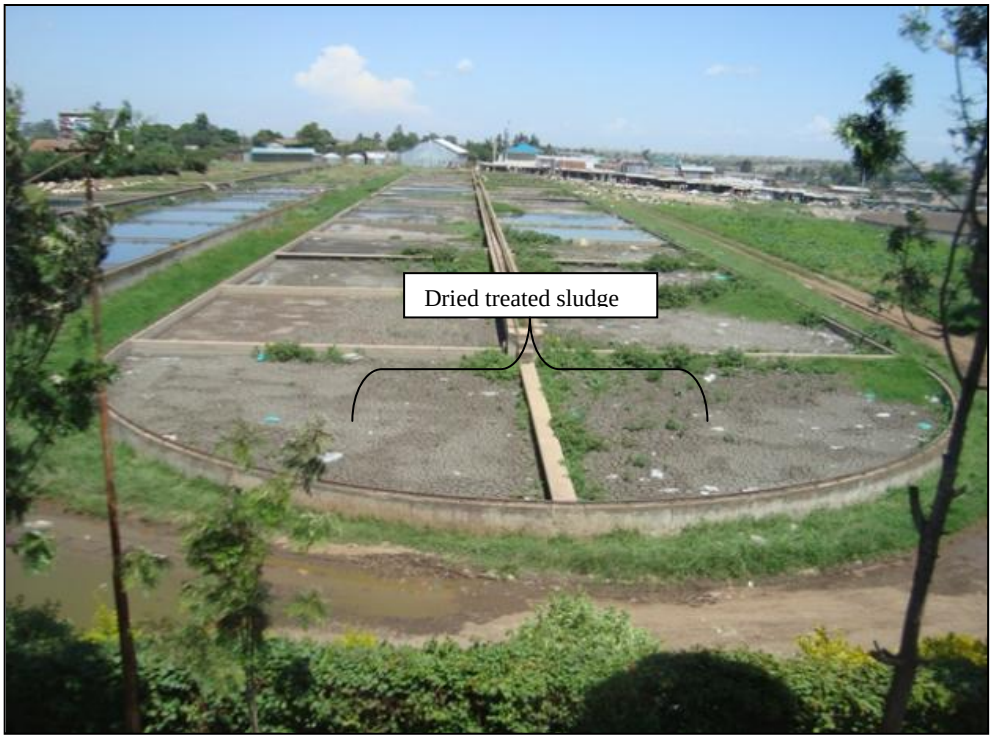


Figure 3-40: Second sludge drying bed at Kariobangi Treatment Plant

The treated and dried FS is sold directly to farmers who use it as night soil for growing a variety of crops such as tea, coffee and in agro- forestry.

Reasons for increasing production:

- **Increase production:** The processed fecal sludge needs to be dried so as to remain with solid organic fertilizer. The drying process is done naturally by leaving the processed fecal sludge in t he field to be dried by the sunlight. The biggest challenge with the present approach is that the process is dependent on the weather. During the rainy and cold season which is 8months of the year, the processed fecal sludge cannot be dried.

In a competitive business value chain, such a scenario would result in a lot of inefficiencies and losses. There is need to fund the treatment plants to acquire drying machines so as to make fecal sludge management a viable business. This will enable the operations to run throughout the year irrespective of the weather conditions.

- **Increase retailing opportunity:** Processed fecal sludge is bulky in nature which makes it very cumbersome and unviable to transport. In order to improve the transportation and distribution logistics of treated sludge, there is need to provide funds for the

establishment of packaging lines at the treatment plants. The packaging line would be able to process many bags per day. This will enable the treatment plants to package the processed fecal sludge in smaller quantities which can be sold at retail stores. This will create market for processed fecal sludge since it is easy to be accessed by small scale farmers.

Treatment plants have been selling treated sludge to local farmers. In general demand far outstrips supply, but transportation remains a big challenge. Most towns are surrounded by large farming settlements and the need for FS based manure would be in great demand, moreover it is by far very affordable. Treated FS costs USD 1.45 per tonne while commercial fertilizer costs USD 900 per tonne. This price differential would be a big driver of demand.

3.5 Details and Recommendations of Business for Investment and Growth

Bio-centres

Sewerage coverage in the 3 cities and across Kenya is very low. Access to quality sanitation is lacking for more than 60% of the population residing in these 3 cities.

The quality of sanitation in the informal settlement areas is in particular very low, sometime lacking and where available fails to meet sanitary standards.

