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Management of FS in the urban areas of low-income countries: a case of Tamale, Ghana

By
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Abstract

Effective management of the excreta or faecal sludge (FS) emptying, transport and disposal mechanisms from the on-plot latrines in urban areas of many low-income countries is critical for the sustainability of urban sanitation. However the literature mentions the lack of an effective management system for urban FS emptying, transport and disposal in the low-income countries. The current management of FS has been fragmented and improper with attendant poor health and environmental pollution problems. In particular, no substantive information was found relating to how far the excreta or sludge removed from the latrines is transported to the disposal points. Also information on household financial needs and their perceptions regarding emptying and transport services was lacking. No study had been done regarding the effects of disposal distance and accessibility on the cost of emptying and transport; neither has work been done on FS reuse implications for emptying, transport and disposal mechanisms. Based on these issues, the research questions and hypothesis were formulated to guide the study. Qualitative and quantitative research techniques were used to triangulate and ensure the reliability and validity of the findings and analysis. From the analysis of the findings, the thesis concludes on these key issues: i) Emptying, transport and disposal mechanisms of the excreta and FS as well as the costs of these depend on the type of latrines, latrine use and the technology available for emptying and transport. ii) Owing to the nature of latrines and the emptying methods used the disposal of the FS was indiscriminate and much was found closer to its source of generation. iii) FS was in high demand for reuse but lacked appropriate marketing strategy that could match supply with the demand. iv) The Household Centred Environmental Sanitation (HCES) approach was found to be limited in content and capacity to effectively address the urban excreta and FS emptying, transport and disposal without the active and full involvement of the municipal and local authorities with clear roles and regulations that address the key processes, linkages, and capacity development issues. Thus, the HCES approach needs periodic review and modifications to take care of the new developments and peculiarities of each urban setting. The study also

recommends the need to look at streamlining technologies and developing capacity to address cross-cutting issues in urban sanitation. It further recommends the need for households, the sanitation authorities and practitioners to understand the links between latrine technology in terms of type, size, use and location vis-à-vis the required emptying, transport and disposal mechanisms in the urban areas of the low-income countries.

Key words: on-plot sanitation, latrine, faecal sludge, excreta, management, HCES approach, costs, low-income, urban, households, emptying, transport, disposal, capacity development.

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Abbreviations and Acronyms

AMA	Accra Metropolitan Authority
CBO	Community-based Organisation
CSD	Commission on Sustainable Development
EAWAG	The Swiss Federal Institute of Aquatic Science and Technology
FS	Faecal sludge
GHK	Gilmore Hankey Kirke (consulting firm)
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (German society for technical cooperation)
GWTF	Gender and Water Task Force, a UN inter agency task force
KMA	Kumasi Metropolitan Authority
TMA	Tamale Metropolitan Authority
DFID	Department for International Development, U.K.
HCES	Household Centred Environmental Sanitation
IDTG-Practical Action	Intermediate Development Technology Group - Practical Action
MDGs	Millennium Development Goals
NGO	Non-Governmental Organisation
OPS	On-plot Sanitation
SANDEC	The Department of Water and Sanitation in Developing Countries at the Swiss Federal Institute of Aquatic Science and Technology
SIDA	Swedish International Development Agency

SIWI	Stockholm Water International Institute
UESS	Urban Environmental Sanitation Service
UN	United Nations
UNCHS	United Nations Centre for Human Settlements
UNEP	United Nations Environment Programme
UNICEF	United Nation's Children Education Fund
UNDP	United Nations Development Programme
UWASNET	The Uganda Water and Sanitation Network
VIP	Ventilated Improved Pit
WAG	Water Aid, Ghana
WB	World Bank
WEDC	Water Engineering Development Centre
WIN-SA	Water Information Network-South Africa
WMD	Waste Management Division
WHO	World Health Organisation
WSSCC	Water Supply and Sanitation Collaborative Council

Glossary of Terms Used

Arborloo latrine

The arborloo is a simple pit latrine built over a shallow pit. The slab and superstructure are portable and are moved from one shallow pit to the next. Soil, ash and leaves are regularly added to the excreta in the pit to assist in the formation of soil-like humus in the pit. Full pits are topped up with soil and planted with young trees.

Aqua Privies

Latrine in which excreta fall directly through a submerged pipe into a watertight setting chamber below the floor, and from which effluent overflows to a soakaway or drain.

Asymptotic Significance

The significance level based on the asymptotic distribution of a test statistic. Typically, a value of less than 0.005 is considered significant. The asymptotic significance is based on the assumption that the data set is large. If the data set is small or poorly distributed, this may not be a good indication of significance. Thus, standard asymptotic methods involve the assumption that the test statistic follows a particular distribution when the sample size is sufficiently large. When the sample size is not large, asymptotic results may not be valid.

Chemical toilet

A chemical toilet is a toilet using chemicals to deodorize and disinfect the waste instead of simply storing it in a hole, or piping it away to a sewage treatment plant. It is commonly found on airplanes, trains and caravans.

Chi-square

This tests the hypothesis that the row and column variables are independent, without indicating strength or direction of the relationship. The chi-square test procedure tabulates a variable into categories and computes a chi-square statistic. This goodness-of-fit test compares the observed and expected frequencies in each category to test either all categories contain the same

proportion of values or that each category is significantly different from the others.

City

A city is an urban settlement with a particularly important status which is densely populated; may include several independent administrative districts.

Community

This is defined as any group of people or neighbourhoods inhabiting a village, town, city or any geographical location capable of taking collective decision and action for their common good.

Compost latrine

This is a latrine with shallow vault into which human excreta are mixed with kitchen waste, soil, ash, or vegetable matter to decompose into a compost which can be dug out and used as fertilizer. In compost latrine, two vaults are necessary so that when one vault is full it is covered with soil to decompose into fertiliser, while the other is used for defecation.

Condominial sewerage

In condominial sewerage, small diameter sewers are laid at shallow gradients to convey the sewerage from the neighbouring housing blocks rather than the housing units. Usually the pipes are laid under the sidewalks or pavements rather than in the middle of the roads as in the conventional sewerage. Whereas the conventional sewerage system essentially provides services to each housing unit, condominial sewerage system delivers services to each housing block or group of dwellings that could be termed a neighbourhood or “condominial” unit. Therefore, the required length of the sewer network is considerably shorter and cheaper than that of a conventional system.

Conservancy labourer

This is similar to scavenger. It is the labourer who empties and cleans latrines for a living..

Cross tabulation

A bivariate table that displays the joint frequency of two variables

Dry Latrine

A latrine where users defecate into a bucket, pan or any receptacle and does not need water to aid in the excreta disposal.

Ecosan Latrine

Ecosan latrine is a latrine designed to recover the faecal and urine wastes by separating the urine and faeces for them to be reused in the fertilization of soil for agricultural purposes. Thus, ecosan latrine is used to recover the nutrients in the urine and the faeces for agriculture; promote hygiene and to avoid groundwater and other environmental pollution.

Exact Statistics

Exact statistics is used in situations where the asymptotic assumptions are not met, and so the asymptotic p-values are not close approximations for the true p-values. When the sample size is not large, asymptotic results may not be valid, with the asymptotic p-values differing perhaps substantially from the exact p-values. Therefore exact computations are based on the statistical theory of exact conditional inference for contingency tables. In addition to computation of exact p-values, PROC FREQ provides the option of estimating exact p-values by Monte Carlo simulation. This can be useful for problems that are so large that exact computations require a great amount of time and memory, but for which asymptotic approximations may not be sufficient.

Excreta

Faeces and urine

Faecal Sludge

This is Sludge of variable consistency collected from on-site sanitation systems, such as latrines, non-sewered public toilets, septic tanks and aqua privies. The faecal sludge comprises varying concentrations of settleable or settled solids as well as of other, non-faecal matter.

Holding tank

This is a temporary storage facility for FS provided at strategic locations within the communities in the city to reduce haul distance for distant disposal site.

Household

A household includes all the persons who occupy a housing unit. The occupants may be a single family, one person living alone, two or more families living together.

Human Excreta

Faeces and urine from humans

Independent t-test

The independent t-test is used to test for a difference between two independent groups (like males and females) on the means of a continuous variable.

Latrine

Place or building for deposition, retention and decomposition of human excreta.

Low-income Country

These are countries in which the per capita gross national income per capita in 2001 was \$745 or less, according to World Development Indicators in 2003. It is a country with very limited income and number of middle class.

Monte Carlo Simulation

This is used for problems that are so large that exact computations require a great amount of time and memory, but for which asymptotic approximations may also not be sufficient.

Neighbourhood

A neighbourhood is a localised settlement within a community with characteristics that distinguish it from the areas around it.

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Night Soil

This is human excreta deposited in a bucket or any receptacle of convenience which are manually removed after the receptacle is full usually at night.

On-plot Sanitation

Sanitation system contained on the plot, which is occupied by a household housing unit.

On-site Sanitation

Sanitation system where the latrine stores the human excreta on the site where the latrine is located.

Overhung latrine

Latrine sited such that excreta falls directly into the sea or any body of water.

Pathogens

Organisms that cause diseases

Pit latrine

Pit-latrines are on-site excreta disposal facilities widely used as anaerobic accumulation system for stabilizing human wastes like excreta, both in rural and urban settlements of developing countries.

Pour-flush latrine

Pit sealed at the surface, generally with a concrete slab, with a shallow bowl providing a water seal. A small quantity of water is usually poured to flush the excreta through the water seal into a pit below.

Reuse

Faecal sludge or wastewater used for beneficial purposes

Sanitation

Sanitation includes the provision of facilities and services for the safe solid waste disposal (including medical wastes), wastewater disposal, human excreta disposal, and drainage of surface (rain) water as well as personal hygiene practices. But in this study, sanitation is referred to the collection and disposal of excreta in a hygienic way to avoid contamination, pollution and spread of diseases.

Scavenger

This is synonymous with conservancy labourer who empties or collects human excreta for a living.

Septic tank

This is water tight chamber into which excreta is flushed from a toilet into it for containment, treatment and discharge of overflow liquid into the ground or sewer.

Sewage

This is wastewater that usually includes excreta that is or to be carried in a sewer.

Sewer

This is a conduit through which sewage passes.

Sewerage

System of interconnected sewers usually placed underground.

Shit

Faecal matter

Simple pit latrine

This is a hole in the ground with a platform and a superstructure to provide privacy.

Soakaway

Soakpit or drainage trench for subsoil dispersion of liquid waste

Soakpit

Hole dug in the ground serving as soakaway

SPSS 15 package

Statistics package for Social Scientists 15 is a revised statistical analysis software package that facilitates data entry, coding, analysis and presentation. The package can be used to analyse both parametric and non-parametric data.

Sullage

This is wastewater that does not come from toilets or industries but from domestic sinks, baths, shower, washbasins and washing machines, etc.

Superstructure

Screen or building of a latrine above the latrine floor that provides privacy and shelter for users

Toilet

This refers to any facility for the disposal of human excreta including latrines, whether or not connected to a sewer system. This and latrine are similar in meaning and so are used interchangeably.

Urban area

This a populated and built up area in which majority of the people is not directly dependent on natural resource-based occupations.

Vacuum toilet

This is a toilet where air is used to assist in the removal of the excreta for disposal.

VIP latrine [Ventilated improved pit latrine]

A pit sealed at the surface with a concrete slab; roofed superstructure built to provide a dark interior; ventilation pipe connected to the pit, located outside the superstructure, with fly screen on top; the vent-pipe greatly reduces smells and flies;

Water seal

Water held in a U-shaped pipe or hemispherical bowl connecting a pan to a pipe, channel or pit to prevent the escape of gases and insects from the sewer of pit.

Wastewater

Sewage or sullage

1. Introduction

The purpose of the introduction to the study is to briefly put into perspective the global sanitation picture as well as to highlight the situation of urban sanitation in low-income countries. It also serves as a prelude to the justification for the study.

1.1 General

Historical records show that sanitation has been a matter of concern to the human race for a very long time (Rosen, 1994). Yet the current picture on sanitation in low-income countries is still discouraging despite past and present campaigns and efforts (Black and Fawcett, 2008). Current official statistics suggest that about 2.6 billion people do not have access to improved sanitation. Out of this number, about 1.98 billion (75%) live in Asia; 0.47 billion (18%) in Africa; and 0.13 billion (5%) in Latin America and Caribbean (SIWI, 2005). In the view of Kabbaj (2005), about 400 million, which is almost half of all Africans, lack access to basic sanitation. Worldwide, it is stated that there are twice as many people lacking access to improved sanitation facilities as those lacking access to improved water supply; and that four out of every ten people do not even have or use a simple pit latrine (Lenton *et al*, 2005; WHO/UNICEF, 2004). The lack of decent latrines or toilets and poor sanitation lead to the deaths of about 3,900 children every day (WHO, 2003; UNICEF, 2006). This means that there is the need for global efforts, as exemplified in the next section, to address latrine and sanitation issues urgently.

Urbanisation is increasing the pressure on urban infrastructural services in the low-income countries, as currently over 50% of the population in developing countries live in the urban areas (Ruiz-Mier and Van Ginneken, 2006; Montangero, 2004). This trend is increasing dramatically (WHO, 2000) with almost all future population growth predicted to take place in the cities of the developing world (Committee for Sustainable Development, 2005). In view of all this, the forms of appropriate sanitation infrastructure and services best

suited for the low-income countries in order to meet the Millennium Development Goals (MDGs) should be a matter of concern nationally and globally, as is demonstrated in the next section.

1.2 Global focus and efforts

This section presents the efforts made globally to address the poor state of sanitation (which has been statistically depicted in the previous section) so as to assess the progress and achievements made so far by the international community for sanitation.

Dating back to the colonial era (pre-1950) of most developing countries, water and sanitation have been recognized as promoting health and development (Seppälä, 2002). This is in recognition of the fact that sanitation has a significant influence on health through bacteriology and therefore has encouraged combined efforts of curative as well as environmental measures to fight against diseases (Rosen, 1994). Between 1961 and 1970 free and subsidised water and sanitation was provided in many developing countries through a supply-driven approach. However this turned out to be unsustainable. Since 1970, the continuous international efforts to improve sanitation worldwide, especially in developing countries, have been relentless. The demonstrations of these efforts are seen in various conferences, debates and establishment of various organisations to address the sanitation problems. In 1972, the UN conference on Human Environment in Stockholm saw the birth of UNEP. Following this in the same decade, there were a series of UN conferences and further establishment of initiatives and organisations, notable among which were the UN Water Conference in Mar del Plata, Argentina in 1977; UNDP-WB Water and Sanitation Programme and UNCHS (Habitat) established in 1978 (Ghosh, 1999; Grover, 1998) whose aim was to address water and sanitation problems. 1981-1990 was designated as the International Water and Sanitation Decade, during which many international meetings took place. Water was declared an economic good and more emphasis was put on public health, affordable low-cost technologies, capacity building and community participation (WELL, 1998; Seppälä, 2002).

In spite of all these efforts, very little achievement has been made in sanitation after the Water Decade, especially for the world's low-income regions. The WHO/UNICEF Joint Monitoring Programme (JMP) in table 1 below shows the regions of the world that are not on track towards achieving the MDG by the year 2015.

Table 1.1: Regional progress towards the MDG sanitation target

Regions not on track (%)	Coverage in 1990 (%)	Coverage in 2006 (%)	Coverage needed in 2006 to be on track (%)	Coverage needed by 2015 to achieve the MDG target(%)
Southern Asia	21	33	46	61
Sub-Saharan Africa	26	31	50	63
Commonwealth of Independent States	90	89	93	95
Developing regions	41	53	60	71
Oceania	52	52	69	76
World	49	58	62	75

Source: WHO/UNICEF, 2008

From the JMP table above, the world will miss the MDG sanitation target without a sharp acceleration in the rate of progress. This gloomy scenario justifies the series of meetings to address sanitation issues, the key one being the Commission on Sustainable Development (CSD) which identified water supply and sanitation as the priority area for the UN and all the collaborative organisations concerned. A demand-driven approach to achieving better sanitation has been suggested in place of supply-driven approaches because the latter was found not to be sustainable (Matthews, 2005).

In 2000, the UN Millennium Assembly met in New York to debate the Millennium Development Goals, part of which concerned sanitation. The World Summit on Sustainable Development in Johannesburg held in August

2002 set the target of halving the proportion of people without access to basic sanitation by 2015 (African Sanitation Conference, 2002). Since then, efforts have been intensified in bringing sanitation to all. The declaration of the year 2008 as the International year of Sanitation is a typical example of the international efforts and focus on sanitation. The table below sums up some important historical efforts made internationally towards water and sanitation.

Table 1.2: Evolution and chronology of concerted efforts on water and sanitation

PERIOD	GENERAL POLICY THINKING	MAJOR EVENTS	EMPHATIC ISSUES	SLOGANS
1950-1960	Water and sanitation promotes health and development	1 st bilateral donor agencies established.	Health	
1961-1970	Free or subsidized water in many developing countries.	Regional development banks such as Asian and African Development Banks established.	Technical issues on water & sanitation.	Intermediate technology& technology transfer.
1971-1980	Water as a social good.	Generation of UN initiatives and preparation for water decade with series of international conferences such as UNEP established in 1972. UN Water Conference (Mar del Plata, 1977). UNDP-WB Water and Sanitation Programme established in 1978. UNCHS-Habitat established in 1978.	Technical issues, Project implementation, Social issues. Rural water supply & Urban Sanitation.	Appropriate technology; Crash programme
1981-1990	Water Decade; Water as an economic good; health. Supply Driven Approach; Low-cost & affordable technologies; Capacity Building; Community participation; Decentralization.	International Drinking Water Supply and Sanitation Decade (IDWSSD, 1981-1990); Global consultation on safe water and sanitation for 1990s in New Delhi 1990; Water Supply & Sanitation Collaboration Council(WSSCC) in 1990; World Summit for Children(WSC) led by UNICEF(1990)	Public health, Low cost & affordable water and sanitation technology, Project implementation; Operation & Maintenance; Socio-economic issues; Capacity Building; Rural water supply and Sanitation	Water and sanitation for all by 2000; 'Some for all rather than more for some'; Sustainable development; Community Participation; Cost Recovery; Cost Sharing; Willingness and ability to pay; Human Resource

				Development; Capacity Building: Women in development
1991-2000	Post water Decade. Water & Sanitation considered as very important and as basic need; Management and use of water as part of environmental protection and sustainable development. Concern about water scarcity and pollution. Management of water at the lowest possible level. Customer orientation. Demand-driven approach. d Development of the world water vision till 2025	UNDP Capacity Building symposium(Delft 1991; Nordic Freshwater Initiative(1991); International conference on water and Environment (Dublin 1992); UNCED Earth Summit(Rio 1992); Rio Declaration; Agenda 21; Series of CSD meetings in New York; Drinking water and Environmental Sanitation Conference& Ministerial meetings(Noordwijk 1994; Harare 1998; and Paris 1998); UN conference on Population and Development(Cairo, 1994);The Global conference on the Sustainable Development of Small Island Developing States(1994); World Summit for Social development(Copenhagen 1995);The 1995 Beijing Conference on Women emphasized women roles in WS&S; Habitat 11(Istanbul 1996); World Food Summit(Rome 1996); World Water Council(WWC 1996) and Global Water Partnership(GWP 1996); First World Water Forum (Marrakesh 1997); Second World water Forum(The Hague 2000); World water	Environmental aspects; Statement of the Dublin principles; NGO and CBO role becoming stronger; Role of women & Gender issues; Water as economic good; Institutional strengthening; Poverty alleviation; Urban and Peri-urban water supply and sanitation	Community management; Stakeholder participation; Demand management; Demand-driven approach; Demand-responsive approach

		vision(2000); Vision 21(2000); Iguacu Action Programme(2000). UN Millennium Assembly (New York 2000); Un Millennium Declaration (2000).		
2001-	Implementation and empowering the proposed vision; Increased responsibility to user communities; Governments as facilitators; Networking and partnership approaches; Advocacy; attention to water scarcity; Transboundary and crossboundary water resources; Water conflicts; River basin management; Water and sanitation as a basic human right	International conference on Freshwater(Bonn 2001); World Summit on Sustainable Development(WSSD, Rio +10, Johannesburg 2002); Third World Water Forum (Kyoto 2003); International Freshwater Year 2003; and the International Year of Sanitation 2008	Hygiene and sanitation; Tradable water rights; water allocation; Hydrosolidarity; water security; water ethics; IWRM; Good governance	Community ownership; community participation in water and sanitation programmes

Adapted from: Seppala, 2002; Matthews, 2005; WELL, 1998; Ghosh, 1999, Black and Fawcett, 2008

In many of the discussions in the above table, water received almost all the attention in principle, to the exclusion of sanitation. Sanitation has been neglected because of lack of understanding of its economic benefits and consequences to policy makers. The relatively few mentions of sanitation were almost always done in conjunction with water supply. When sanitation was mentioned, the emphasis was on the coverage of latrines. This is confirmed in the declaration of the International Year of Sanitation in 2008, which highlighted the need for accelerated coverage of latrines in order to meet the MDG in a timely way.

Putting emphasis on coverage only while ignoring other equally important sanitation facets such as excreta collection, transport and disposal, could bring about diseases and environmental pollution (Ingallinella et al, 2002). The only international effort that has been made to discuss the above-mentioned sanitation facets was the 1st International Symposium on Faecal Sludge Management Policy organised in Dakar, Senegal, in 2006. However, the discussion at the meeting focused on rather generic capacity development needs for urban FS management in the developing countries (EAWAG/SANDEC, 2006) and failed to come up with any specifics regarding an appropriate management approach that could effectively address the urban excreta or FS emptying, transport and disposal problems.

1.3 Latrine Disposal Systems in Low-income Urban Areas

About two-thirds of the population in the developing world has no hygienic means of disposing of excreta (Rose, 1999). Latrines are meant to uphold hygiene by transporting or keeping human excreta safely. In the low-income urban communities, there are several latrine options for human excreta disposal.

Cotton and Franceys (1991) classify latrines, according to their location and role, as on-plot sanitation, off-plot sanitation and communal latrine systems. The on-plot sanitation as a disposal system is defined as latrines in which safe

excreta disposal takes place on or near the housing plot. Examples of this include various forms of pit latrines and septic tanks (refer to the glossary). In the off-plot sanitation system, excreta are collected from the individual houses and are carried away from the household precincts to be disposed of farther away from the household or neighbourhood. Examples here include sewerage and vault latrines (refer to the glossary) whose contents are carried away from the household latrines for disposal. A communal or shared latrine system is one where a number of households share a latrine which can be an on-plot or off-plot system. As a system, both the on-plot and off-plot sanitation, involve facilities, processes and actors which make the systems work. However, these are not coherently presented in the literature.

A critical look at latrines as the major part of the excreta disposal system in an urban environment reveals that they should be used in a hygienic way either to store or conduct away human excreta safely. Based on these roles, latrines facilities can serve as:

1. Permanent and safe storage of human excreta (i.e. where the faecal sludge {refer to glossary} is never removed but remains safely in the pit or on the site).
2. Temporary hygienic and safe storage of human excreta (i.e. where the excreta or faecal sludge ought to be periodically removed from the container or site and to be transported away. e.g vault latrines and septic tanks)
3. Safe and hygienic conducting of human excreta (i.e. where the excreta is transported by water into the sewer line as soon as it is dropped into the latrine).

The selection of the most appropriate form of any latrine technology belonging to any of the sanitation systems would depend on a number of factors, key among which are the level of service for water supply as well as other technical, cultural, financial, and institutional factors (Cotton and Franceys, 1991). The literature cites that on-plot sanitation is the dominant form of urban sanitation in most urban areas of low-income countries in Africa, Asia

and a considerable proportion of countries in Latin America (Hardoy *et al*, 1990; Saywell, 2000; Strauss *et al*, 2000; Cairncross, 2003; Swiss Agency for Development and Cooperation, 2004).

Whereas much information is available in the literature about latrines and treatment facilities and processes for developing countries (Mara, 1996; Rose, 1999; Metcalf and Eddy, 2002), very little is available for the emptying, transport and disposal mechanisms that connect the latrines and the treatment facilities. The latrines serving as temporary storage for the human excreta as well as their emptying, transporting and disposal requirements are not coherent but fragmented. Nevertheless, urban on-plot latrines need to be emptied to allow the reuse of the latrines (McGranahan *et al*, 2001; Jones 2005; Schaub-Jones, 2006; Jenkins and Slugden, 2006). So far, the latrines and their emptying services have been neglected or unsatisfactorily managed (Montagero *et al*, 2002; Ingallinella *et al*, 2002; The Water Wheel, 2005; Chaggu, 2004; Klingel *et al*, 2002; Scott and Reed, 2006).

This implies that an effective management of the on-plot disposal system should not only end at the latrine but should encompass the whole service chain embodying the emptying, transport, final disposal, treatment or reuse (see Figure 1.1). But, as has been mentioned before, the major steps taken towards urban sanitation have been about the latrines and the treatment of the FS to the neglect of the emptying, transport and disposal services.

1.4 Scope of the Research

Section 1.3 above has mentioned the fact that on-plot latrines dominate the excreta disposal system in the urban areas of most low-income countries and that they need to be emptied on regular basis to allow the sustainable use of the latrines. But the section established that the emptying, transport and disposal mechanisms that link the facilities of the latrines and the treatment plants, as shown in Figure 1.1 below, have been neglected in the literature.

Therefore the management of these three sequences of services are combined as the main focus of this study.

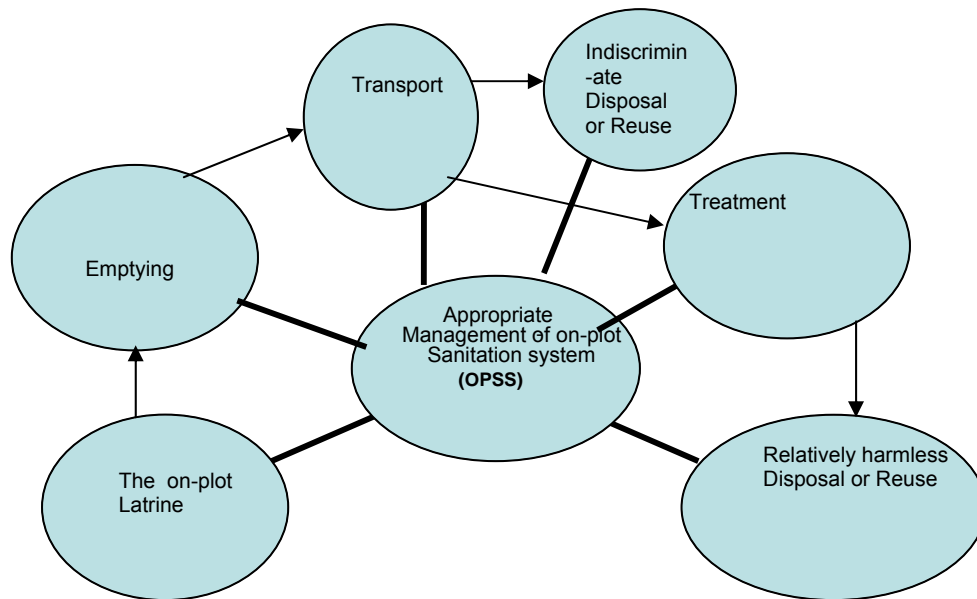


Figure 1.1: Display of Urban Faecal Sludge (FS) or Excreta Emptying, Transport and Disposal mechanisms from On-plot Sanitation System

The above figure shows that once latrine is emptied the excreta or FS is transported either to be disposed of indiscriminately or reused; or it is transported to be treated before its relatively harmless disposal or reuse.

1.5 Purpose of the research

The purpose of this work is to contribute towards effective management of sustainable urban sanitation by examining the latrine emptying, transport and disposal mechanisms in the city. The purpose will be achieved through tracing the emptying and transport of excreta or faecal sludge (FS) disposal from the latrines to their final destinations (i.e disposal points, treatment sites and reuse points). The system elements that will be empirically scrutinised are the activities, actors, technology, finance and the overall appropriate management

option for faecal sludge emptying, transport and disposal in the urban areas. The hypothesis, the conceptual framework, the objectives and questions for the study are explained in chapter three.

1.6 Chapter conclusion

The introduction of the study has explained the state of sanitation in the developing world; presented a picture about the statistics of the world population lacking access to sanitation; and discussed global efforts made to address the sanitation problems. The chapter also discussed the scope and purpose of the study. The next chapter attempts to scrutinise the scope by a detailed examination into the subject matter through the viewpoints of urban sanitation cross-cutting issues which are technical, social, financial, planning, policy, institutional and organisational. By so doing, weaknesses and gaps in urban excreta or FS emptying, transport and disposal are identified for the study.

2. Literature review on urban on-plot sanitation and FS emptying and transport

2.1 Chapter introduction and outline

Chapter one provided a broad introduction to this research by covering global sanitation issues and efforts. It then discussed, in broad terms, the latrine disposal systems prevalent in the low-income urban communities and the scope of the study which is the emptying, transporting and disposal of the excreta from the latrines to make them reusable in the urban areas. The purpose of the research was also explained. This chapter discusses the literature about the broader human excreta emptying, transport and disposal mechanisms starting from where the excreta are taken through to their final destination points. The chapter is based on both published and grey literature which concerns technology and managerial aspects of human excreta's journey through the city from their time of emptying from the pits or buckets to their final destination points. In the discussions, weaknesses and gaps in knowledge are identified, whilst areas of theoretical and empirical weaknesses are also discussed. In the light of this, the chapter has four objectives in mind:

- to justify the need for appropriate excreta and FS emptying as well as their transport and disposal in urban areas,
- to distinguish what has been done and what has not been done in the FS emptying, transport and disposal in urban areas,
- to identify key problems with the FS emptying, transport and disposal in the urban areas; and
- to evaluate the effectiveness of the technology and management of the FS emptying, transport and disposal.

2.2 Publications reviewed

The literature review covered a wide range of published and grey literature on urban on-plot sanitation, FS emptying and their transport to disposal points of safety. Search tools such as Metalib, Scopus, Compendex and Google led to the examination of more than 300 documents and materials relevant to the

research covering issues such as technology, socio-culture, finance, institutions and organisations, policy, planning and management. Documents and materials for the research were obtained from the WEDC library, Pilkington Library of the University of Loughborough, Inter-library loans and British Council Library. Besides, personal requests were made for materials from the Swiss Department for Environment, Water and Sanitation in the Developing Countries (EAWAG/SANDEC) Office in Switzerland since they have been particularly involved with FS emptying and transport issues. In Ghana, both grey and published literature was also obtained mainly from the Sanitation Department of the Ministry of Local Government and Rural Development and the Ghana Statistical Service Department. All these generated a large volume of citations which had to be reduced to the materials that were more relevant to the research.

2.3 Excreta disposal methods

This section addresses the whole spectrum and types of disposal mechanisms in the urban areas, with the view to broadening the understanding about the subject.

The health benefits of safe excreta disposal in terms of preventing diarrhoeal death in children (UNICEF, 2006; Jinadu *et al*, 2004; Curtis *et al* 2000; Esrey, 1996; Cairncross, 1999; Bateman and Smith, 1991) and other diseases are well documented. Besides the diarrhoeal prevention, improvements in excreta disposal are known to control transmission of helminth infections that are known to impede growth and cognitive development of children (Khanom and Leonard, 1989; Nokes *et al*, 1992); as well as reduce the incidence of ascariasis, *Trichuris* (whipworm) and *Ancylostomiasis Necator* (hookworm)(Norhayati *et al*, 2003).

Excreta disposals are seen in two broad terms which are safe and unsafe disposal systems. The safe disposal systems include the reticulated sewerage and the fragmented on-plot or on-site systems. Since the reticulated sewerage

system allows the excreta from the latrines to pass straight into pipes or drains away from the households, it can provide safe means of disposal if there is appropriate treatment facility to receive the excreta. The on-plot/site sanitation system can also provide safe and hygienic means of disposal in the urban area if the excreta are emptied properly when the pits are full. The unsafe excreta disposal systems can be seen as open defecation and the 'wrap and throw' or 'flying' toilets where there is no appropriate measure for their control and management.

Pickford (1995) relates excreta disposal methods to the types of latrines in which excreta are dropped, decomposed or removed as explained in the Table 2.1 below. In Pickford's definitions of excreta disposal methods, pit emptying and excreta or FS transport are not clear. They are obscured in the term, 'removal'.

Table 2.1: Classification of excreta disposal method (after Pickford, 1995)

CLASSIFICATION	EXCRETA DISPOSAL METHOD
Decomposition	Compost latrines Algae tanks
Decomposition and infiltration	PIT LATRINES Simple pits VIP latrines Double or Twin pits Pour flush latrines Aqua privies
Removal, decomposition and infiltration	SEPTIC TANKS
Removal	PIPE SYSTEMS Conventional sewerage Non-conventional sewerage like Condominium sewerage Vacuum systems

	NON-PIPE SYSTEMS Container systems Vaults Chemical toilets Overhung latrines
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The sewerage system is the dominant disposal system in the advanced and rich countries, and so more work has been done on such sewage disposal and treatment services. But very little has been done about the emptying of the on-plot latrines and transporting the excreta or the FS for disposal or treatment. The literature fails to address, in particular, any effective management systems in the low-income countries regarding the emptying, transporting and disposal of the excreta in the urban areas as a coherent system. The on-plot latrines and associated services are fragmented and therefore lack of monitoring, coordination and regulation might lead to indiscriminate disposal, environmental pollution and health risks.

2.4 Urban on-plot latrines and emptying requirements

On-plot latrines are the first and major methods of disposal of human excreta in urban households and so the need for their establishment and emptying requirements are critical for the urban sanitation.

2.4.1 The necessity of on-plot latrines

Inferences from the literature (Black and Fawcett, 2008; Stoner, 1977; Esrey *et al*, 2001; Lettinga, *et al*, 2001; Zeeman and Lettinga, 2001; El-Gohary, 2002; Otterpohl, 2002; Mgana, 2003, Scott *et al*, 2003), offer the following reasons why the on-plot latrines have become the dominant form of urban sanitation in many developing countries:

- The on-plot latrines are relatively cheap to build and operate,

- The acute shortage of water.
- Lack of essential resources such as human, financial and technical resources to provide sustainable conventional sewerage for the majority of urban dwellers in developing countries.
- Very few towns and cities in the developing countries can afford conventional sewerage systems.
- The need for reuse possibilities for the FS removed from the on-plot latrines.