The location of bio-centres in densely populated areas has the highest impact on hygiene and health as it offers an alternative and better access to sanitation. Bio centres may be classified into two categories, namely:

- Bio-centre – Town complex: - this includes bathrooms, toilets and grocery stores. These are often located in the town areas, and often connected to the sewer system. They generally tend to replace public toilet facilities where some were provided in the past by the local authority.
- Bio-centre – Estate complex: this includes bathrooms, toilets, cooking centre, social hall, cyber café, office block and grocery store. These are often located in the settlement areas and act as a service provision initiative, as the informal settlements lack decent facilities. They may or may not be connected to the sewer line, but often they are not connecting to any sewer line. In most cases their location is inaccessible by motor vehicle and therefore emptying is carried out by manual emptiers.

Bio-centres of both kinds are a key initiative in FS management in the 3 cities covered under the study. At present there are more than 100 bio-centres at the national level.

3.5.1 Current Service Levels

Service levels

Bio centre complexes provide at least 6 services (Table 3-132**).**

1. Sanitation facilities:- bathrooms and toilets including hot showers
2. General grocery:- retails household items and refreshments
3. Hire of public kitchen:- this is operated on biogas
4. Social hall for hire:-this is available to members of the public
5. Office space for hire:- this includes very short term lease offices including day hire offices
6. Cyber café services:- this service is available to members of the public

Table 3-132 : Bio –Centre Complex Service Levels

Town Bio-centre Complex	Estate (Residential Area) Bio-centre Complex
1. Sanitation facilities:- bathrooms and toilets including hot showers 2. General grocery:- retails household items and refreshments	1. Sanitation facilities:- bathrooms and toilets including hot showers 2. General grocery:- retails household items and refreshments 3. Hire of public kitchen:- this is operated on biogas 4. Social hall for hire:-this is available to members of the public 5. Office space for hire:- this includes very short term lease offices including day hire offices 6. Cyber café services:- this service is available to members of the public

3.5.2 Current Profitability

Traffic to a very well performing bio-centre sanitation block of 8 toilets and 8 bathrooms exceeds 1000 people per day (Table 3-133).

Table 3-133 : Data on Typical Bio-Centre

High Performing Bio- centre Income Statement	Bio Centre Estate Complex		Bio Centre Town Complex	
Revenues	**Per Month**	**Per Annum**	**Per Month**	**Per Annum**
Sanitation fees	1,034	12,414	1,379	16,548
Gas fees	207	2,483		
Other fees	207	2,483	200	2,400
Total Revenues	**1,448**	**17,379**	**1,579**	**18,948**
Operating Costs				
Salaries	161	1,931	241	2,897
Water fees	14	166	20	240
Electricity	11	138	20	240
Detergents	7	83	15	180
Toiletry	69	828	80	960
Total Costs	262	3,145	376	4,517
Net Income	**1,186**	**14,234**	**1,203**	**14,431**

Source: Umande Trust

These are top performing biocentres and the average profit for bio centres is about USD 400 per month and USD 4,800 per annum. Relative to the cost of a bio-centre, the pay back period is within 5 years.

3.5.3 Projected Profitability in 3-5 years

Unit profitability does not increase rapidly but the group profit of the managing unit is driven by expansion in order to lower unit cost of centralized management. Operation of more than 50 units provides economies of scale. The revenue combined of 50 units would be approximately USD 20,000 per month in profit and more than USD 240,000 per annum.

However, to invest back in the community, a system has to be devised that pays more than 80% of these amounts reported as profit back to the community groups that works within the development of the bio-centre. Therefore scaling up does increase the profitability and sustainability of the entire service as all stakeholders experience welfare improvements.

3.5.4 Investment Required

A single bio centre estate complex costs USD 19,540 to construct. There exists already a large demand for bio centres in the country. The biggest challenge to establishing bio-centres has been funding. The demand is estimated as needing 300 units, therefore requiring a total investment of USD 5.8 million.

The distribution is as follows:

- 170 units in Nairobi
- 80 units in Mombasa
- 50 units in Kisumu

We propose the implementation to be as follows:

- Appointment of a fund administrator: to manage the funds received to be invested in bio-centres and disburse the funds under a micro-finance set-up where then a revolving fund is to emerge.
- Call for Request for Proposals: call out for proposals from interest groups to provide bio-centre implementation.
- Vetting Criteria: Establish criteria for determining the organizations or individuals that would be suitable to work with on the implementation.
- Funding Selection criteria: Establish a criteria for qualifying those who are eligible for funding under the bio-centre funding initiative
- Service provider criteria: In order to ensure greater value for money, establish a listing of accredited service providers which includes bio-centre management service providers, contractors, manual emptiers, mechanical emptiers and social workers. The objective is to ensure value for money as well as building long term capacity in the FSM sub sector.