As part of the excreta disposal system, on-plot latrines could provide the first safe disposal place in the excreta's transport across the city . As a result, this creates the first barrier to excreta-related pathogens and diseases through routes such as contact with infected stool and other contaminated sources which include water, soil, fingers, flies and food (Singh, 2003). Therefore, it could be possible that in the absence of improved latrines (such as the on-plot latrines) in the urban households, open defecation and 'mobile or flying' toilets may be practised with a high possibility of direct and indirect contacts with human excreta with ill-health consequences (Schaub-Jones *et al*, 2006; Satterthwaite and McGraham, 2006; Black and Fawcett, 2008; Jones, 2005). Thus, the benefits of improved latrines to households in the urban areas cannot be overemphasized. In the extreme cases of refugee influx into an area, unimproved systems like the 'cat' or trench forms of latrine may be acceptable as short term solutions to sanitation (Reed and Shaw, 1993).

Thus, the importance of latrines, especially the on-plot latrines, in the urban communities of low-income countries calls for the need to promote and scale up improved latrine ownership in the households through effective social marketing and demand responsive approach (Obika, 2003). By so doing, this will prevent excreta-linked diseases (Emerson *et al*. 1999, 2004, 2005).

2.4.2 Some problems with urban on-plot latrines

Research in several areas, notably Bangladesh, India, Malawi, Lesotho and Vietnam, shows that on-plot latrine construction interventions alone are not

sufficient to overcome the health threat posed by human excreta; they must be supported by hygiene promotion (Curtis *et al*, 2000; Cairncross *et al*, 1996; Daniels *et al*, 1990) and the accompanying emptying and transport services.

In the urban areas where the urban on-plot latrines dominate, there is the need to empty them periodically and the FS or excreta transported to disposal points of safety. However, the poor management framework for the excreta emptying, transport and disposal (Pandey and Kaul 2000; Koande, 2006), has resulted in health and environmental pollution problems (Ingallinella *et al*, 2002; Montangero *et al*, 2002; Strauss and Montangero, 2002; Parkinson and Tayler, 2003).

Below are some lists of management problems expressed in the literature about the state of urban latrines and their excreta or FS emptying and transport in the low-income countries:

- Bucket and pit latrines fill up and overflow without being emptied (Van der Geest, 2002; Pandey and Kaul, 2000).
- Lack of appropriate equipment and expertise for the emptying and transport resulting in an environmental and aesthetic mess (Chaggu *et al*, 2002).
- Constant breakdown of emptying and transport machines with little or no chance for repair or replacement due to lack of funds and availability of spare parts (Boot, 2007).
- Appropriate policy for emptying and transport is lacking (Jones 2005; Chaggu *et al*, 2002, Klingel *et al*, 2002;).
- Poor settlement and infrastructural siting hamper or deny vehicular access, and unnecessarily increase costs to the users (Ingallinella *et al*, 2002).
- Households' poor knowledge and attitude to latrine use, also affect choice and operation of latrines (Tiberghien, 2002).

These issues highlight the following concerns about the idea of storing excreta in on-plot latrines and removing the excreta from the latrines to disposal points

of safety in the urban areas:

- i) How to address the fragmentation in excreta emptying services in time and space
- ii) On-plot latrines in an urban setting could only prevent diseases when the latrines are in good condition, regularly emptied and are accompanied by hygienic behaviour and the overall good safe excreta disposal behaviour and practice (Mertens *et al*, 1992).
- iii) Once the latrines are emptied, the transport of the pit contents to disposal points should be safely handled and managed.
- iv) There should be unhindered access to the emptying and transport of the excreta.
- v) Appropriate equipment and tools should be used for the emptying and transport.

2.4.3 The emptying requirements of the on-plot latrines

This subsection looks at the overview of the on-plot latrines often found in the urban areas of low-income countries and discusses their emptying requirements.

Typically there are several different types of urban on-plot latrines in a low-income country city, which when properly adopted and used, can help to reduce the amount of contamination from exposed human faeces (Emerson *et al*, 2000, 2001). Pit sizes in low-income countries are not standardised and so the latrine type, quality of design and use could determine the liquid or solid contents to be emptied. As a result, this could create confusion in the emptiers' minds as to what is expected to be removed from a pit when called for duty (Chaggu *et al*, 2002). Besides, the rate at which pits fill and the composition of their waste could vary between households. For instance, Franceys *et al* (1992) have suggested different accumulation rates of pits in dry and wet conditions as shown in the table 2.2 below. The wet conditions

refers to a situation where the groundwater level is above the top of the sludge.

Table 2.2: Maximum sludge accumulation rates (litres/person/year) after Franceys et al, 1992

Pit Contents	Pit accumulation Rate
Wastes retained in water; degradable anal cleansing material used	40
Wastes retained in water; non-degradable anal cleaning materials used	60
Waste retained in dry conditions; degradable anal cleaning materials used	60
Wastes retained in dry conditions; non degradable anal cleaning materials used	90

Apart from the suggestions of Franceys *et al* , Still (2002) also shows that the accumulation rates for household pits can vary between 18 and 70 litres/person/year(l/p/y). For emergencies, Harvey (2007) suggests even higher accumulation rates at 0.5 litres/person/day (l/p/d) or 182.5 l/p/y for solids; 0.8 l/p/d (292 l/p/y) for urine accumulation; and 1.3 l/p/d (474.5 l/p/y) if water is used for anal cleansing. In Ghana where the study has taken place, fresh excreta (urine and faeces) generated is about 1.5 l/p/d or about 548l/p/y (Heins *et al*, 1998). The same source claims that sludge (including water used for anal cleansing material) collected from bucket latrines is about 2l/p/d, while that collected from digested pit latrine is between 0.15 to 0.2l/p/d or 54.7l/p/y to 73l/p/y (discounting the solidified sludge at the bottom of pits, which when taken into consideration could be higher). All this depicts the degree of variability that exists in sludge generation rates that could differ from place to place and from household to household.

Thus, latrines in different locations and areas can fill up at different rates depending on several factors, principal among which are the number of users; shape of pit; volume of waste produced by each user; anal cleansing materials and volume of other materials in the pit (including sullage and other domestic waste); decomposition rates of the wastes in the pit; and the permeability of the soil surrounding the pit (Reed, 1999; Practical Action, 2009). All this implies that emptying requirements for pits could vary from place to place depending on the use, pit's contents, decomposition process and location of pit.

Depending on the permeability of the pit and the surrounding soil as well as the amount of water used, on-plot latrines can be dry or wet as explained below.

2.4.3.1 Dry on-plot latrines

This section discusses the nature of dry on-plot latrines by dividing the section into three parts. Part (a) gives the characteristics of dry on-plot latrines. Part (b) gives an overview of dry on-plot latrines and their emptying requirements; whilst part (c) discusses ecosan latrines as part of the dry on-plot latrines.

a) Characteristics of dry on-plot latrines

Dry on-plot latrines do not use water to aid excreta disposal. Complex biological and chemical reactions render the excreta and the organic cleansing materials in the pits into solid matter, water and gases (Wright, 2008). These complex natural bio-chemical reactions and or bio-additives added to the faecal matter in the pits have been helpful in reducing emptying frequency of the pits (Carter and Byers, 2006).

Where the inside of the disposal vault or pit is not sealed, gases and water resulting from the biochemical reactions could seep into the surrounding soil leaving only the solid matter available for emptying, provided there is no infiltration from the surrounding soils. The gases also can escape into the atmosphere through the top of the pit or through a special vent mounted on

top of the pit's superstructure (eg, ventilated improved latrines). Example of these gases produced and ready for escape include, carbon dioxide, nitrogen and maldorous ones like ammonia, sulphides, mercaptans and skatoles (Metcalf and Eddy, 1991).

Depending on the rate of use, pit size and soil infiltration properties, pathogens from the excreta in the pits die off with time, especially when ash or a base is added to increase the pH (Schönning and Stenström, 2004). Also the decomposed excreta turns solid which compacts and consolidates with time in the pit. With full decomposition, manual emptying of the pits with simple hand tools could be applied with less risk.

b) Overview of dry on-plot latrines and their emptying requirements

The design of the pit creates the difference in the types of dry latrines available. For example, on the basis of its design, a simple pit latrine is seen as consisting of a seat or squatting hole over a pit, in which the human waste collects (Paterson *et al*, 2007). A simple pit may be designed and used by an individual, households or communities. Its constraint is its unsuitability for large multifamily dwellings in urban spaces without appropriate mechanisms to ensure regular emptying (Whittington *et al*, 1992). Other dry pit latrines (refer to the Glossary and Appendix 9) include VIP; borehole latrines; double (alternating or composting) pits; arborloo and overhung latrines (Franceys *et al*, 1992).

In the urban areas, single VIP and double alternating VIP latrines are commonly used. If the simple and the VIPs are to be manually emptied then more access is needed than if they are to be mechanically emptied. It would be more economical if the slabs are easily removable and replaceable without destroying them when emptying is required. Similarly the superstructure of the latrine must facilitate easy access to emptying so that it is not destroyed. Sludge content in the pits depends on the rate of decomposition (Francey *et al*, 1992) as well as the anal cleansing materials and other materials dropped into the pits (Mara, 1996). Also the thickness of the sludge will depend on the

lining of the pits and the permeability of the surrounding soils. All this has implications for emptying requirements.

c) Ecosan latrines

The ecosan latrines, also known as ecological latrine, is a new latrine paradigm whose core principles are not only containment of human excreta, but also the treatment to remove harmful bacteria, and reuse of the sanitised excreta after emptying (Winblad and Simpson-Hébert, 2004). Reuse as part of ecological sanitation is discussed in detail in section 2.6.6.

The harmful bacteria in the ecosan latrines are removed through the right application of physical, chemical and biological factors such as regulation of the moisture content, temperature, pH, oxygen and microbes (Winblad and Simpson-Hébert, 2004). There are a host of ecological latrines which include dehydrating and urine diverting ventilated improved (VI) latrines ((WIN-SA, 2006). Ecological latrines encourage recycling and reuse for both food and energy production. Ideally, emptying is less frequent in ecological latrines and the digested sludge safer to handle than in the other pit latrines in the urban areas. With proper use and appropriate emptying requirements, ecological and double pit latrines could last for a very long time (Schönning and Stenström, 2004). Ecosan latrines come in different designs. Picture 2.5 below is an example of urine diverting ecological (ecosan) latrine.



Picture 2.1: Example of an Ecological Latrine in South Africa

Source: Mara, 2008

Picture 2.1 depicts three essential facilities about the ecosan latrine. These are the pedestal (the latrine seat), a urine receptacle (for collecting urine separately) and a bucket for ash (to increase pH and reduce odour). There are however two possible problem scenarios associated with the latrine in the picture:

- a) It would be difficult for children and women to use the urinal facility successfully, and
- b) not everyone will have the time and discipline to separate the urine before defecating since the two facilities are separated from each other.

2.4.3.2 Wet on-plot sanitation systems

Wet on-plot sanitation systems include all latrines that require the use of water to contain the excreta (e.g. aqua privy) and flush the excreta into the pit, cesspool, tank, vaults or any container within the dwelling space or compound of the household (WASTE, 2005; Tayler *et al*, 2003). The flushed excreta is meant to be contained in a tank or pit while the wastewater is allowed to infiltrate into soakpits or join the reticulated sewerage system (refer to Appendix 9 for illustrations of various forms of latrines). The sludge, and some liquid accumulated in the tanks, needs to be emptied periodically in a more or

less semi-solid state. This requirement could be key to its sustainability. Wet on-plot latrines are many, but the following four examples are common ones used in the households in the urban areas of most low-income countries:

- a) *Latrine with septic tank* is relatively expensive and the septic tank comprises a sealed tank with inlet and outlet pipes or chutes (Reed, 1999; Mara, 1996; Cotton *et al*, 1995; Cotton and Saywell, 1998). Excreta and other wastes from the toilet are flushed into the septic tank through the inlet pipes. After some days of retention, partially treated effluent flows out of the tank through the outlet pipes into an infiltration bed or soakage system. During the retention period, solids settle out by gravity and undergo a process of anaerobic decomposition in the tank, producing gases, water, sludge and a scum layer which floats. After enough sludge has been accumulated on the base of tank, emptying should be carried out (Matagi, 2002). Depending on the size of the tank, its useful life could be significantly prolonged if two alternating drain fields are connected such that when one is clogged by debris and biological slimes, it is allowed to rest and biodegrade before being reused (Wright, 2008).
- b) *Pour-flush latrine* is a system where water is poured to flush the excreta after use into a pit which may be directly under the pan or offset from it (Cotton and Saywell, 1998; Saywell and Shaw, no date). The offset pit is convenient because it can be emptied without destroying the superstructure (Cotton and Franceys, 1991). Pour-flush is conveniently applicable where water is used for anal cleansing (suitable for moslem communities where water is used for ablution) (Mara, 1985). A collection pan connected to a shallow u-shape bend with water trap is fitted to the cover slab (Reed, 1999). The water trap, with its stagnant water, seals and isolates the contents of the pit from the user and effectively controls smells and flies. The pan is wetted before defecation to prevent sticking of faeces to it (WEDC, 1998). Depending on the amount of water used, The nature of the pit contents, which tend to be more liquid, calls for mechanized emptying as the more convenient way.

c) *Anaerobic (Biogas) latrine* is made up of a watertight tank with an airtight cover. A pipe is connected to carry away the gas for use. Both human excreta and a liquid slurry of animal dung and vegetable wastes are put for fermentation to take place to produce methane and other gases (GTZ, 2000). The idea is to make use of the combustible methane for energy generation to be used by households. The digested product may not be free of bacteria or may contain roundworms, so should be handled with care during emptying and transport.

i) *Modification of water-borne on-plot systems*

To minimise emptying, water-borne on-plot systems can be modified into off-plot systems through settled sewerage or small-diameter variable-slope sewers (SDVSS) as explained below.

1) *Settled Sewerage*

Settled sewerage is established by connecting the outlet from septic tanks to sewer system or any drainage channel that will transmit the liquid while allowing the solids (sludge) to settle in the tank within the household compound (Metcalf and Eddy, 1991). This is sometimes called small-bore or solids-free sewerage. It is best used in areas where the soil for the drain field is no longer able to accept the increasing volumes of wastewater generated from the septic tanks. The solid-free effluent from the septic tank is discharged into small-diameter (about 75 mm) plastic sewers laid at shallow depth which roughly follow the ground contour (inflective gradient design approach). As the sewers receive only a solids-free wastewater, their hydraulic design is very different from that of conventional sewers since there is no requirement for minimum self-cleansing velocities (Reed, 1993, 1995; Otis and Mara, 1985).

This system can be used to serve a number of households within the community as sewage from a number of households could be discharged into a settling tank for removal of floating and suspended solids; the liquid then overflows into shallow, small diameter collector sewers for off-site

treatment and disposal. Grit, grease and other solids which might cause obstruction in the sewers are separated from the waste flow in interceptor tanks installed upstream of every connection to the sewers. The solids which accumulate in the tanks should be emptied but less regularly (Mara, 1985). Settled sewerage comes in many other forms such as 'small-bore gravity sewers' and 'common effluent drainage system' (Otis and Mara 1985; South Australian Health Commission, 1982).

2) Small-diameter Variable-slope Sewers (SDVSS)

In the United States of America, an innovative form of settled sewerage called 'small-diameter variable-slope sewers' (SDVSS) is installed such that there is a net positive slope from the inlet to the outlet (Metcalf and Eddy, 1991). Wastewater put in at the upper end will eventually exit from the lower end through gravity. One good thing about the SDVSS is that it is laid at approximately the same depth below the surface of the ground regardless of the grade. This implies that the flow of wastewater will involve some delays, surging, and transitions from full to partial pipe flow (Metcalf and Eddy, 1991). The importance of the above deliberations lies in the facts that they can help avoid emptying and its problems and also make some savings in construction costs compared to the conventional system in the range of 50-70% (Mara 1996). Part of the reason for this is that the sewers need not be designed for the self-cleansing criteria to ensure transportation of solids. This allows the design criteria of the downstream sewer network to be relaxed, producing savings in capital and operating costs.

In conclusion, section 2.4 has discussed the types of urban on-plot latrines commonly used in the low-income countries, their characteristics and emptying requirements. Also how these urban on-plot latrines can be modified into off-site latrines to reduce or completely eliminate emptying has been explained. It could be inferred from the nature of the latrines and their emptying requirements, that there is fragmentation and heterogeneity in terms of the latrines and their times and mechanisms for emptying in the urban

areas. The literature does not show how these fragmentation and heterogeneous challenges are effectively managed.

2.5 *Latrine location and accessibility problems*

Location and accessibility problems are mentioned as obstacles to successful pit emptying and FS transport (Montagero *et al*, 2002). Therefore this section is divided into two subsections to discuss in detail the location and accessibility problems, respectively.