3.5.5 Risk Analysis

The projects do face numerous risks but those associated with performance are mitigated by careful analysis to understand the environment better and the involvement of the local community as stakeholders. This also secures the project against vandalism or other form of physical destruction.

1. Unsuitable location either by population, acceptance or accessibility. This risk is mitigated by an analytical methodology that is used to evaluate each bio-centre project.
2. Initial low traffic users: This should be mitigated by bringing onboard the local community as stakeholders and working with a community group to champion the use of the facility. In the town centre areas, the role of the local authorities, utility companies and other stakeholders shall be incorporated to provide the project with the sufficient levels of goodwill.

3.5.6 Future Service levels

These include:

1. Sale of treated FS for re-use
2. Sale of piped biogas to households
3. Sale of cylindered biogas to households

Various stakeholders are currently undertaking product research in these areas and are in the process of developing the product prototypes and in other cases there are plans for early stages of product testing in December 2011.

i. Expected Impact

Table 3-134 indicates the city statistics showing the number of households per square kilometers, the area and city population densities. The bio centers are expected to have a social-economic impact to the people within the bio centre proximity and by extension the dwellers of the three cities. Assuming that typical household has at least 6 members, the total population we expect the project to service will be over 200,000 persons (Table 3-135).

Table 3-134 : City Statistics on Population

City	Area km^2	Households	Density per km^2	Population by city
Nairobi	695.1	985,016	4,515	3,138,369
Mombasa	126.2	140,535	4,146	523,183
Kisumu	917.9	148,494	674	618,556
Total	1,739.2	1,274,045		4,280,108

Source:Kenya National Bureasue of Statistics, Census Data 2009

We expect impact at 4 levels

1. Employment
2. Access to quality sanitation
3. Health improvement
4. Industry formalization

Table 3-135 : Projections for Population to be Served

Service radius in meters per Biocentre	**225**
Area Coverage (Km^2) per Biocentre	0.16
Total area in km^2 for the 3 cities	1,739
Households per Sq km	733
Estimated Population (HH)	117
For 300 Bio centers	34,966
Number of Persons Per HH	6
Total Population	209,796

On the whole we expect employment of over 3,000 people on a sustainable basis. More than 10,000 people shall indirectly be employed and well over 100,000 people shall economically benefit from the bio-centre facilities. These employees include- contractors, maintenance staff, administration staff, emptiers, social workers, community workers, shop keepers, farmers, transporters and security personnel.

With 300 bio centre facilities, more than 30,000 families shall receive direct access to improved sanitation especially in the informal settlements. In addition the facilities shall be available to more than 500,000 users across the three cities.

The 30,000 families will have access to better sanitation including more than 150,000 children who are likely to be exposed to a more sanitary environment.

From the level of organization to be brought onboard in executing the implementation of the bio-centres, the FSM sub- sector will enjoy enhanced capacity and develop the much needed formal structures to help shape future national policy. This formalization is likely to improve the welfare of the people and the environments they live in.

CHAPTER 4. CONCLUSION

Following the landscape review of FSM practices in the 3 cities of Nairobi, Kisumu and Mombasa , the findings indicate that most households have on-site sanitation and far too many use manual emptiers as opposed to mechanical emptiers. The main reason for the preference of manual emptiers is affordability. Only 19.5% of Kenyan households are connected to the sewerage system in all the cities and towns in the country. The remainder use on-site sanitation facilities – with the simple pit latrine accounting for whopping 74.1% in the rural areas and 62.5% in towns (Table 4-1).

Table 4-1 : HH by Main Mode of Faecal Waste Disposal – Kenya

	Mode of disposal	% Urban	% Rural
1.	Main Sewer	19.5	0.2
2.	Septic Tank	8.0	0.5
3.	Cess Pool	0.7	0.1
4.	VIP Pit Latrine	5.9	4.3
5.	Pit Latrine (Covered/Uncovered	62.5	74.1

Source: 2009 Kenya Population Census

The data at the City level for Mombasa and Kisumu shows a predominance of on-site sanitation in these two towns (Table 4-2). Nationally, Nairobi remains by far the most sewered town in the country and most towns having on-site sanitation. The rapid urbanization in Nairobi and other towns is increasing the proportion of on-site sanitation comprising of septic tans and cess pools and predominantly pit latrines in the informal settlements. The construction and usage of the simple (or ordinary) pit latrine varies considerably from place to place and in varied socio-economic situations – in regard to safety, hygiene and privacy parameters, so much so that, some could not qualify to be regarded as being “safe and hygienic mode of excreta disposal.”

Table 4-2 : HH by Main Mode of Faecal Waste Disposal-Kisumu, Mombasa and Nairobi

Households statistics	Kisumu	Mombasa	Nairobi	Total
Number of Households	148,494	140,535	985,016	1,274,045
Number of households with onsite sanitation facility	124,830	115,228	502,839	742,897
Households with pit latrines	97,367	62,223	331,874	491,464
Households with Septic tanks	24,966	24,198	65,369	114,533
Households with Cess pools	2,497	28,807	105,596	136,900
Households with sewer connections	16%	18%	49%	42%
Number of households with onsite sanitation facility	84%	82%	51%	58%
Households with pit latrines	66%	44%	34%	39%
Households with Septic tanks	20%	21%	13%	15%
Households with Cess pools	3%	46%	32%	28%

Manual emptying included: closing the pit when full and digging another one, burying the pit, directing the sludge into existing drainage channels or directing liquid FS into farms, closing the pit when full and reusing it after some time when the sludge has reduced (Table 4-3).

Table 4-3 : Methods of Emptying Fecal Sludge in the Three Cities

	Nairobi		Mombasa		Kisumu	
	Mechanical	**Manual**	**Mechanical**	**Manual**	**Mechanical**	**Manual**
% of Method of Emptying by HH with on-site sanitation	52%	48%	7%	93%	25%	75%
% of Share of Volume of FS emptied by method	32%	68%	10%	90%	2%	98%
% of the HH with on-site sanitation having pits in the city emptied	38%	62%	7%	93%	17%	83%
% of the HH with on-site sanitation having septic tanks in the city emptied	71%	29%	8%	92%	53%	47%
% of the HH with on-site sanitation having cesspool in the city emptied	84%	16%	8%	92%	87%	13%
Total (# in absolute terms)	825,741		287,080		269,966	

The methods of fecal sludge emptying as determined by the study indicate that in all the three cities, most households with on-site sanitation facilities use manual emptiers as the main mode of fecal extraction confirming that indeed the main method of emptying sanitation facilities when full is manual based (Table 4-4 and Table 4-5).

Table 4-4 : FS production per City and Method of Emptying

Faecal sludge production	Kisumu	Mombasa	Nairobi	Total
P1 -Fs produced M^3	691,903	853,342	4,604,702	6,142,329
$P1_{me}$ -mechanically emptied M^3 (P1-$P1_{ma}$)	6,240	28,142	299,520	333,902
$P1_{ma}$ -manually emptied M^3(P1-$P1_{me}$)	266,789	261,766	629,766	1,158,321

The study indicated that the operations of mechanical operators remain insufficient to meet the existing demand of emptying services, though neither is the effective demand sufficient to cause the operators to operate at larger capacities. This sluggish effective demand for mechanical emptiers and the extensive use of manual emptiers is most explained by

1. Price and affordability: - many HH opt for manual emptying as mechanical services are unaffordable
2. Illegal dumping: - it was common to observe emptying channels constructed connecting SP or CP to storm drains.
3. Weak enforcement and corruption: Enforcement is generally weak creating room for illegal connections of ST and CS to storm drains.

Table 4-5 : Share of FS Emptying by Manual and Mechanical Emptiers

	Kisumu	Mombasa	Nairobi	Total
$P1_{me}$ -mechanically emptied M^3 (P1-$P1_{ma}$)	**29%**	**7%**	**33%**	**29%**
$P1_{ma}$ -manually emptied M^3(P1- $P1_{me}$)	71%	93%	67%	71%

There are 43 mechanical FS services businesses operating in the cities that among them operate 74 trucks (Table 4-6). These trucks remain by far inadequate to meet the demand for FS

emptying. Across the 3 cities the financial performance of most mechanical operators is dismal and generally record losses.

Table 4-6 : Data on Mechanical Operators in Cities

	Kisumu	Mombasa	Nairobi
# of private mechanical businesses in city	3	14	26
# of trucks run by private businesses	4	10	60
# of trucks owned by utilities	0	0	4
What are utility trucks used for (HH? Govt institutions use, sewer cleaning?			
# of private businesses that are small (1 truck)	1	3	8
# of pvt businesses that are medium (2-5 trucks)	2	3	18
# of pvt businesses that are large (>5 trucks)	0	0	0
What are the capacities of private trucks (m^3)	10	10	8
What are capacities of Utility trucks (m^3)	0	0	10
Price for new truck (10 m^3 capacity) USD-2nd hand import	48,000	48,000	48,000
Price for USED truck (10 m^3 capacity) USD-fabricated	20,000	20,000	20,000

Based on the survey a number of operators run the FS emptying service as part of existing businesses, however, the market leaders in each city were observed to be solely focused on mechanical FS emptying as the core business.