2.5.1 Location problems for latrines

The design and maintenance of pits are location specific (Riberio, 1985; Chaggu *et al*, 2002). Some of these location specific issues are the location of the latrine vis-à-vis the available space; and the geographical location of the household compound in the neighbourhood which does not only affect the nature and size of the latrine but also the accessibility. Another dimension to the location specific problem is the fact that an inappropriately located latrine in an unsuitable soil formation can lead to collapse of the latrine during emptying operations (Mara, 1996). Besides, the physical limitations imposed by the sites at poor peri-urban and slum areas, can be a major constraint to FS emptying and transport. This is because poor peri-urban and slum settlements are almost always found on lands with the cheapest value, with unattractive physical features such as rocky soils, steep slopes, swampy and inundated areas as well as areas subject to frequent flooding (Hogrewe *et al*, 1993; Schaub-Jones, 2006). Although, these poor sites and terrain conditions can affect costs of construction of latrine infrastructure, maintenance and emptying operations (Sugden, no date), it is not empirically stated in the literature how much these costs could be.

2.5.2 Accessibility problems for latrines

As could be inferred from the previous section 2.5.1, accessibility problems could stem from the way housing components, the service facilities (electricity poles, water standpipes, and latrines, etc.) and the physical environment interact with each other (Okpala, 2004). Lack of proper urban planning and settlement pattern render vehicular accessibility to some latrines almost impossible (Montangero *et al*, 2002). Therefore in narrowly accessible situations, there is the need for small-size emptying and transport equipment that ought to overcome accessibility limitations placed on it. However, the existing small-size technologies are unable to empty dense sludge (Cotton *et al*, 1995) as well as large volumes per operation. Therefore they may have to come to the same pit several times before complete emptying can be done (Kone, 2008). This, in addition to high frequency of pit visitation and long haulage distance to a disposal point make excreta or FS emptying cumbersome and expensive (Ingellinella *et al*. 2002).

Available openings to reach the pits' contents are also an important accessibility factor to consider (Bosch and Schertenleib, 1985). For example, fixed non-removable slabs as well as inaccessible superstructure of the latrine may have to be destroyed to allow machines or humans to gain access for emptying. As has been mentioned already, there could be accessibility problems regarding the very steep terrain as well as muddy and geologically unstable environments where the poorest of the poor with land tenure problems live (Hogrewe *et al*, 1993). Such areas and the interfaces with jurisdictional difficulties could present real challenge to urban excreta management. What the literature fails to provide are the empirical data on the impacts of the location and accessibility problems have on the health, environment, and the socio-economy of the households, as far as excreta or FS emptying, transport and disposal are concerned.

2.6 FS Emptying and transport

2.6.1 Introduction

Conventionally, the quality and quantity of waste (including FS) generated would determine the selection of specific equipment for collection and design of the waste collection routes, transfer stations, and disposal facilities (Tchobanoglous *et al*, 1993). The same source states that the quality of the waste determines whether it is hazardous or non-hazardous. Hazardous wastes are explained as having safety-related and health-related properties. The health-related properties mentioned include 'infectivity'. This therefore places human excreta that are not fully digested and contain infectious bacteria (Mara, 1996) under hazardous waste. Unfortunately, from the literature, the emptying, transport and disposal practices of excreta or FS in the low-income countries seem not to take the hazardousness or the health and safety issues into consideration.

2.6.2 Emptying methods and technologies

Literature points to three principal emptying methods and technologies for FS or excreta collection done according to the type and contents of the latrine (Mara, 1996; Chaggu *et al*, 2002; Van der Geest, 2002; Bosch and Schertenleib, 1985). These are :

- Hauled pan or bucket systems where the pans or buckets used for FS storage are either emptied there and then into another bucket to be hauled or the same bucket is hauled to the disposal or transfer sites (i.e. holding tanks), emptied and either returned to the original location (i.e. set-out set-back mode) or some other location.
- Digging or scooping such that the FS is removed with simple manual hand tools ; and
- Siphoning under vacuum and pneumatic forces, where a tanker is used to suck the FS from vaults, pits or septic tanks through automated or manually operated means.

In this study, the above emptying principles are grouped broadly under manual and mechanical methods depending on the amount of technology involved. Thus, manual emptying involves use of bare hands up to simple rudimentary tools. Mechanical emptying involves more sophisticated and conventional equipment such as vacuum and pneumatic tankers. Small size technology lies in between the manual and the mechanical technologies.

2.6.2.1 *Manual emptying*

This subsection is divided into two parts. The first part describes the general manual emptying methods and operations, whilst the second part deals with manual emptying examples in Africa and other parts of the world.

2.6.2.1.1 *General*

Manual pit emptying is less effective than the conventional mechanical emptying (Mara, 1996; Chaggu *et al*, 2002; Van der Geest, 2002) due to its slow rate of operation and rudimentary tools used. Nevertheless, the conventional mechanical emptying is also beset with many emptying problems due to its high capital and running costs; lack of access; contents of the pit (not conducive for mechanical emptying); and mechanical breakdowns (Bosch and Schertenleib, 1985; Montagero *et al*, 2002; Ingelinellina *et al*, 2002; Chaggu, 2004).

Manual emptying technologies in low-income countries have included hand tools and accoutrements such as hand-operated pumps, bare or gloved hands, brooms, buckets, drums, scoopers, pick axes, spades, ladders, ropes, and boots (Debomy, 2000; Kone, 2008). In Kibera, Nairobi, manual pit emptiers work inside pits at night by torch-light, without protective clothing, with basic emptying equipment which is sometimes rented. The waste is commonly disposed of by dumping it into the settlement's streams (Eales, 2005). The reasons why the emptiers preferred to work in the night but not by the day was not provided. In another development, manual operators in the form of small teams have used hand-operated pumps to siphon sludge which

is then filled into drums for onward transfer to disposal sites (Pickford and Shaw, 2002; Strauss and Montagero, undated).

2.6.2.1.2 Manual emptying examples from Africa and their implications

Below are four examples of manual emptying in different countries and their modus operandi.

i) Pit emptying in Nigeria

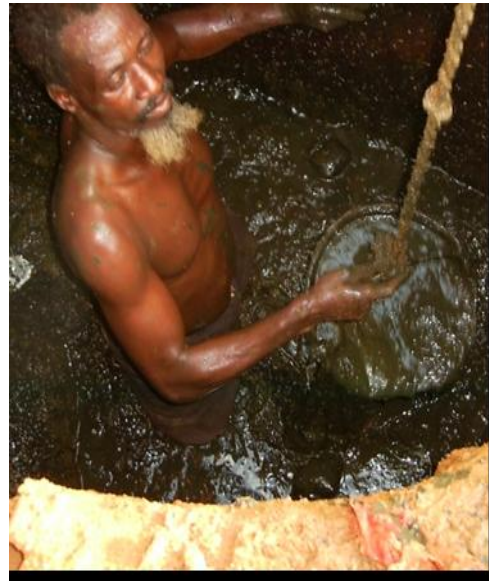
Manual pit emptying in Kano, Nigeria, has involved the following procedure and items (Debomy 2000):

- Diggers or hoes for excavating hardened or consolidated excreta.
- Shovels for removing the excreta and putting it into containers.
- Buckets for conveying the excreta out of the household where a hand truck cannot enter.
- A long wooden stick for measuring the depth of the latrine (for determining cost for emptying)
- Small hand truck for conveying the excreta to the dumping site.
- Kerosene and ash used in controlling odour.

ii) Pit emptying in Burkina Faso and Tanzania

In Burkina Faso and Tanzania emptiers have been found to immerse themselves in the sludge filled pit in order to get the sludge emptied (See picture 2.2 below).

Picture 2.2: Manual emptiers immersed in shit to get it emptied



Sources: Kaupp, 2006 -Tanzania;

Kone, 2008 -Burkina Faso

Picture 2.3: Manually Emptied Sludge in Tanzania



Source: Sudgen, undated

Pictures 2.2 and 2.3 depict manual emptying from different sources and countries, yet they bear the following common features about the emptiers and their modus operandi:

- The manual emptiers are sometimes immersed in the shit-filled pits and do not wear any protective clothes such as gloves and or shirts.
- The manual emptiers use simple hand tools, such as bucket, rope and shovel.
- The manual emptiers are exposed to bodily contamination with faecal matter and possible infection.
- Unimproved manual emptying is aesthetically indecent.

Besides the above observations, further examination of Picture 2.2 reveals that more than one person might be involved in the manual pit emptying as someone might be above the pit to collect the FS collected from down the pits. In Picture 2.3 it is unclear whether only one person is involved or another is inside the pit supplying the FS to the one seen in the picture.

A critical look at Picture 2.3 above, reveals the following two key issues:

- Looking at the sludge colour, the sludge seems to be well digested and therefore could be safely handled. This is an improvement over a scenario where a recently used latrine could contain fresh excreta with many pathogens (Mara, 1996).
- The emptied sludge is left to spread uncontrollably in the compound. This could restrict available recreational space for the residents of the households, especially children. It also implies that, where the sludge is not fully digested, an opportunity could be created for rain water, flies and scavenging animals such as rodents, pigs, dogs and chicken to interact with the faecal matter and spread diseases to the inhabitants nearby and beyond.

iii) Manual emptying in Ghana

Picture 2.4 below shows a man emptying FS manually from a septic tank in Kumasi, Ghana.

Picture 2.4: Manual emptying service in Kumasi, Ghana.



Source: Vodounhessi, 2006.

This picture demonstrates that the bucket is an important tool for manual emptying of FS. Another useful lesson from the picture is that the manual emptier is wearing gloves for protection. It is also unclear from the picture whether the man is alone or a second person is in the pit emptying and supplying him with the sludge above. In any case the sign of spillage messing the surrounding area is quite visible.

In another development, Van Der Geest (2002) provides a description about bucket latrine emptying in Ghana by the manual operators in the Box 2.1 below which is messy and lacks health and safety mechanisms:

Box 2.1: A description of bucket latrine emptying in Ghana

'Almost the whole atmosphere was dead. Everybody was asleep and I met nobody on the way. I got to Atia's place at 11.25 p.m. exactly. I knocked on his window and he came outside in his 'uniform', a white shirt with stains, a sack over his shoulder and a cutlass inside the sack. We went to the first house where his bucket was waiting. He hung the sack over a nearby flower hedge. He opened the door and pulled the full bucket towards him. He then pushed his own empty bucket against the full bucket. I began to feel [smell, svdg] the stench of the ebin (shit). Mr. Atia dipped his left hand (without gloves) into the shit of the bucket and scooped some of it into the empty bucket. He did this four times, because the other bucket was too full to lift without spilling. Then he took the full bucket, and poured the contents into his own bucket. He wiped his hand on the grass to clean it and took his small hat with the foam layer from his sack and put it on. He lifted the full bucket from the ground, rested it a moment on his lap and then placed it on his head, with ease. He then started walking to the dumping ground...'

iv) Pit emptying in Kenya

Picture 2.5 below is another example of manual emptying in Nairobi, Kenya.

In the picture, the following points are deduced:

- Two men are involved in the emptying operation, signifying team work in manual emptying.
- Even though the two men are not in full personal protective equipment, they are, at least wearing hand gloves.
- Local and improvised emptying buckets are used, which is significant for sustainability purposes.
- The sludge is quite watery and so easily spread around. This may be due to improperly designed latrines that allow infiltration from rain or surrounding soils. Or it may be due to human activity where domestic wastewater is put into the pit.
- The emptiers are quite soiled with the sludge, thus stressing the risky and unhygienic nature of manual emptying with unimproved tools.

Picture 2.5: Manual emptying in Nairobi, Kenya



Source: Schaub-Jones *et. al*, 2006

In the pit emptying pictures above, it could be inferred that manual pit emptying is risky and unhygienic. It also requires team work. But how the teams operate in terms of organisational structure and roles is not clear in the literature. This is in contrast with the bucket latrine system where single-handed operation is the norm (Van der Geest, 2002).

2.6.2.1.3 The risks associated with the manual emptying

In the discussions of manual emptying above, the literature does not provide records or specification for health and safety issues required for the manual emptiers. However, digging the FS manually from pits without adequate precaution and protection is risky and can get one infected with bacteria and worms (Cotton *et al*, 1995; Scott and Reed, 2006). Badly constructed pits can cave in (Macleod, undated). In some instances the sludge being emptied spills around the vicinity of the latrines, on the streets and on the bodies of the emptiers (Van Der Geest, 2002; Muller, 1997) which could get them infected by the pathogens in the excreta. In the case of the bucket latrines, the remaining layer of the 'nightsoil' in the bucket and the surroundings provides a

breeding environment for flies, insects and pathogens which can attack the households (Muller 1997). Also flies and scavenging animals attracted to the excavated sludge, left in the open without proper management, could carry infection to the households nearby (Pickford and Shaw, 2002). Sometimes the manual emptiers who cannot withstand the stench and nastiness of the human excreta resort to the use of chemicals like paraffin to control the odour (Debomy, 2000), and this could lead to possible environmental pollution.

All the above risks highlight the need for clear health and safety issues meant for excreta or FS emptying, transport and disposal in a city. The risks also imply that, the use of rudimentary manual tools for FS emptying could not only expose emptiers and households to diseases but also create aesthetic mess, contamination and environmental pollution. Therefore there is the need to opt for more appropriate form of emptying such as the conventional mechanical emptying which is less risky and messy.

Besides the health and safety issues, the manual emptying service does not provide the following important information:

- The distance between the latrines where the sludge was taken and the disposal site where it was deposited.
- How the emptied sludge was disposed of.

Information on the above issues could help us understand and manage better the various disposal mechanisms after emptying.

2.6.2.2 *Conventional mechanical emptying*

This subsection addresses the suction or vacuum force and the size of the emptying container in terms of its utilization.

2.6.2.2.1 *The suction force of the emptying equipment*

With the conventional mechanical emptying of latrines, the basic principle has been the use of vacuum or pneumatic pressure of varying sizes to desludge or empty the pits (Mara, 1996; Bosch and Schertenleib, 1985). Where accumulation of FS has occurred at the bottom of pits only specialised and

expensive tankers with adequate pneumatic pressure or vacuum force may be able to empty the FS (Mara, 1996). Unfortunately such expensive emptying equipment may either be beyond the affordability of many emptiers, or inaccessible to pits in the low-income countries. For, example Heinss *et al.* (1998), conducted a faecal sludge collection survey in Accra and recognised that only the top portions of pit latrines, of approximately between 0.7m to 1m, were presumed to be removed by the suction tankers since the lower portions of the pits were often solidified to an extent which did not allow vacuum emptying.

Where desludging is still a problem for suction, as a result of sludge thickness or consolidation, there is a suggestion that water be added with stirring, to soften the sludge to make suction relatively easy (Mara, 1996; Bosch and Schertenleib, 1985). However, doubts have been expressed about the practicability and economic viability of such an endeavour (Bosch and Schertenleib 1985). Therefore, should sludge in a pit be consolidated or become too hard to be emptied by vacuum or suction pressure an alternative means such as manual emptying should be considered. Apart from the consolidated sludge problem, vacuum tankers may find it difficult to empty pits filled up with objects such as wood, plastics, sticks, sand, stones, and other obstructive objects dropped in by users or passers-by (Bosch and Schertenleib, 1985). This implies that, in spite of the fact that mechanised vacuum and suction tankers can empty pits faster and transport the FS farther and faster than the manual equipments, they may be incapable of siphoning consolidated sludge accumulated at the bottom of pits or obstructive bulky objects even at relatively large suction force.

Therefore, to prevent consolidation of FS at the bottom of pits, which reduces the effective pit size with time (Boot, 2007), two recommendations have been made:

- i) To change the latrine design in such a way that the lower portion of pits could be sealed and a fixed pipe reaching to the pit bottom inserted (EAWAG/SANDEC, 2006).

- ii) Reduce the size of the pits to reduce time required for emptying (Boot, 2007).

2.6.2.2.2 Container or tanker size and utilization for FS

In a situation where each emptying container or tanker filled up, requires a long round trip to the disposal site or transfer point, a large container or tanker size fully utilized has an economic importance (Tchobanoglous *et al*, 1993). Thus, the bigger the tanker size the better it is to carry much sludge at any emptying operation for distant disposal or transfer site.

Due to the sludge consolidation problem, how much sludge is taken from a pit could best be estimated through a gauged tanker or container in the large vacuum tankers (Bosch and Schertenleib, 1985). This implies that container utilization in the vacuum tankers without functioning gauges cannot be easily ascertained. This is a concern that must be addressed in order that emptying and transport tankers can be fully utilised. Or else, knowing how much is taken from a pit at any given emptying operation and the full utilization of the conventional tanker may not be ascertained.

Between the manual and the conventional mechanised emptying lies the small-size emptying technologies whose advantages and disadvantages are outlined below.

2.6.2.3 Small-size technologies for emptying FS

Literature mentions that there exists small-size technologies that are adapted to take care of the accessibility peculiarities associated with the unplanned urban setting and address the inefficiencies associated with the manual rudimentary tools. What has not been done is the centralisation of information on these technologies for easy retrieval and referencing. This makes it difficult for communities to access and make informed decisions on a wide variety of emptying technology examples. Compilation from the literature has resulted

in the following small-size technologies in Box 2.2 below which are adapted to particular locations in the low-income countries. Brief explanation has been compiled about each technology to express the advantages associated with their use for emptying of FS.