The vast majority of trucks currently in use in all the cities are old and fairly unreliable, and experiencing frequent breakdowns. In the last 6 months however, new trucks into the industry have been procured in departure from past practice. In the past, mechanical emptiers preferred to purchase old trucks and thereafter fabricate the ferrying tanks as well as fit in the needed pumps. However, more recently, the new tanks in two of the three cities have been second hand reconditioned specialized exhauster trucks. This new trend not to attempt local fabrication appears to be informed by experience, economy, maintenance costs and suitability of the specialized trucks. Across the 3 cities there are other challenges experienced by the emptiers besides those associated with trucks and these include a poor regulatory framework.

This is not surprising as the main institutional context for the effective delivery of FSM in Kenya is outlined within the Ministry of Water context and therefore is difficult to operationalize at a city level.

Collected FS by mechanical emptiers is usually dumped at a WWTP. Each of the 3 cities has a single dumping point (Table 4-7). Though the cities operate WWTP none is actively engaged in regular production of treated FS for re-use.

Table 4-7 : Wastewater Treatment Plant in Nairobi, Kisumu and Mombasa

	Nairobi	**Mombasa**	**Kisumu**
What is the official dumping site for city? (WWTP, FSTP, wetlands, landfill, official open land, or nothing?	Ruai	Changamwe	Nyalenda (Stabilization Pond)
What is the m3 capacity of this treatment facility?		17,000	2,000
Where is it located? (Center of city, edge of city, outside city..?)	Edge of the city	Edge of the city	Edge of the city
What is the dumping fee truckers have to pay? USD (Per Truck)	2.17	10.87	-
Is this payment per trip or per month or m3 or?	Per Trip	Per Trip	N.A.

An innovative FSM solution available in low income areas in the 3 cities is the existence of communal sanitation blocks known as bio centres. Bio centres are funded in most instances as a combination of public and private capital under a framework broadly described as public private partnership (PPP). Bio centres may be classified into two namely,

- Bio-centre – Town complex: - this includes bathrooms, toilets and grocery stores. These are often located in the town areas, and often connected to the sewer system. They generally tend to replace public toilet facilities where some were provided in the past by the local authority.
- Bio-centre – Estate complex: this includes bathrooms, toilets, cooking centre, social hall, cyber café, office block and grocery store. These are often located in the settlement areas and act as a service provision initiative, as the informal settlements lack decent facilities. They may or may not be connected to the sewer line, but often they are not

connecting to any sewer line. In most cases their location is inaccessible by motor vehicle and therefore emptying is carried out by manual emptiers.

The location of bio-centre in densely populated areas has the highest impact on hygiene and health as it offers an alternative and better access to sanitation. At present there are more than 100 bio-centres of both kinds at the national level.

Kenya – like many other developing countries elsewhere in the world, is currently faced with the twin challenges of urban poverty and inadequate sanitation infrastructure in urban slums and other low income areas. The challenge of FSM requires a multi-pronged approach, which brings together numerous stakeholders but however begins with the urgent need for a coherent policy because of the rapid urbanization taking place. There are significant environmental and health pressure effects building in the urban areas.

The landscape analysis offers a good starting point to obtain an overall perspective of the status. The subsequent actions include a combination of policy and direct intervention measures. The direct intervention measures include funding of construction of hundreds of bio centres and enhancing the capacity of FSTP. Admittedly the fiscal requirements to put in place sanitary facilities in the urban areas in time are out of reach of the financial strengths of Government, hence the need to bring on board the private sector in several ways particularly to spearhead sustainable service delivery models. As the report indicates FS sub-sector is also an important and emerging industry that needs proactive policy formulation.

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APPENDIX A: DATA COLLECTION INSTRUMENT

Landscape Analysis and Business Model Assessment in Faecal Sludge Management: Extraction and Transportation Models in Africa

Households' Survey

This questionnaire intends to better understand the system of Fecal Sludge Management in the cities covered by the study. The survey is realized in the framework of a Project funded by Bill and Melinda Gates Foundation.

The results will be used in an anonymous way. We request you to answer to questions sincerely and spontaneously. The interview will take almost 30 to 45 minutes.

Interview N°: **……....**

Name and Surname of Interviewer: **……...**

Date of interview : **…….....**

Address: Phone No. **…….....**

PART 1 : GENERAL INFORMATION ON THE HOUSEHOLD

1- **Name and surname:**.....

2- **Sex:**

Male 1❑

Female 2❑

3- **a)Is the interviewed leading the Household :**

Yes 1❑

No 2❑

b) What is your relationship with the head of the household?

.....

.....

4- **Educational Level**

Primary 1❑

Secondary 2❑

Tertiary(college,university) 3❑

Non-formal/adult literacy 4❑

None 5❑

5- Status of Household Head

Owner 1❑

Tenant 2❑

Other 3❑ Specify :.....