Box 2.2: Some small emptying technologies

- ASLET (Arian Suction Latrine Emptying Technology)= Hand operated diaphragm vacuum pump and cart for pit emptying. An innovation by Arian Tech which is an Afghanistan enterprise with financial assistance from UNDP/UNCHS Habitat of Afghanistan in 1998. Cost of production as at 1998=\$1500. It's manual-mechanical, small in size and can access narrow streets and lanes (Yarmand, 1998).
- BUMI hand pump, which is also hand-operated diaphragm pump, with only three wearing parts developed by Dunlop, in Zimbabwe (Bosch and Schertenleib, 1985).
- Vacu-tug pit latrine exhaustor of UNCHS Habitat and Manus Coffey Associates in Kenya. It is mechanical. Smaller than conventional vacuum tankers (UN-Habitat, undated).
- MAPET (Manual pit-latrine emptying technology project) designed and developed by Waste Consultants Netherlands in Nairobi, Kenya. Cost as at 1992 =\$3000 (Muller and Rijnsburger, 1994).
- Gulper developed by London School of Hygiene and Tropical medicine (LSHTM). This is handy, manual and cheap. (Sugden, undated)
- Larsen Dung Beetle (used for bucket latrine emptying) in Ghana. Quite small and manoeuvrable (Boot, 2007).

In spite of the manoeuvrability advantages in the urban areas, these technologies can only empty small volumes of FS per operation and travel slowly to discharge of the FS at distant disposal sites. Also, they cannot empty consolidated sludge at the bottom of pits.

Inferences from the emptying discussions so far point to the following key problems:

- Different emptying methods and equipment are used at different locations for different latrines and sludge concentrations.
- Human behaviour such as dumping obstructive objects into the latrines, hamper mechanical emptying.
- Sludge solidification and accumulation at the bottom of pits is difficult to be removed mechanically by existing mechanical suction or vacuum tankers. So far, the solution to this technological weakness has not

been adequately addressed in the literature regarding mechanical emptying.

- As compared to the conventional or large-size tankers, the small-size technologies can only empty small volume of sludge per emptying operation. Also they cannot empty consolidated sludge at the bottom of pits as well.

After the FS or excreta have been emptied, they ought to be transported to the place of approved and safe disposal point. The technology and method for the FS or excreta movement is the focus of the next section.

2.6.3 Transport methods and technologies for FS or excreta

Transporting excreta or FS within cities in low-income countries has been done by various technological means ranging from the very basic to advanced means. Thus, the transport methods and technologies are as varied as their emptying counterparts in the urban areas of the low-income countries.

The basic means of transporting the excreta or the FS, which is referred to as manual in this study, is by means of carrying buckets, pans or baskets on the head or shoulders and pulling of carts by men or animals (Hurtado 2005, Van der Geest, 2002; Gupta, 1997). The advanced technological means, also referred to as mechanical in this study, has been through vacuum or pneumatic tankers, trucks and tractors and all forms of motored carts (Mara, 1996; Bosch and Scertenleib, 1985). Usually the means by which the latrines are emptied are the same by which they are transported for disposal as reported in the literature. The key constraints to getting the excreta or FS smoothly transported are the distance to travel for disposal and accessibility to transport.

2.6.3.1 Haulage distance and accessibility to transport

Indiscriminate dumping could occur in a community with no accessibility for transport equipment. Also in a situation where long haulage distance and

traffic jams are involved, this could contribute to high transport costs (Ingellinella *et al*, 2002; Montagero *et al* 2002). The long haulage distance problem could be addressed through careful and diligent planning. For instance, community based holding tanks, localising treatment site facilities as well as reuse possibilities could be used to address the long haulage distance problem (GHK, 2002; EAWAG, 2005; Parkinson and Taylor, 2003; Wright, 2008). On the other hand, traffic jams could be averted by avoiding peak times of the day.

In environments where the streets are too narrow for large vacuum tankers to apply, it is the relatively small technologies that perform better. Due to their relatively small volumes, it is sometimes more economical to empty their contents into transfer points or a bigger container for onward transport to final disposal sites which are often distant from the city centre (Tchobanagolous *et al*, 1993). A good example here is in Nairobi, Kenya, where a community has adopted the idea of using the sewer mains as a sludge transfer station served with the Vacutug system {See Box 2.2 in Section 2.6.4 for details} (Luthi, 2008). In some instances the large vacuum tankers also solve the long haulage problem by discharging their contents into the sewer mains (Schaub-Jones *et al*, 2006). Or smaller-size tankers with less powerful pumps could be mounted on a vehicle to access the narrow lanes to empty the FS sludge (Pickford and Shaw, 2002). Alternatively, a system of sludge transfer between a small-size tanker and a conventional-size vacuum tanker is done in such a way that the latter is placed on a road nearest to the congested area served by the mini tanker (Strauss and Montagero, undated). Thus, the key advantage that the small-size tankers or emptying equipments have over the conventional tankers is accessibility. However, as already pointed out, they are unable to empty large volume per operation as well as travel fast and far to distant disposal sites.

2.6.3.2 Urban transport of waste and FS

Appropriate waste transport networks for cities entail route layout; haulage distance; transfer stations and operations; as well as various time-bound operations (Tchobanagolous et al, 1993). In the low-income countries, waste transport has involved informal waste collectors whose role has been critical in urban waste collection and transport. However finding ways of integrating their services fully into the city-wide waste collection operations has been a problem due partly to municipal procedures and attitudes that constrain integration (Ali, 1997).

When it comes to the transport of FS, one critical area of concern which is unclear in the literature is the form in which the FS is to be transported—Is it liquid, solid or mixture of both?

2.6.3.3 Comparing solid waste and faecal sludge management in a city

During the recent meetings of the UK Community for Sanitation Practice, it emerged that essential parallels could be drawn between solid waste management and FS management in cities of low-income countries (UK Community for Sanitation Practice, 2008). By so doing, solid waste management systems could offer valuable lessons for FS management in a low-income city. For example, transfer stations could be used to address fragmentation and haulage distance problems. This is particularly so because transfer stations can make excreta and FS transport economical if (Tchobanagolous *et al* 1993):

- i) long haul distances are involved and relatively small, manually operated systems are used for the collection of excreta o the FS
- ii) very large quantities of waste must be hauled over long distances; and,
- iii) One transfer station or holding tank can be used by a number of collection vehicles or bucket latrines.

By following the way solid waste is handled in the cities of the developed countries, the cost for FS emptying and transport could depend on time-bound activities or tasks, mechanical and labour or personnel factors. The time-bound activities would include: Pick-up, Haul, At-site and Off-route tasks (Tchobanagolous *et al*, 1993), The explanations of the tasks adapted from the concepts put forth by Tchobanagolous *et al* (1993) are explained below in relation to the pit or bucket emptying service:

1) Pick-up task depends on the type of collection system at stake. In FS transport, this task will be relevant for the bucket latrine system. In this case, pick-up task for hauled bucket latrine systems in a conventional mode could refer to the time spent in moving or walking to the next bucket after an empty bucket has been deposited; the time spent picking up the excreta-filled bucket, and the time required to redeposit the bucket after its contents have been emptied. If the haul system is operated in the exchange bucket mode, pick-up includes the time required to pickup the excreta-filled bucket and to redeposit the bucket at the next location after its contents have been emptied.

2) Haul time also depends on the type of collection system used. But this can be applied to all the latrine systems. For bucket latrines, haul time could be the time required to reach disposal or transfer station after picking the filled bucket, and time for returning the emptied bucket back to base. With pits and septic tanks, haul time could be the time required to reach the disposal site or transfer station after emptying and returning to the next pit or yard of the transporting company.

3) At-site task is the unit of operation at the disposal point or transfer station. It refers to the time spent at the location where the contents of the vacuum tanker or any excreta-filled container are unloaded. It includes the time spent waiting to unload as well as the time spent unloading the wastes from the container or the collection vehicles.

4) Off-route includes the times spent on activities not directly connected to emptying and transport activities such as times spent for lunch, rest, maintenance and refuelling of vehicle.

It must be stated that these procedures mentioned operate in well planned and organised societies and therefore might not work well in unplanned and disorganized societies. Therefore, where possible, the application of these

procedures should be tied to the unique socio-economic and technological problems that pertain to a particular society.

In view of the limitations drawn from the literature about the existing manual and conventional mechanical emptying technologies and processes, it is necessary to consider the use of other emptying technologies to supplement the emptying efforts in order to overcome the accessibility and other emptying problems.

Thus, combining the literature facts about the emptying technologies and operations, the following technological and operational gaps and weaknesses emerge:

The technological gaps and weakness

- The technology that can empty consolidated sludge at the bottom of pits is lacking
- Technological gap that can address the accessibility problems, empty a substantial amount of sludge per emptying operation and travel relatively fast enough to distant disposal sites.
- The rudimentary manual tools cannot effectively address the health and safety issues.

The operational gaps and weakness

The literature does not provide clear information about the following key operational issues regarding emptying and transport of the FS within the city:

- The basis for the emptying operational costs.
- How far the excreta or sludge emptied from the households is transported to the disposal points.
- What happens to the sludge or excreta after it has been emptied—is it reused, disposed of indiscriminately or buried or sent to disposal site?

In view of the emptying and transport problems associated with the existing technologies, the selection and adoption of any technology that could

effectively empty and transport FS safely and sustainably in the urban areas should possess the following key attributes:

- Ability to empty and transport the human excreta or FS successfully without destruction of the latrine infrastructure and or causing environmental pollution.
- Ability to access the latrines for emptying.
- Ability to protect emptiers and transporters from direct physical contact with excreta.
- Ability to haul the emptied contents with relative ease without resorting to indiscriminate dumping or polluting the environment.
- Desirability and affordability to the users.
- Physical robustness and durability.
- Ease of manageability by the operators who use and maintain the technology.
- Availability of spare parts in the country or locality to replace or repair broken equipment.

Apart from the equipment and the operations involved in emptying and transport, there is the need to consider the actors or labour involved in the emptying and transport business as is addressed in the next section.

2.6.5 Labour requirements and gender in FS emptying, transport and disposal

Whatever the labour force or actors involved in excreta emptying and transport, it is expected that the individuals, institutions or organisations concerned should demonstrate enough capacities for the job because failure to do so could allow pathogen infested excreta to pose a health threat to the community. Thus, there is the need for all actors, formal and informal, in the industry to have the requisite skills and understanding about the health and safety issues regarding management of excreta within the city in order to prevent diseases and environmental contamination. However, the literature points out the lack of capacity and coordination among individuals and

organisations working in the sanitation sector in general and FS management , in particular (Schaub-Jones et al, 2006; WaterAid-Ghana, 2005; Parliamentary Office of Science and Technology, 2002; Larbi, 2006; EAWAG/SANDEC, 2006).

Apart from the few isolated incidences in the developing world, such as in Uttar Pradesh, in India, where women are mentioned to be involved in carrying and transporting human excreta (Manecksha, 2007), men are the main emptiers and transporters of human excreta in the literature. The importance of involving both women and men in the management of sanitation issues has been recommended at the global level (UN-GWTF, undated), however, it seems that much of the advocacy for mainstreaming women in the sanitation issues is restricted to hygiene promotion; latrine use; infrastructural set up and maintenance (WaterAid and UWASNET-Uganda, 2002; IDTG-Practical Action, 2005). Thus, in excreta management, women are seen more as the guardians of household hygiene (The World Bank Gender and development Group, 2007; Kolsky, 2004), where they are particularly engaged in the cleaning of the latrines as well as the collection and disposal of excreta from infants and invalids from the households (McGranahan *et al*, 2001; Idehen and Oshodin, 2007).

After emptying and transporting the excreta or the FS, it has to be disposed of untreated, treated or reused. The next section discusses reuse in the context of ecological sanitation.

2.6.6 Reuse as part of disposal and ecological sanitation

After FS has been emptied and transported it could be disposed of for further treatment and or reuse (Strauss *et al.*, 2003). As part of the destination points for FS or excreta transport and ecological sanitation, this section addresses the benefits and problems of FS reuse in agriculture.

Ecological sanitation systems enable a complete recovery of nutrients in FS, urine and wastewater for reuse in agriculture (Winblad and Simpson-Herbert, 2004; Winblad and Kilama, 1985). Examples of ecosan latrines that provide product recovery for reuse include urine diverting and composting latrines. In urine diverting latrines, the urine is directed away from the faeces to keep the volume of material small and processing chamber (pit) contents dry. The products can be sanitised separately and used as fertiliser (Winblad and Simpson-Herbert, 2004). In the composting latrines, urine and or the faeces are deposited in a processing chamber along with household organic, garden refuse as well as bulking agents such as straw, wood shavings and twigs to enhance the composting (Winblad and Simpson-Herbert, 2004).

Reuse with ecosan products helps to preserve soil fertility and increase food production, whilst at the same time, minimizes the consumption and pollution of water resources and the overall environment. This is demonstrated in the Figure 2.1 below:



Figure 2.1: A Diagram depicting the benefits of Ecosan

Source: Werner, 2006

Due to the presence of nutrients such as N, P and K in the human excreta, it has been reused for soil fertilisation or amelioration and fishponds in many parts of the world, especially Asia and Africa (Nkansah, 2001; Strauss, 2000, Rose 1999). Reusing excreta in this way reduces the need for expensive artificial fertilizers to increase food production (Cofie, 2003; Strauss *et al.*, 2003; Shende, 1985). Apart from the area of agriculture, excreta can also be reused to generate energy (EU,1999) and raw materials for cement manufacturing (Taruya *et al*, 2002).

What is unclear in the literature is the socio-economic role reuse plays in the emptying and transport business of the excreta or the FS. This might help to encourage more efficient emptying and transport mechanisms in a city. This is because more farm reuse of the excreta or the FS could lead to a reduction in the sludge loading rate at treatment plants and reduction in indiscriminate dumping. For example, farmers scramble for suction truck drivers to dump faecal sludge on their farm lands during the dry season in Tamale, Ghana (Asare *et al*, 2003). A scenario like this could lead to less indiscriminate disposal, increase in the efficiency of emptying and transport of FS and reduction in the loading rate of the treatment ponds in the city. Reusing the excreta or the FS also has the potential to create jobs and help address sanitation funding shortfalls. This is important because issues of finance are critical to the success and sustainability of FS emptying and transport in the urban areas. Yet the literature has not linked these potential benefits of reuse to the management of FS emptying and transport.

In spite of the above actual and potential advantages, reuse can also be a health risk since the wastewater, excreta or the FS is likely to contain viruses, bacteria, helminth eggs and toxic substances (Amahmid and Bouhoum, 2000; Cutolo *et al.*, 2006). This is because, in the majority of cases, the excreta or the sludge applied in the developing countries is untreated or only partially treated through storage, thus creating a potential health hazard for both the handlers and appliers, for farmers as well as consumers of produce from such farms (Agodzo *et al*, 2003; Blumenthal *et al.*, 2000). It is therefore important that the excreta or the FS is treated to a high degree before it is used in food

production. Also users must take care to reduce the amount of toxic substances that might end up in the FS meant for reuse. What is good though, is the fact that the contents of heavy metals in the sludge are either absent or generally low, in many low-income countries (Jimenez *et al*, 2004).

2.7 Financing sanitation

This section looks at the financial problems besetting the sanitation sector in general and pit emptying in particular, with proposed solutions to address the problems.

2.7.1 The financial difficulty in meeting the sanitation needs

In low-income countries, sanitation expenditures are bound up with general investments in water supply and sanitation (Evans, 2004). Therefore, it is hard to estimate the exact expenditure figures of governments for sanitation. Nevertheless, some estimates suggest that several tens of billions of US dollars are required to improve the sanitation situation in the developing countries (Baietti and Raymond, 2005). These relatively huge estimates make it extremely difficult for the developing countries to adequately meet their sanitation needs, especially in the face of constrained public resources and aid flows coupled with debt servicing, fiscal constraints and absence of adequate cost-recovery mechanisms.

It is stated by Xie (2008) that the maximum proportion of a household income to be spent on water and sanitation should be between 3-5% (Xie, 2008). Although this proportion gives an idea as to how much each household could spend on joint services of water and sanitation, it fails to offer the estimated proportion of household income on sanitation alone. However, It is known that about 90% of total national investment in sanitation in the low-income countries comes from the household (Cotton, 2009). This portrays the

significance of households' contribution to sanitation in the low-income countries.

2.7.2 Financing excreta or FS emptying and transport

State subsidies for services such as FS emptying, transport and disposal associated with on-plot sanitation have been neglected in many low-income countries (McGranahan *et al*, 2001; Mehta and Knapp, 2004; Pramanik, 2007). Yet, it is mentioned that the poor in the urban areas suffer from the highest emptying frequencies and payments due to the relatively higher usage rate for the relatively small latrine volume (Vodounhessi and Von Munch, 2006). The authors did not, however, specify the volume sizes of the pits emptied and the operational costs associated with the volume sizes emptied. Below are some examples of the operational costs associated with pit emptying in some low-income countries.

2.7.2.1 Operational emptying costs in different countries

Macleod (undated) reported that in the year 2000, the cost of emptying a pit in eThekweni Municipality in South Africa, could exceed about US\$ 143 (i.e. value of R1000 in 2000). He attributed the high cost of emptying to the following issues:

- The difficulty in emptying the pits because they were unlined or the top structures were in a precarious situation and therefore subject to catastrophic collapse whilst the pits were being emptied.
- The pits were constructed in locations which were inaccessible to conventional vacuum tankers.
- The contents of the pits were often not homogenous and included rags, plastic bags and household refuse, which made emptying by pumping difficult, if not impossible, even after the addition of water in an attempt to liquefy the contents.
- The sizes of the pits varied considerably, with the average volume being approximately 2 cubic metres.