6- Number of persons living in the Household

Total : .....

7- Main Occupation of the Household Head

Salaried 1❑

Self employed 2❑

Trader 3❑

Artisan 4❑

Farmer 5❑

None 6❑ Specify if :(disabled/retired/unemployed)

Other 7❑ Specify :.....

8- Secondary Activity/occupation

.....

9-a) Does the Household Head hold any position in the community?

Yes 1❑

No 2❑

b) Does the household head belong to any self help group?

Yes 1❑

No 2❑

10-⇨if Yes, specify:

.....

For the countries where it is not easy for people to talk about their income

11- Transportation means

Bicycle 1❑

Motocycle 2❑

Car 3❑

Boat 4❑

Donkey 5❑

None 6❑

12- Do you have ?

Radio 1❑

Electricity connection 2❑

TV 3❑

Fridge 4❑

Mobile Phone 5❑

For the countries where it is easy for people to talk about their income

13-What is your monthly income in Ksh?

Less than 10,000 1❑

10,000-20,000 2❑

20,000-30,000 3❑

30,000-40,000 4❑

40,000-50,000	5❑
Over 50,000	6❑

14-Source of water supply ?

Individual connection (water company)	1❑
Individual connection (private)	2❑
Borehole	3❑
Water Kiosk	4❑
Water Vendors	5❑
Well	6❑
Surface water	7❑
Others	8❑

PART 2 : HYGIENE AND SANITATION

15- Do you have access to a sanitation facility within the household premises/compound?

Yes	1❑
No	2❑

b) How many households use/share the facility?

.....

⇨If No, ask the question 16 and go to question 37

16- Where do you go to answer a call of nature?

Drainage channel	1❑
The neighbor	2❑
Open space	3❑

Other 4❑

Public Toilet 5❑

➪If Yes go to question 17

17- What kind of Facility ?

Sewerage connexion 1❑

Ordinary Pit Latrine 2❑

VIP Latrine 3❑

Septic Tank 4❑

No Mixed Toilet 5❑

Cess Pool 6❑

18- What is the level of satisfaction with the facility?

Very Satisfied 1❑

Fairly Satisfied 2❑

Not Satisfied 3❑

19- Why?

.....

.....

.....

20- When the facility is full, what do you do?

I empty immediately 1❑

I empty if I have money	2❑
I close the pit	3❑
Not yet full	4❑
Other	5❑

21- What kind of emptying service do you use?

Manual	1❑
Mechanical	2❑
Other	3❑
N/A (Sewered)	4❑

22- If Manual emptying, who does it?

Family Members	1❑
Manual Emptier (commercial)	2❑
Other	3❑

23- On which criteria do you choose type of emptying service?

Cost	1❑
Availability	2❑
Quality of Service	3❑
Other	4❑

24- How do you pay the emptying service?

One time	1❑
By tranche	2❑
When I have money	3❑
Other	4❑

25- a) How much do you pay for the service?

..... (in Ksh) for Manual Emptying

..... (in Ksh) for Mechanical Emptying

b) Do you pay per trip or depending on volume?

.....

.....

26- Are you happy with the payment method?

Yes 1❑

No 2❑

27- ⇨ if No, please propose a payment method

.....

28- Are you pleased with the quality of the service?

Yes 1❑

No 2❑

29- ⇨ If No, Why?

.....

.....

30- What is the emptying frequency?

Twice a year 1❑
Once a year 2❑
Every couple of years 3❑
Other 4❑

31- Do you reuse the sludge?

Yes 1❑

No 2❑

32- If Yes, for what?

.....

.....

PART 3 : FSM IMPROVEMENT

33- Do you think that your way of managing FS has impacts on water quality, health and environment?

Yes 1❑

No 2❑

If Yes how ?

.....

34- What could be the benefits of improving FSM in the city?

.....

.....

35- If your present level of service is improved, how much will you be willing to pay?(Ref to Qn 17,25)

..... Ksh

36- Would you accept that sludge from your sanitation facility are treated and sold?

Yes 1❑

No 2❑

37- a) Do you know any legal requirements on FSM?

Yes 1❑

No 2❑

b) If yes, state which one

.....

.....

38- a) Do you feel these requirements are reasonable?

Yes 1❑

No 2❑

b) If No why?

.....

.....

39- What should be the role of City/Municipal Council?

.....

.....

40- What should be the role of the Water and Sanitation Utility?

.....

.....

41- a) What should be the role of NGOs?

.....

.....

b) List names of active NGO'S

.....

c) What should be the role of local CBOs?