It is unclear from the above explanations whether the cost quoted for the pit emptying at the time was for manual or mechanical emptying. But Eales (2005) reports specifically that the eThekweni Municipality had been providing a municipal desludging service mechanically, where accessible, at a subsidised fee to households of R81 (US\$ 13) per emptying against the real mechanical cost ranging from R450 (US\$73) to over R1500 (US\$246), with the average cost being around R600 (US\$90). According to the same source, many of the areas most urgently in need of servicing were in low-income settlements not accessible to suction tankers, because of bad roads, high settlement densities, steep slopes, etc. At the time of reporting, no small-scale service providers had emerged to provide an alternative service. She attributed the reason to the fact that the municipally-subsidised price offers little incentive to them to compete; and the fact that the capital and operating costs of conventional suction tankers were too expensive for the small-scale providers.

In another development, Steiner *et al* (2003) found that, depending on the pit volume, a typical emptying fee by a vacuum truck in a West African city was in a range between US\$ 15 – \$30. In Nam Dinh, Vietnam, the emptying fee for a septic tank in 2001 amounted to about US\$ 17 (Klingel, 2001). From the examples cited, it can be inferred that pit emptying could occur at varying operational costs even within the same community, region or country

2.7.3 The proposed solutions

Subsidy has been an alternative means of financing sanitation in low-income countries in an attempt to address the sanitation problems. However, sustainability of full-scale subsidy has been questioned (Kar, 2003; Mehta and Knapp, 2004). Discounting subsidy as a sustainable choice of sanitation financing, leaves the choice of financial solution limited to either a move towards mobilizing more sources of private financing or a mixed financing scheme that blends public and private finances (Baietti and Raymond, 2005). In these arrangements, various financing mechanisms have been tested in the field to try to increase the demand required to stimulate household

investments. These include leveraging, micro-financing and credit, revolving funds and sanitation surcharges (Mehta and Knapp, 2004; Rosemarin, 2005, Black and Fawcett, 2008; Toubkiss, 2008). Even though it has not been mentioned in the literature, these finance schemes could similarly be used to enhance pit emptying in the urban areas as well.

Research from Africa and case studies in Asia have shown that the private sector market for pit emptying, though small in scale, has been quite successful without any financial support (Evans, 2004). Evans' assertion does not, however, distinguish between services of the formal and better organised emptiers and those of the small-scale informal emptiers. With regard to the small-scale informal emptiers, Obika (2009) is of the opinion that they lack the requisite technical and financial capabilities to deliver pit emptying services effectively without major financial assistance and capacity development. Thus, although the service rendered by the small scale informal pit emptiers to address the pit emptying problems is encouraging, it fails to effectively address the pit emptying problems in the urban areas.

What has not been discussed in the literature is whether the users are satisfied with the services they are getting either from the small or large scale service providers. Also, empirical records in the literature about various cost elements such as emptying frequency, pit volume and pit filling rates associated with the pit emptying and transport services are not available. Thus, it would be necessary to know the users perceptions as well as other cost factors that may affect emptying and transport empirically.

2.7.4 Factors that affect cost of FS emptying and transport

To address the financing of emptying pits, tanks or vaults adequately, factors such as types of latrine technologies; means of emptying the pit; pit re-emptying frequency; differences in pit sizes; user numbers per pit; pit filling-up rates and times at different locations as well as haulage distance and how they relate to the emptying costs should be discussed. But so far the literature does

not provide any empirical data that relate these issues to the cost of emptying and transport.

The filling up of pits at different locations and times leads to fragmentation of demand for emptying and transport in a given community (Schaub-Jones, 2006). Addressing the fragmentation issues and the associated economy of scale problems is very important in managing FS emptying and transport because the success of these will depend not only on the users' ability to pay but also on the emptier's continuous and sustainable service operations.

Ideally, to benefit from the economy of scale, it would be economically expedient for emptiers and users to balance their demand for emptying and transport of FS aggregated for the mutual cost benefit of each other. Inference from the literature suggests that the fragmentation in FS emptying per se does not imply that the overall FS generation in a city ready for daily collection is by any means small. For instance, the city of Kumasi in Ghana with over 1 million inhabitants, daily generates 500m³ of faecal sludge (FS) collected from on-site sanitation systems (Mensah, Cofie and Montangero, 2003). With an average conventional vacuum tanker size of about 5m³ in the city (Vodounhessi and von Munch 2006), it will take about 100 vacuum tanker operations in a day to do the job of FS emptying and transport. The sheer scale of such an emptying operation could overcome the economy of scale problems if there is appropriate coordination and monitoring mechanisms in place.

In communities with relatively low population density and dispersed latrine distribution, reducing the size of the latrine vaults could increase the frequency of emptying and thus, make latrine emptying viable business for emptiers (Boot, 2007). This can be achieved by the users or through other external factors such as the high settlement density with space restrictions; a high water table; and an inappropriate soil structure (Feachem and Cairncross, 1978). Besides these factors, the consolidation process that takes place at the bottom of pits with time reduces the active volume of pit available for use and emptying (Sugden, 2005; Wright, 2008). Overall, latrine sizes can purposefully be constructed to:

- reduce the cost of construction,
- overcome some space or terrain problem,
- reduce sludge consolidation and thickening and, thus, increase the frequency of emptying (Boot 2007; EAWAG/SANDEC, 2006), and
- to create economy of scale (Boot, 2007; Schaub-Jones, 2006)

2.8 Organisational and institutional issues

It has been noticed in South Africa that adequate funding alone, for sanitation projects without institutional or organisational capacity, could not address the sanitation problems (Blackett and Moonieya, 1999). This implies that sanitation programmes need proper organisations or institutions with skilled planners, decision-makers, and professionals who are trained in evaluating different approaches to providing, operating and maintaining sanitation (Parliamentary Office of Science and Technology, 2002). But there are weaknesses in existing organisations or institutions running sanitation programmes in the low-income countries (Bohman, 2005). These organisational problems extend to pit emptying and FS transport as well (Montangero *et al*, 2002).

2.8.1 The organisational and Institutional problems

The literature points to a shortage (in both the public and the private sectors) of administrators, engineers and field workers needed to provide the technical and managerial skills to develop sanitation programmes, including the effective management of excreta (WaterAid-Ethiopia, 2004; Parliamentary Office of Science and Technology, 2002). According to Nair (1993), some of the common weaknesses in the existing sanitation organisations and institutions are untrained staff, poor pay scales, the lack of incentives to do a good job, and corruption. These, according to him, lead to inadequate supervision of workers and inadequate maintenance of facilities.

In many cases, sanitation sector is divided between different government agencies such as health, water, and education whose actions are uncoordinated (Saywell and Cotton 1998). Besides, NGOs' roles in the sector are also not coordinated and networked, thus, resulting in confusion, project duplication and waste of funds. In Ghana, for example, many governmental and non-governmental agencies are involved in sanitation without any proper coordination between them (WaterAid-Ghana, 2005). The many actors in the sector with fragmented interests and operations could also jeopardise effectiveness if there is not a body which is directly or specifically charged for sanitation and properly coordinates the activities of the various actors in the sector (Saywell and Cotton, 1998).

2.8.2 Addressing the organizational or the institutional problems

How to address the above organizational or institutional problems effectively in an appropriate management framework has also been the subject of debate. Saywell and Cotton (1998) commend unbundling sanitation programmes both vertically and horizontally into manageable segments down to the community levels so that sanitation can be appropriately managed. GHK (2002), and Parkinson and Taylor (2003) also offer strategic decentralisation as key to solving the sanitation management problems in the low-income urban communities through decentralized decision-making and participatory planning involving the key stakeholders. Such an institutional system in FS management offers potential benefits relating to increased responsiveness to local demands and needs; and therefore, leads to increased willingness of communities to pay for improved services. What is unclear in the literature is how the contents and management style of the decentralised and unbundled institutions should be constituted, especially, in the low-income communities which are very heterogeneous in terms of sanitation needs, socio-economic status, tenure arrangements, religious backgrounds and power structures (Saywell and Cotton, 1998; Manikutty, 1997; Encheverri-Gent, 1992).

When it comes to FS emptying and transport specifically, the literature provides some clues as to how to involve the stakeholders in an organisational or institutional arrangement meant for management. For example, Campbell (2000) suggests that the sludge or excreta management solution must reflect the unique needs of the individual communities and must involve the public from the very beginning in the decision making process. He therefore advises that the sludge management options selected should be based on a critical evaluation of the needs of each specific situation and locality. Duqqah (2002) agrees with a similar view that an organisational framework for effective human excreta management should be based on local conditions. The problem that is still not addressed in these suggestions is how to effectively involve the public as well as the local communities, with diverse interests and uses, in order to solve the excreta or the FS emptying and transport problems.

The suggestions regarding the organizational set up for managing urban excreta are several and varied, but deductions from the discussions mean that any organization or institution formulated to meet the excreta management target and sustain its progress should be decentralized. Part of the localised or decentralized strategy could be to promote partnerships with the private sector, which are mainly in the form of local enterprises, in their efforts for providing sanitation services (Sohail, 2003). Saywell (2000), however, advises that there is the need to take caution in such a way that the working cultures of the local government institutional structures would not conspire against effective communication between the stakeholders. His view emphasizes the point that mere set up of organisation without the right stakeholder ingredients, structures and capacity empowerment could amount to failure (Tandon, 2002; Burger, 2002).

2.9 Sanitation Policy and regulations

2.9.1 Policy

Lack of sanitation policy can constrain management as well as the coverage and the improvement of sanitation in the developing countries (Seppälä, 2002; Elledge, 2003; Cotton *et al*, 2003; Tayler and Scott , 2005; WELL, 1998). This implies that policy could serve as a an empowerment tool to stop or enhance sanitation practice. Several views have been expressed on how to get the sanitation policies drawn and implemented (Elledge *et al*, 2002; Cotton *et al*, 2003; and Tayler *et al*, 2003, 2005). Nevertheless, there is still no consensus as to how to get the sanitation policy drafted and implemented in the low-income countries, thus leaving room for poor and fragmented policies for implementation or even complete lack of it in some countries (Tayler and Scott , 2005).

Thus, many countries in the developing world, especially Africa, either lack sanitation policy entirely or have an unclear and often contradictory policy (Elledge, 2003; Seppälä, 2002). In some instances, there is an expressed lack of knowledge and understanding among policymakers about technical issues and the importance of sanitation (Lenton *et al*, 2005).

South Africa is one of the few countries in Africa with quite a comprehensive sanitation policy in Africa (DWAF, 2002) followed by countries like Uganda and Ghana (Government of Ghana, 1999; Government of Uganda, 1997, 2003). Even within these exemplary sanitation policies, there exist some duplication and negligence of duties due to confusion and lack of clarity of roles and responsibilities for various sanitation sectors (WaterAid-Ethiopia, 2005; WEDC Briefing Notes, 2005). For example, as far as urban pit emptying and excreta or FS transport are concerned in Ghana, the policies are inadequate to address all the necessary linkages.

Developing sanitation policy is one thing whilst implementing it is another. According to Samanta and Van Wijk (1998), policies should encourage

technologies and practices that match users' own frames of reference in order for them to be effective. This assertion is confirmed by study done by Tiberghien (2002) who found out that people's perception and attitude affected sanitation choice and use in Mexico. Since traditions and practices may compromise or affect hygiene (Sattenspiel, 2000; IP3, 2004), the sanitation policy should be comprehensive enough to recognise key hygienic practices, such as hand-washing which are necessary to reduce morbidity (Koopman, 1978, Hoque *et al*, 1999). This means that drafters and implementers of sanitation policy should be conversant with both general and specific sanitation issues at stake. In this light, Kalbermatten and Associates call for the need for policy to develop better approaches towards solving sanitation problems effectively (Kalbermatten Associates, 1999, 2000). These better approaches, in the view of DFID, involve the promotion of inclusive policy dialogues and pro-poor policy frameworks (WELL, 1998). However, pro-poor policies can be effective only after taking into considerations factors that impact on costs to users as well as their perceptions, attitudes and practices. This confirms Auer's (2000) point of view that sanitation policy and its scope should be crafted according to the predispositions and personalities of the intended audience, which in this research are the households.

Therefore with faecal sludge emptying and transport, it is essential to consider in the policy the costs, socio-cultural interests and other concerns of the users, the emptiers and the transporters. This could help to prevent bad defecation practices and poor handling and transport of the excreta or FS within the city. . What is important is that any FS emptying and transport policy put in place should not only be realistic but also take account of all relevant stakeholders (Tayler and Scott, 2005) with a possible link to the appropriate drivers of change, such as the Poverty Reduction Strategy Papers(PRSP) (ERM, 2005).

2.9.2 Regulations

Whereas policy provides guidance and framework for operating sanitation activities, it is the regulations which provide the formal requirements for action,

monitoring and enforcement. The regulatory functions in the water and sanitation sector could be broadly divided into three major categories: economic, environmental and public health (Johansson and Kvarnström, 2005). Thus, in the implementation of FS emptying, transport and disposal issues, the regulatory framework could entail price mechanisms as well as service quality that will provide environmental protection and hygienic safety to the households and the public at large. This means that both the public and private service companies need regulation so as to be able to resist improper service price and quality, especially in the absence of real competition (Klein, 1996). The key to effective regulation is to allow for generation of good rules that can be followed to achieve the intended objectives (Klein, 1996).

2.10 Urban sanitation planning

From the literature, the two main approaches to sanitation planning are supply and demand driven which are outlined below.

2.10.1 The supply-driven sanitation planning

Supply-driven sanitation planning implemented by governments without considering what the users want and are able to afford, has not worked for many developing countries (Wright, 1997). The IWA Task Force on Sanitation (2006) also does agree with this view by stating that the normative technical planning approaches in the supply-driven approach seem to be failing because the objectives upon which decisions are based:

- are distorted by special interests, or by a poor understanding of the real needs of the population, and therefore result in plans which do not respond to the rapidly changing urban context and diverse conditions which pertain in modern urban areas.
- fail to make a realistic assessment of the inertia which impedes capital investment;
- result in systems which place an unrealistic management burden on all levels of the city.

Inference from the IWA Task Force statements implies that there is the need for some level of consultation with the users whose views and concerns ought to be taken into consideration by the sanitation engineers and planners. However Tilley *et al.* (2008) think that in order to reduce the ambiguity in the sanitation planning systems and allow for harmony and completeness within sanitation planning in a city, it is necessary to standardize the sanitation system by categorizing and linking the technologies. Although this seems to be a good idea, implementing it on the ground is by no means easy because of the differences in household sanitation demands in the low-income countries.

2.10.2 Demand-driven sanitation planning

The demand-driven approach shifts away from the supply-driven approach towards a more inclusive planning approach (EAWAG, 2005; IWA Task Force on Sanitation, 2006; Ockelford and Reed, 2002). The key factor in demand-driven sanitation planning is to ensure that there is a demand for sanitation and *that every latrine is a wanted latrine and will therefore be used* (Cotton, 2009). This is necessary because unless investments in centralized resources reduce risk at the household level, they will not contribute to health (Cotton, 2009). Therefore in the demand-driven planning approach, there is the need to sensitize households and communities to express demand and organize themselves to implement decisions on choice, financing and maintenance of their sanitation systems. Thus, it is necessary to allow users' participation in the planning process of sanitation projects in order to offer them sense of ownership (Kvarnstrom and Petersens, 2004; Tandon, 2002; Burger, 2002); boost their demands, and increase the probability of success of the sanitation projects (Schonning and Stenstrom, 2004).

Several suggestions as to how to address the planning mechanisms for the demand-driven planning approach have been put forward. For example, the Strategic Sanitation Approach (SSA) for the low-income countries is a demand-driven approach that is useful to address urban sanitation problems (Wright, 1997). By its demand-oriented service delivery system, SSA can be

flexibly applicable to different responses to demand in different areas and contexts, and by so doing, offer alternative technological and institutional options for the service delivery (Saywell, 2000). GHK (2002) and Tayler *et al* (2003) also propose decentralised planning of sanitation systems in a city so that the systems can be effectively and transparently managed.

So far, there is lack of consensus and coherence on demand-driven sanitation planning mechanisms (Saywell *et al.*, 2005). However when it comes down to FS emptying and transport, it would be more reasonable to involve users in the planning process, since they are the closest to the excreta and therefore can better identify places of excreta disposal in their households or neighbourhoods. Such grassroots participation in the excreta management could lead to identification of problems closest to their sources. This could be achieved, more especially, where the planning is open and easily understood by the users. Therefore an effective decision making for planning and managing sanitation systems in the urban areas of low-income countries can be narrowed down to the following key issues:

- geographical limitations and contiguity
- socio-economic and cultural patterns
- system financing
- policy and legal frameworks
- natural environmental conditions
- infrastructure (present and future)

An appropriate mix of these issues in the planning framework could result in a management system that is more effective at meeting the service objectives of the sanitation utility; and lead to more services reaching the poorest and the unserved areas.

What is missing from the literature is the lack of an effective management system that coherently articulates all the FS emptying, transport and disposal issues already discussed in terms of the technology, finance, institutions/organisations, policy and planning. Therefore the next section

addresses the various management approaches and their relevance as a framework for urban excreta or FS emptying, transport and disposal in the low-income countries.

2.11 Sanitation management approaches for the low-income countries

Unlike urban water management, urban sanitation management approaches found in many low-income countries are limited and comprise one or combinations of the following modes of sanitation provision:

- Conventional, and
- Low-cost.

2.11.1 The conventional mode

At one extreme of the conventional mode is the public provision of sanitation services, where the municipality provides sanitation services to the households characterized by the supply-driven master plans which are often meant for the management of the whole city. This has been mainly a top-down management approach, which has, so far, not met the coverage and overall sanitation management expectations in many low-income countries because the plans have always excluded the concerns of households and residents closest to the sources of the waste generation (Schertenleib, 2005; Schertenleib and Morel, 2003; EAWAG, 2005). At the other end of the conventional mode are the private sanitation companies which operate purely under the capitalist notion of supply and demand. One key weakness associated with this mode of sanitation provision is that, the private firms or companies have the freedom to enter and leave the industry depending on demand for their services by the households and or regulatory and legislative mechanisms in place (Edwards and Stevens, 1978).

2.11.2 The low-cost management mode

The informal management mode, mainly community based, is mainly a bottom-up, fragmented and piecemeal management approach often organised by NGOs, community based organisations (CBOs) and community self-help groups (Mara and Alabaster, 2008). Although this has helped a number of communities, it lacks consensus and coherence and so it is difficult to scale up (Matthews, 2004).

The low-cost management mode is demand driven but fails to have any significant city-wide effect on poor sanitation in the urban milieu (Tayler, 1999). The Community Led Total Sanitation (CLTS) model is an example of low-cost sanitation intervention which promises total sanitation for rural communities. Since its inception CLTS has enabled a number of communities to gain almost total sanitation (WSP, 2007). But, there are two problems that CLTS does not address:

- i) CLTS does not address excreta removal, transport and disposal issues.
- ii) It does not address sanitation problems in the urban setting.

2.11.3 Household-Centred Environmental Sanitation (HCES) approach

The HCES approach was developed by the Environmental Sanitation Working Group (ESWG) in Switzerland as a paradigm shift from either 'top-down' or 'bottom-up' approaches (EAWAG, 2005) to take care of the inefficiencies in the two management approaches in the developing countries. The idea behind the approach is to employ the good elements in all the sanitation management approaches in an integrated and flexible framework with emphasis on the households at the core of the decision-making, planning and implementation process. The model is therefore designed in such a way as to respond directly to the needs and demands of the households better than those imposed from the top-down or bottom-up alone.

The HCES model considers a city as a set of interlinked communities with possibility of intra- and inter-specific relationships for a common sanitation good (EAWAG, 2005). Thus, the approach brings closest to the households technical and administrative personnel who understand the needs of households and are prepared to work with and for the households. In the approach, households are to be involved in the planning and management of sanitation programmes with a view to solving the sanitation problems closest to them. The next section discusses the suitability of the HCES approach in managing urban FS emptying and transport

2.12 The HCES approach and the urban FS emptying and transport

The on-plot sanitation system is fragmented both in infrastructure and services. As such, it could be heterogeneous in latrine types and uses even within the same neighbourhood and community. Therefore there is the need for a management system that can address these challenges effectively.

In addition to the above problems, on-plot latrines provide storage facilities for excreta which the users in the households may have to live with for relatively long period of time. Thus, residents in a household with on-plot latrines which are unhygienic are likely to be most at risk from contamination since much of the users' time is spent in the household. This makes it imperative that urban on-plot latrines that are filled are emptied and the excreta disposed of in a carefully managed manner. Therefore how to effectively manage the fragmented emptying, transporting and disposal of the excreta of the FS under the HCES approach is what is discussed in the ensuing sections. The discussions start with the HCES principles followed by its guidelines and model.

2.12.1 The proposed HCES approach, principles, guidelines and model

The HCES offers principles, guidelines and a model for decision-makers for urban sanitation planning (Luthi et al, 2007) which are described below.

2.12.1.1 The principles of the HCES approach

Schertenleib (2005) stipulates the following principles for the HCES approach:

- Stakeholders belonging to a particular zone act as members of that zone. Starting from the innermost circle outwards, zones are represented as: households, neighbourhood, community, city, country or some larger regional area.
- Multi-actor approach, where decisions are reached through consultation with all stakeholders affected by the particular sanitation problem, in accordance with the methods best suited to the zone(s) in question.
- Problems should be solved as close to their source of generation as possible.
- Decisions, planning and the responsibility for implementing programmes, flow from the household, which is the source of excreta generation, to the community, then the municipality and finally to the central government.
- The model considers waste as a resource which can be reused rather than thrown or wasted away.

Implementing bullet points 3 and 4 of the principles of the HCES approach could be very challenging. For instance, it would be very challenging to solve excreta or FS problems close to slums such as in Kibera in Kenya where free space for operation is almost non-existent. It would also be very difficult for the urban poor, who are mostly uneducated and have land and latrine tenure problems, to make any meaningful decisions and planning for effective excreta management in their places of abode. Therefore not all the HCES approach principles enlisted above could be applicable everywhere.

2.12.1.2 The proposed HCES approach guidelines

The HCES approach guidelines developed by SANDEC/EAWAG provide specific guidance for creating an enabling environment for the application of the HCES approach, undertaking a 10- step process for its development and implementation (See Figure 2.2 below).

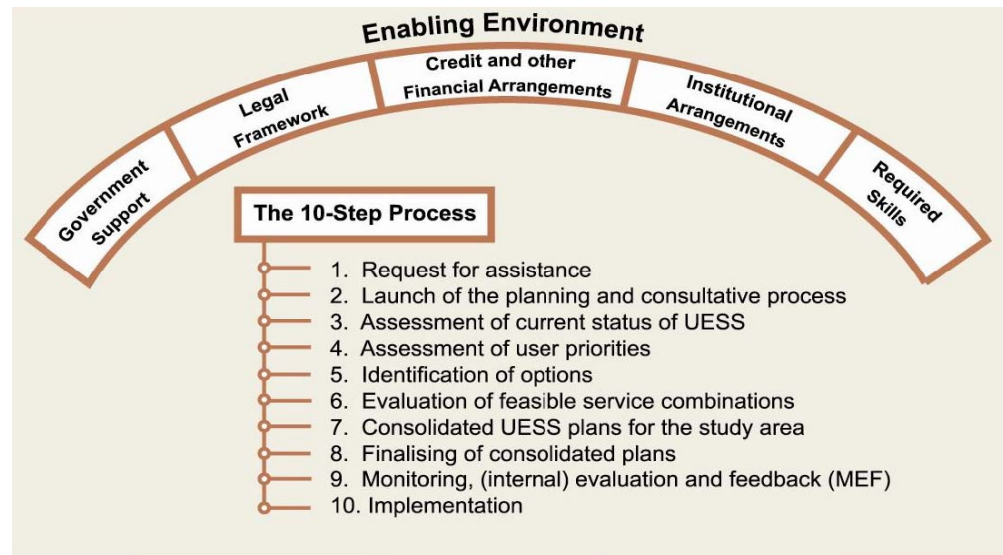


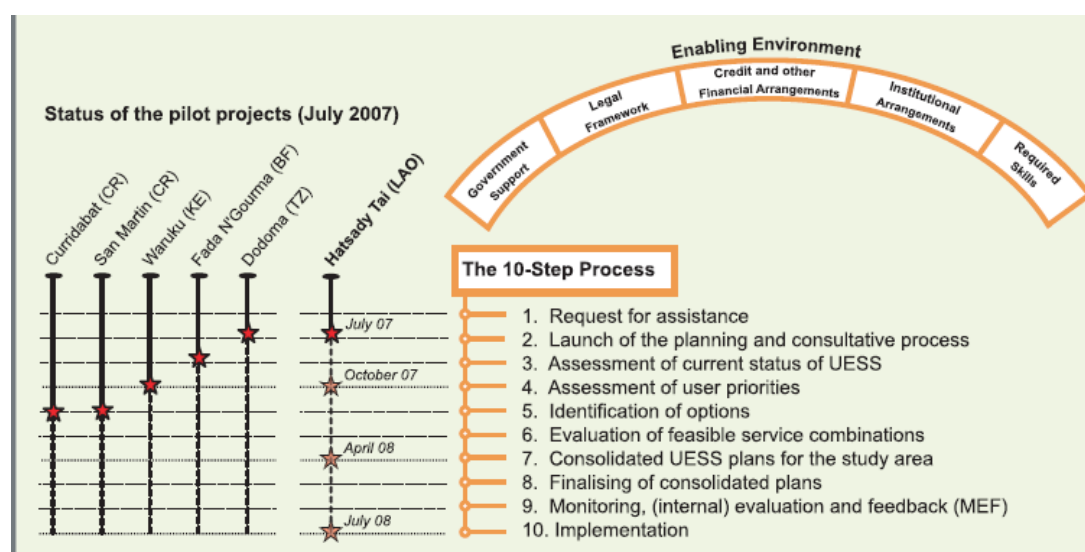
Figure 2.2: Preliminary HCES approach guideline for decision-makers

Source: SANDEC, 2005

A critical look at the ten-point guideline shows that it will be difficult to wholly involve the households who may be managerially and technically incapable of understanding fully the scale and dynamics of urban sanitation problems confronting the low-income communities. It is also difficult to engage households with tenancy problems such as those that occur in the slums of many low-income urban communities.

In spite of the above possible challenges and difficulties, Morel and Luthi (undated) have mentioned some successes using the HCES approach in six testing sites: two sites in Costa Rica (CR); one in Burkina Faso (BF); one in Kenya (KE); one in Tanzania (TZ); and one in Laos (LAO). These are captured in the diagram below.

Figure 2.4: Status of the six HCES pilot projects & the two main components of the HCES approach



Source: Morel and Luthi, *Undated*

Morel and Luthi did not, however, specify which aspects of sanitation were deemed successes. For instance, it is difficult to know whether pit emptying and FS transport were included in these success stories. Also it is not mentioned which part of the city was the HCES approach practised---Was it practised in the slums as well as in the formally planned communities? Besides, a critical look at the diagram reveals that, so far, only two Costa Rican cities have reached the middle of the '10-step Process'. This means that enough time is needed to arrive at a decisive conclusion. This is because, it would be difficult to measure the full success of the programme unless it is fully implemented, evaluated and scaled up successively. In another development, Mara and Alabaster (2008) have proposed a kind of HCES approach where households form cooperatives to solve urban sanitation problems successfully in the developing countries. Their proposal is also yet to be tested successfully at full scale in the field.

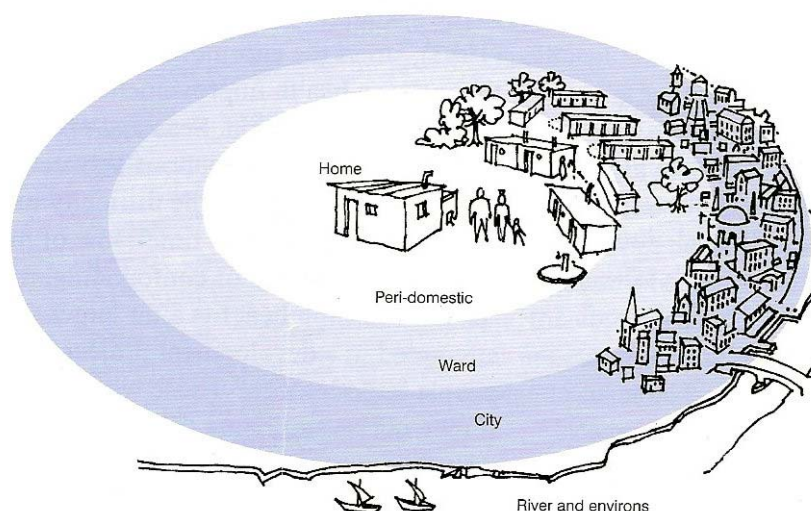
Thus at the theoretical level, the HCES approach may look good, but remains untested practically at full scale on the ground in the urban areas of low-income countries.

2.12.1.3 The proposed HCES model

Apart from the ten-point guideline, the HCES approach also offers a model which unbundles a city into a series of mutually exclusive management zones. This is based on the assumption that households are at the core of the approach because they are the source of excreta and other waste generation and so take the basic decisions on hygiene and other environmental services in the city (WELL, 1998; SIWI, 2005; Kolsky, 2004).

The zones in the model (See figure 2.3 below) are made of contiguous concentric circles radiating outwards beginning with the households (home); then rise upwards through the neighbourhood or peri-domestic, the ward or community and up to the city or regional level

Figure 2.3: Diagram showing concentric zones of the HCES approach:



Source: WELL, 1998

Flow of communication among stakeholders within and without a particular zone in the model is two-way and therefore allows multi-actors to interact to address environmental sanitation services problems in the city (Schertenleib, 2005). This implies decisions on determining the type of environmental sanitation services to be implemented are done in consultation with relevant stakeholders based on the actual needs and means of the households and the society at large. It is thus important to emphasise that putting the

household at the centre of sanitation management does not exclude the important roles played by the other stakeholders at the neighbourhood, ward or city level. In fact, it is putting together these stakeholders in an appropriate interactive process that will help bring about a sustainable sanitation solution in a city (Luthi *et al*, 2007).

2.13 Chapter summary

In this chapter, a review of the literature on the management of FS/excreta emptying, transport and disposal in the urban areas of low-income countries was discussed with emphasis on technology, finance, planning, policy, institution and organisation. The review shows that on-plot latrines and associated excreta/FS emptying, transport and disposal system are fragmented, heterogeneous and uncoordinated, lacking coherence and effectiveness in management. Within this overarching management gap, the following specific gaps were noted in the literature:

- a) Technological weakness associated with:
 - Health and safety for the rudimentary hand tools;
 - Accessibility problems with the conventional vacuum tankers;
 - Consolidated sludge and economic volume emptied per operation by both the small-sized and conventional vacuum equipments.
- b) The cost elements for emptying, transport and disposal mechanisms.
- c) Households perceptions about the emptying services they receive
- d) Advantages of reuse to FS emptying, transport and disposal in the city.
- e) The empirical data showing how far the excreta or the sludge collected from the households is transported to the disposal points.
- f) Fragmentation in the organisation and institutional arrangement for emptying, transport and disposal.
- g) Lack of consensus and common focus on existing proposed participatory planning in the urban sanitation management.

With regard to the quest for an effective management system for the excreta/FS emptying, transport and disposal in urban areas, the HCES has

been proposed in this study as providing an effective framework. Therefore, the model and principles of the HCES approach have been discussed in the chapter. It was evident from the literature that the HCES approach is quite new and has not been subjected to rigorous academic and field testing. Nevertheless, the HCES approach, in the theoretical sense, has been acknowledged as an effective management approach for urban sanitation in low-income countries. Of particular importance of the HCES approach to this study is the fact that the description of urban excreta/FS emptying, transport and disposal mechanism fits well into the HCES model. This is because when the excreta or FS removed from the households' pits or buckets it is either deposited within the household precincts or transported and deposited within the neighbourhood; or transported through the neighbourhood to the community or city level and beyond. Thus, with this mode of emptying, transport and disposal of the excreta, the HCES model offers more decentralised and yet more interactive approach where the creators of the excreta problems (which are the households, in this case) are the very ones who should be at the core of decision making, planning and management of the sanitation problems. And they (the households) together with the neighbourhood, communities or the municipal authorities should be able to put their heads and efforts together in an interactive manner to find solutions to the urban excreta problems.

Even though the management of emptying, transport and disposal involve more than the households as the key stakeholders, as well as issues such as legal, institutional, planning and policy, etc, this study focuses mainly on the household issues due to the facts that::

- The households form the core of the HCES management approach,
- The unit of analysis of the study is the household latrine,
- Time and resources could not permit detail study on the wide range of the other management issues.

3. The conceptual and study frameworks; research question, hypothesis and objectives

The conceptual and study framework as well as the research question, hypothesis and objectives set for this study are related to the conceptual model of the HCES outlined in the previous section, 2.12.1.

3.1 *The conceptual framework for the study*

The HCES model in figure 2.3 could be compared with the different environmental sanitation priorities for the many city-dwellers. Since sanitation and hygiene issues stem primarily from households (Kolsky, 2004), the first environmental sanitation priority for families is a clean and pleasant household and its immediate surroundings. This is followed by a cleaner and better environment in their streets; then followed next by a cleaner neighbourhood, and community. It is only after these priorities are upheld that households will be concerned about city-wide environment and beyond (WELL, 1998).

Linking this scenario to excreta and FS emptying, transport and disposal in the urban areas, some parallels can be drawn whereby occupants of a particular household would like to see that the excreta or FS emptied from their household is transported from the precincts of the household to make their immediate surroundings clean. But when the sludge or excreta goes away from the household, users become increasingly less concerned the further it moves away from their sphere of influence or abode. This means that excreta or FS emptying, transport and disposal in the urban area should be managed and monitored right from the household where it is taken, through the neighbourhoods and communities across which it is transported, and up until the final disposal point. The study therefore focuses on the FS management problems from the households (the core of the HCES model) and how they connect to the overall transport and disposal in the city. This should be done so that the principle of sanitation as both a private and a public good will be fully upheld (Schaub-Jones *et al*, 2006). The justification for this transport and disposal arrangement is well captured from Sugden's

(undated) statement that there is, *“the need to remove the faeces from the community, not just the household”*.

The above analogy and the discussions in chapter 2, section 2.12 give rise to the following main concepts italicized below, which have formed the basis of the investigation, carried out in this research.