.....

.....

d) List names of active CBO'S

Thanks for your support!

APPENDIX B: DATA FOR FS CALCULATIONS

Calculations- KISUMU		
Number of households inthe city =	148,494	Source National Bureau of Statistics
% of the city HH with On-site sanitation=	84%	
Number of the city HH with On-site sanitation =	124,830	
% of the HH with on-site sanitation having pits in the city (from your HH survey) =	80%	
% of the HH with on-site sanitation having septic tanks in the city (from your HH survey) =	17%	
% of the HH with on-site sanitation having OTHER (i.e. cesspols, holding tanks) in the city (from your HH survey) =	2%	
Number of the HH with on-site sanitation having pits in the city (from your HH survey) =	99,864	
Number of the HH with on-site sanitation having septic tanks in the city (from your HH survey) =	21,720	
Number of the HH with on-site sanitation having Cess pools in the city (from your HH survey) =	2,871	
% of the HH with on-site sanitation having pits in the city using Mec. Emp (from your HH survey) =	17%	
% of the HH with on-site sanitation having septic tanks in the city using Mech. Emp (from your HH survey) =	53%	
% of the HH with on-site sanitation having OTHER (i.e. cesspols, holding tanks) in the city using Mec. Emp(from your HH survey) =	87%	
% of the HH with on-site sanitation having pits in the city using Man Emp (from your HH survey) =	83%	
% of the HH with on-site sanitation having septic tanks in the city using Man. Emp (from your HH survey) =	47%	
% of the HH with on-site sanitation having OTHER (i.e. cesspols, holding tanks) in the city using Man. Emp(from your HH survey) =	13%	
% of households with On-site sanitation using mechanical emptying	25%	
% of households with On-site sanitationusing manual emptying	75%	
Number of the HH with on-site sanitation having pits in the city (from your HH survey) using Mec. Emp=	16,977	
Number of the HH with on-site sanitation having septic tanks in the city (from your HH survey) Using Mec. Emp=	11,512	
ıer of the HH with on-site sanitation having OTHER (i.e. cesspols, holding tanks) in the city (from your HH survey) using Mec. Emp=	2,498	
Number of the HH with on-site sanitation having pits in the city (from your HH survey) using Man. Emp=	82,887	
Number of the HH with on-site sanitation having septic tanks in the city (from your HH survey) Using Man. Emp=	10,209	
ıer of the HH with on-site sanitation having OTHER (i.e. cesspols, holding tanks) in the city (from your HH survey) using Man. Emp=	373	
Typical volume of the septic tank (SV) =	5	cubic metres
Typical volume of the pits (PV) =	2.6	cubic metres
Typical volume of the Cesspool/Holding tanks (CV) =	5	cubic metres
Fecal sludge ratio on pits =	0.6	
Fecal sludge ratio on septic tanks =	1	
Number of Users	6	
Number of trucks =	4	
Capacity of trucks =	7.5	cubic metres
Number of trips per truck per year (Assume 4 trips for every 6 days in 6 days of week for 52 weeks) =	208	Survey shows 430 trips every 6 months
Number of pits emptied manually per year =	82,887	
Number of septic tanks emptied manually per year =	10,209	
Number of cesspool emptied manually per year =	373	

Calculations - MOMBASA		
Number of households inthe city =	140,535	Source National Bureau of Statistics
% of the city HH with On-site sanitation=	82%	
Number of the city HH with On-site sanitation =	115,228	
% of the HH with on-site sanitation having pits in the city (from your HH survey) =	54%	
% of the HH with on-site sanitation having septic tanks in the city (from your HH survey) =	21%	
% of the HH with on-site sanitation having OTHER (i.e. cesspols, holding tanks) in the city (from your HH survey) =	25%	
Number of the HH with on-site sanitation having pits in the city (from your HH survey) =	62,223	
Number of the HH with on-site sanitation having septic tanks in the city (from your HH survey) =	24,198	
Number of the HH with on-site sanitation having Cess pools in the city (from your HH survey) =	28,807	
% of the HH with on-site sanitation having pits in the city using Mec. Emp (from your HH survey) =	7%	
% of the HH with on-site sanitation having septic tanks in the city using Mech. Emp (from your HH survey) =	8%	
HH with on-site sanitation having OTHER (i.e. cesspols, holding tanks) in the city using Mec. Emp(from your HH survey) =	8%	
% of the HH with on-site sanitation having pits in the city using Man Emp (from your HH survey) =	93%	
% of the HH with on-site sanitation having septic tanks in the city using Man. Emp (from your HH survey) =	92%	
HH with on-site sanitation having OTHER (i.e. cesspols, holding tanks) in the city using Man. Emp(from your HH survey) =	92%	
% of households with On-site sanitation using mechanical emptying	7%	
% of households with On-site sanitationusing manual emptying	93%	
Number of the HH with on-site sanitation having pits in the city (from your HH survey) using Mec. Emp=	4,356	
Number of the HH with on-site sanitation having septic tanks in the city (from your HH survey) Using Mec. Emp=	1,936	
HH with on-site sanitation having OTHER (i.e. cesspols, holding tanks) in the city (from your HH survey) using Mec. Emp=	2,305	
Number of the HH with on-site sanitation having pits in the city (from your HH survey) using Man. Emp=	57,868	
Number of the HH with on-site sanitation having septic tanks in the city (from your HH survey) Using Man. Emp=	22,262	
HH with on-site sanitation having OTHER (i.e. cesspols, holding tanks) in the city (from your HH survey) using Man. Emp=	26,502	
Typical volume of the septic tank (SV) =	5	cubic metres
Typical volume of the pits (PV) =	2.6	cubic metres
Typical volume of the Cesspool/Holding tanks (CV) =	5	cubic metres
Fecal sludge ratio on pits =	0.6	
Fecal sludge ratio on septic tanks =	1	
Number of Users	6	
Number of trucks =	11	
Capacity of trucks =	16.4	cubic metres
Number of trips per truck per year (Assume 1 trips for every 2 days in 6 days of week for 52 weeks) =	156	Survey shows 500 trips every 6 months
Number of pits emptied manually per year =	57,868	
Number of septic tanks emptied manually per year =	22,262	
Number of cesspool emptied manually per year =	26,502	

Calculations- NAIROBI		
Number of households inthe city =	985,016	Source National Bureau of Statistics
% of the city HH with On-site sanitation=	51%	
Number of the city HH with On-site sanitation =	502,839	
% of the HH with on-site sanitation having pits in the city (from your HH survey) =	66%	
% of the HH with on-site sanitation having septic tanks in the city (from your HH survey) =	13%	
% of the HH with on-site sanitation having OTHER (i.e. cesspols, holding tanks) in the city (from your HH survey) =	21%	
Number of the HH with on-site sanitation having pits in the city (from your HH survey) =	331,874	
Number of the HH with on-site sanitation having septic tanks in the city (from your HH survey) =	65,369	
Number of the HH with on-site sanitation having Cess pools in the city (from your HH survey) =	105,596	
% of the HH with on-site sanitation having pits in the city using Mec. Emp (from your HH survey) =	38%	
% of the HH with on-site sanitation having septic tanks in the city using Mech. Emp (from your HH survey) =	71%	
HH with on-site sanitation having OTHER (i.e. cesspols, holding tanks) in the city using Mec. Emp(from your HH survey) =	84%	
% of the HH with on-site sanitation having pits in the city using Man Emp (from your HH survey) =	62%	
% of the HH with on-site sanitation having septic tanks in the city using Man. Emp (from your HH survey) =	29%	
HH with on-site sanitation having OTHER (i.e. cesspols, holding tanks) in the city using Man. Emp(from your HH survey) =	16%	
% of households with On-site sanitation using mechanical emptying	52%	
% of households with On-site sanitationusing manual emptying	48%	
Number of the HH with on-site sanitation having pits in the city (from your HH survey) using Mec. Emp=	126,112	
Number of the HH with on-site sanitation having septic tanks in the city (from your HH survey) Using Mec. Emp=	46,412	
HH with on-site sanitation having OTHER (i.e. cesspols, holding tanks) in the city (from your HH survey) using Mec. Emp=	88,701	
Number of the HH with on-site sanitation having pits in the city (from your HH survey) using Man. Emp=	205,762	
Number of the HH with on-site sanitation having septic tanks in the city (from your HH survey) Using Man. Emp=	18,957	
HH with on-site sanitation having OTHER (i.e. cesspols, holding tanks) in the city (from your HH survey) using Man. Emp=	16,895	
Typical volume of the septic tank (SV) =	5	cubic metres
Typical volume of the pits (PV) =	2.6	cubic metres
Typical volume of the Cesspool/Holding tanks (CV) =	5	cubic metres
Fecal sludge ratio on pits =	0.6	
Fecal sludge ratio on septic tanks =	1	
Number of Users	6	
Number of trucks =	60	
Capacity of trucks =	12	cubic metres
Number of trips per truck per year (Assume 4 trips for every 3 days in 6 days of week for 52 weeks) =	416	survey shows 1800 trips per month
Number of pits emptied manually per year =	205,762	
Number of septic tanks emptied manually per year =	18,957	
Number of cesspool emptied manually per year =	16,895	