- *Households are mainly responsible for urban on-plot latrines and the generation of urban FS, therefore, they bear the brunt of the cost for FS emptying and transport.* However, how much they pay for each pit and the basis of payment for pit emptying and transport are not ascertained in the literature. Besides, their perceptions and role or involvement in pit emptying and FS transport are not fully understood since previous studies have paid little attention to these issues.
- *Urban households in the low-income countries have fragmented and heterogeneous characteristics in terms of behaviour, economic status, latrine technology, and services.* This makes it difficult to provide them with effective and sustainable excreta or FS emptying and transport services using top-down or bottom-up conventional service strategies. Therefore unique strategy for serving the urban households with emptying and transport services should reflect the peculiar characteristics and capabilities of all categories of the urban households.
- *Understanding the way FS is transported and disposed in the city is essential for its effective management.* This is because the defecation or emptied excreta/FS could be deposited within the households or the neighbourhood. Beyond the household jurisdiction, however, the problem is carried over into the neighbourhood, community, the city or regional level.
- *The mode of transport and disposal described above, which follows the pattern of the HCES model, can provide useful clues for managing emptying, transport and disposal services more effectively using the HCES approach.* Thus, the HCES approach by its concept, model and

principles provides a useful framework for understanding the way urban excreta or FS is transported in the city and hence its effective management.

3.1.1 The study framework

The study framework outlined below emanates from the conceptual as well as the key gaps in the literature concerning effective management of excreta or FS emptying, transport and disposal:

- a) Technological weakness associated with excreta collection and emptying regarding:
 - Health and safety issues;
 - Latrine technology
 - Distance and Accessibility issues;
- b) Households' financial needs and the cost elements for emptying, transport, and disposal mechanisms.
- c) Households' social issues regarding emptying, transport and disposal as well as their knowledge, attitude and perceptions about the overall emptying services
- d) Reuse possibilities, advantages, and disadvantages with regard to emptying, transport, and disposal.
- e) The empirical data showing how far the excreta or the sludge collected from the households is transported to the disposal points.
- f) The empirical study on the effects of disposal distance and accessibility on the cost of emptying and transport;

The above framework forms the basis for analyzing the HCES approach as an effective management system for urban excreta/FS emptying, transport and disposal in low-income countries.

3.2 The research question.

The primary research question is:

To what extent is the HCES approach applicable for effective management of the urban FS emptying, transport and disposal?

Emanating from the primary question, are five other subsidiary questions which also reflect on gaps and weaknesses in the literature:

- 1) What are the cost elements of the emptying, transport and disposal of excreta or FS in the urban areas?
- 2) What are the main constraints to effective excreta/FS emptying, transport and disposal in the urban areas?
- 3) How far is the excreta/FS transported from the households to the disposal points?
- 4) What are the perceptions of the users (customers) about the quality of the emptying, transport and disposal service provided by the emptiers?
- 5) What opportunities exist for reuse in the communities after emptying and transport of faecal sludge?

3.3 The hypothesis

The hypothesis set for the study is that: *The HCES management approach provides an effective management model for excreta and FS emptying, transport and disposal in the urban areas of low-income countries.* The 'effective' management stated in the hypothesis means that the FS emptying, transport and disposal service is managed hygienically and satisfactorily at affordable cost. The hypothesis is to be tested in the study area which has been discussed in chapter five.

3.4 The research objectives

The main aim of the study is to explore an effective management approach for the urban on-plot sanitation services, with particular reference to faecal sludge (FS) emptying, transport and disposal in the low-income urban communities. For this reason, the primary objective of this research is to reject or accept the hypothesis stated in chapter three that the HCES approach is able to manage urban FS emptying, transport and disposal effectively. Apart from the primary objective, there are secondary objectives which are linked to the secondary questions as well as to the gaps in the literature. These are presented in the form of a matrix as shown in Table 3.1 below.

Table 3.1: Matrix of gaps in literature, research questions, and objectives

GAP AND WEAKNESS IN LITERATURE	SUBSIDIARY RESEARCH QUESTIONS	OBJECTIVES
The cost elements of FS emptying, transport and disposal.	1) What are the cost elements of the emptying, transport and disposal of excreta or FS in the urban areas?	To investigate cost implications of latrine size, number of users, emptying frequency and emptying technology as well as disposal distance to the households
The influence that knowledge, attitude and practices about latrines and FS have on emptying and transport.	2) What are the main constraints to excreta/FS emptying and transport in the urban areas?	To find out the constraints that affect the emptying, transport and disposal of the FS in the urban areas
How far the excreta or the FS is transported to the disposal site after emptying is not well accounted for in the literature	3) How far is the excreta/FS transported from the households to the disposal points?	To investigate how far excreta or FS is transported from the households to the disposal sites.
Household perceptions about the quality of emptying and transport service in their communities of abode	4) What are the perceptions of the users about the quality of the emptying, transport and disposal service provided by the emptiers?	To investigate households satisfaction levels with the emptying and transport services they receive in their communities
Households' acceptability of FS agricultural reuse as an opportunity for enhancing FS emptying and transport.	5) What opportunities exist for reuse in the communities after emptying and transport of faecal sludge?	To investigate the social acceptability of FS reuse in agriculture and how this may influence emptying and transport

The outcome of the study will help to facilitate the effective management of urban FS emptying and transport.

4 The research design and methodology

4.0 Research design

A research design is defined by Neuman (1997) as the blueprint of how a research study is to be conducted. A research design can also be seen as a plan that helps answer the research question(s) and guides the process of collecting, analyzing and interpreting the observations of a study (Mayer and Greenwood, 1980). It is therefore a logical sequence of steps linking the initial research questions to the data collected and ultimately to a series of conclusions arising from the study (Yin, 1994; Yin, 2003). As far as social science is concerned, Grinnell (1997) defines social research design as a structured enquiry that utilizes acceptable methodology to solve human problems, and create new knowledge that is generally applicable.

The design of a research is based on the research problem or question as well as the aim; and contains logical steps developed to obtain the necessary information that addresses the research question adequately (Yin, 2003; Mouton, 2001). An example of these logical research steps to be taken to arrive at valid conclusions is provided by Yin (1994). Based on Yin's recommended steps for good research design, this study adopted the following steps in helping to design the research to arrive at valid conclusions. Yin's recommended steps are in bold, whilst the explanations in response to the steps are in plain text.

The study question(s):- the main research question is: *To what extent is the HCES approach applicable for effective management of the urban FS emptying, transport and disposal?*

The study propositions:- The HCES approach is able to address the urban FS emptying, transport and disposal effectively.

- **The unit of analysis:-** The unit of analysis for the study is the household latrine.
- **Logic linking data to proposition or hypothesis:-** This is the method

by which data are linked to the hypothesis or proposition. This research therefore ensured that the data obtained were adequate, covered all the research questions and were relevant to addressing the FS emptying, transport and disposal questions. These data were then systematically analyzed and organized towards accepting or rejecting the hypothesis.

- **The criteria for interpreting the findings:-** This refers to the analytical framework employed to manage the data collected. This is a substantive test of the research design in terms of reliability and validity. This step therefore requires the researcher to anticipate any limitations that may apply to any inferences drawn. By looking at the nature of the research questions and the types of data collected, this research adopted the use of both quantitative and qualitative analyses to interpret the data. This helped the researcher to overcome analytical weaknesses inherent in any of the techniques when used alone.

4.1 Research methodology

Research Methodology, on the other hand, means the entire process of the study (Creswell, 2003). The methodology involves a systematic investigation to establish facts or find answers to a problem (Burns, 2000). It is a procedure or principle used to collect information on a subject by means of defined methods or series of actions (Leedy, 1989). The research methodology focuses on the process or steps and the kind of research tools and procedures needed to obtain the requisite data for the study (Mouton, 2001). The purpose of describing the research methodology in this study is to raise an understanding of the research methods employed for the research.

Mouton (2001) summarizes the difference between research design and methodology as shown in the following table 4.1 below.

Table 4.1 Summary of the differences between research design and methodology (after Mouton, 2001).

RESEARCH DESIGN	RESEARCH METHODOLOGY
Focuses on the end product-i.e. What kind of study is being planned and what kind of result is aimed at?	Focuses on the research process and the kind of tools and procedures to be used.
Point of departure is the research problem or question	Point of departure is the specific tasks at hand such as the data collection or sampling
Focuses on the logic of research:-i.e. What kind of evidence is required to address the research question adequately?	Focuses on the individual steps in the research process and the most objective procedures to be employed

The next sections under the chapter discuss the research methods; approaches; techniques; strategies; and process chosen for the study. Each section gives the literature background about the topic before justifying its use for the study. Further, the chapter discusses survey study design by describing the sampling technique and size; survey administration and responses. The data analysis techniques used for the study are also discussed.

4.2 The Research methods

Research methods could be categorized as pure and applied research methods which are explained below.

4.2.1. Pure research

Pure research is driven by a curiosity or interest in a scientific question and it is the source of most new scientific and social ideas and ways of thinking about the world (Neuman, 1997; Bless and Higson-Smith, 2000). The main motivation is to expand knowledge. Thus, it is more academic in nature than the applied research method and addresses more theoretical than practical issues to advance knowledge (Robson, 2002). An exploratory approach is the most common in pure research (Robson, 2002).

4.2.2 Applied research

Unlike pure research, applied research is designed to solve practical problems of the modern world, rather than to acquire knowledge for knowledge's sake. Applied research is conducted if the researcher's motivation is to assist in solving a particular problem (Reinard, 2001; Bless and Higson-Smith, 2000). Thus, applied research is focused on specific situations or answers questions which are practical and contemporary. Evaluation research is a widely used type of applied research (Neuman, 1997) and has as its primary goal a testing of the application of knowledge within a specific programme or project (Powell, 1997).

Both pure and applied research methods were used for this study. The pure research method was adopted to review the research background, define the scope of the research and identify gaps and the theoretical framework. Applied research method was used to test the application of the HCES approach to the effective management of the urban FS emptying, transport and disposal.

4.3 Research approaches

Four approaches to research are noted depending on the research objectives or questions. These are exploratory, descriptive, correlational and explanatory (Bless and Higson-Smith, 2000). These approaches, which are applicable to both pure and applied research methods, were adopted for the study. Their explanations and relevance to the study are discussed below.

4.3.1 Exploratory approach:

An exploratory research approach is used when very little is known about the research topic (Bless and Higson-Smith, 2000). According to Neuman (1997) exploratory researchers should be creative; open minded; flexible and investigative exploring all sources of information. He further comments that

exploratory researchers frequently conduct qualitative research. But Smith (1998) remarks that a typical outcome from exploratory research would be generation of a number of hypotheses that could be taken forward for quantitative testing at a later stage of the project. Since little is known about the effective management of urban FS emptying, transport and disposal mechanisms, open mindedness and flexibility were employed, especially at the pre-test phase, to explore more information for the main study.

4.3.2. Descriptive approach

A descriptive research approach is suitable for further description of a situation or problem after an extensive previous knowledge of it (Robson, 2002). It also provides a solid platform for helping to understand current, and possibly predict future behaviour (Smith, 1998). Besides, it presents a picture of the specific details of a situation, social setting or relationship (Neuman, 1997). Therefore a descriptive approach was used in this study for the events which were directly observed in order to present a picture of the details of the emptying, transport and disposal situations.

4.3.3 Correlational research

A correlational research approach is used when the research question requires an understanding of the relationship between variables (Bless and Higson-Smith, 2000). It is based on systematic comparison, manipulation and control of variables. Correlational research is not only useful when no clear causal relationship exists, but also allows for an estimation of the strength of the relationship between two variables even when one variable is influenced by many others (Bless and Higson-Smith, 2000). This research therefore employed the use of correlations in the form of chi-square and cross-tabulations to provide relationships between variables and the significance thereof.

4.3.4 Explanatory approach

An explanatory research approach is used when the research question demands that the researcher explains the relationship between variables and demonstrates that change in one variable causes change in another variable (Bless and Higson-Smith, 2000). According to Neuman (1997:20) the desire to know why things are the way they are is the purpose of explanatory research. He explains that explanatory research builds on exploratory and descriptive research to identify the reason why something occurs. It therefore examines the reasons why something exists or operates in the way it does (Robson, 2002). In this study, the explanatory approach was used to explain:

- the relationship between the variables;
- the quantitative and qualitative data
- the significance of the findings to the study

4.4 Research techniques

Research techniques could be categorized as qualitative, quantitative or the triangulation technique which is a combination of both quantitative and qualitative techniques. The following sections explain the significance and application of these techniques to research in general and to this study in particular.

4.4.1 Quantitative technique

Natural science research leans more towards a positivist paradigm where quantitative technique is used in a systematic and controlled empirical way for a critical investigation of facts about natural phenomena.(Kerlinger, 1986). Positivists think that things exist as meaningful entities independent of consciousness and experience; and believe that these things have a meaning residing in them from which research can attain an objective truth (Crotty, 1998). In other words, quantitative technique or analysis allows for deductive reasoning from measuring and quantifying phenomena so that generalization of findings from the surveys can support the hypothesis or not. Therefore in

quantitative research, emphasis is placed on the measurements and analysis of causal relationships between variables (Denzin and Lincoln, 2005). This implies that, a key strength of the quantitative paradigm is its ability to produce quantifiable, valid and reliable data with wider applicability. Its weakness, however, lies in its inability to recognize the importance of human behaviour in a real world setting (Bryman, 1988). Based on these explanations this study employed a quantitative technique to produce quantifiable data for wider application on issues of emptying, transport and disposal technology, finance, disposal mechanisms as well as users knowledge, attitudes and practices.

4.4.2 Qualitative technique

Qualitative technique, on the other hand, is a constructivist paradigm which stipulates that complete objectivity implied by the positivists is not possible since all observations are driven by pre-existing theories or concepts which determine how and why objects are constituted and selected (Seale, 1999, 2002). Thus, qualitative technique assesses inductively a process or dynamic view of social life, as contrasted with quantitative technique that provides a static account (Bryman, 1988). Besides, in qualitative research, a socially constructed nature of reality, the intimate relationship between the researcher and what is studied, and the situational constraints that shape enquiry, are stressed (Denzin and Lincoln, 2005). This offers the researcher the opportunity to clarify and interpret what and how meanings are embodied in the language and actions of social actors (Schwandt, 1994).

The advantage of using qualitative methods is the generation of rich detailed data that maintain the originality of the participants' perspectives and provide a context of the behaviour being studied. The disadvantage however, is that data collection and analysis is labour-intensive, time-consuming and expensive (Schwandt, 1994; Denzin and Lincoln, 2005). Based on the advantage of the qualitative technique expressed above, this study used qualitative technique to obtain rich and detailed data from the households, focus groups and key informants to supplement and complement the quantitative data.

4.4.3 Triangulation technique

Cresswell (2003) states that researchers should make use of both qualitative and quantitative techniques in understanding social phenomena. A combination of the qualitative and quantitative methods is termed as the triangulation method. The need to use the triangulation technique in a study stems from the two research paradigms already discussed. The triangulation technique allows the researchers to gain insights and results to assist in making inferences and in drawing conclusions (Denzin and Lincoln, 2005).

Considering the strengths and weaknesses in the two paradigms of the techniques, this study employs the triangulation technique in order to compensate for the shortcomings of using one technique alone; and to maximize the validity and reliability of the data collected for the study (refer to table 4.3 in section 4.7.2).

4.5 Research strategy

Yin (1994) describes five research strategies that characterize research. These are experiments, surveys, case studies, archival analysis and history. Each of these strategies can use either quantitative or qualitative techniques or a combination thereof. The choice of an appropriate research strategy depends on the question that the research seeks to answer, the control over the phenomenon studied and whether the phenomenon is historical or contemporary (Yin 1994). Apart from these, the choice of the research strategy also depends on the budget for the research; time and target dates available for the research; and the skills of the researcher (Denscombe, 2007)

Based on the reasons for choosing an appropriate strategy for a research, Yin (1994) developed a cross referencing table (shown below as table 4.1) which helps in the selection of the most appropriate research strategy that can be used for any research.

Table 4.2: Comparison of research strategies and the relevant conditions for selection as proposed by Yin (1994)

RESEARCH STRATEGY	FORM OF RESEARCH QUESTION	CONTROL OVER BEHAVIOURAL EVENTS?	FOCUSES ON CONTEMPORARY EVENTS?
Experiment	How, Why	Yes	Yes
Survey	Who, What, Where, How Many, How Much	No	Yes
Archival analysis	Who, What, Where, How Many, How Much	No	Yes/no
History	How, Why	No	No
Case study	How, Why	No	Yes

Source: Yin, 1994

Due to the facts that this research did not exercise control over any behavioural phenomenon; and that the variables selected for the research, were not subjected to experimental analysis, the option for experiment as a design strategy was not employed. Also due to the contemporary nature of the research, neither archival analysis nor history was selected as strategy. As seen from Yin's table above, case study research strategy has a particular advantage when a 'how' or 'why' question is being asked about a contemporary set of events over which the investigator has little or no control. Looking at the nature of the research questions for this study which are mainly 'what' and 'how' questions, survey strategy rather than case study was considered to be the most favourable strategy for the study. Besides, survey as a strategy was chosen for the study because it has several other advantages, such as the possibility to reach a large number of respondents; generate standardized, quantifiable and empirical data as well as some qualitative data; and offer confidentiality or anonymity (O'Leary, 2005)

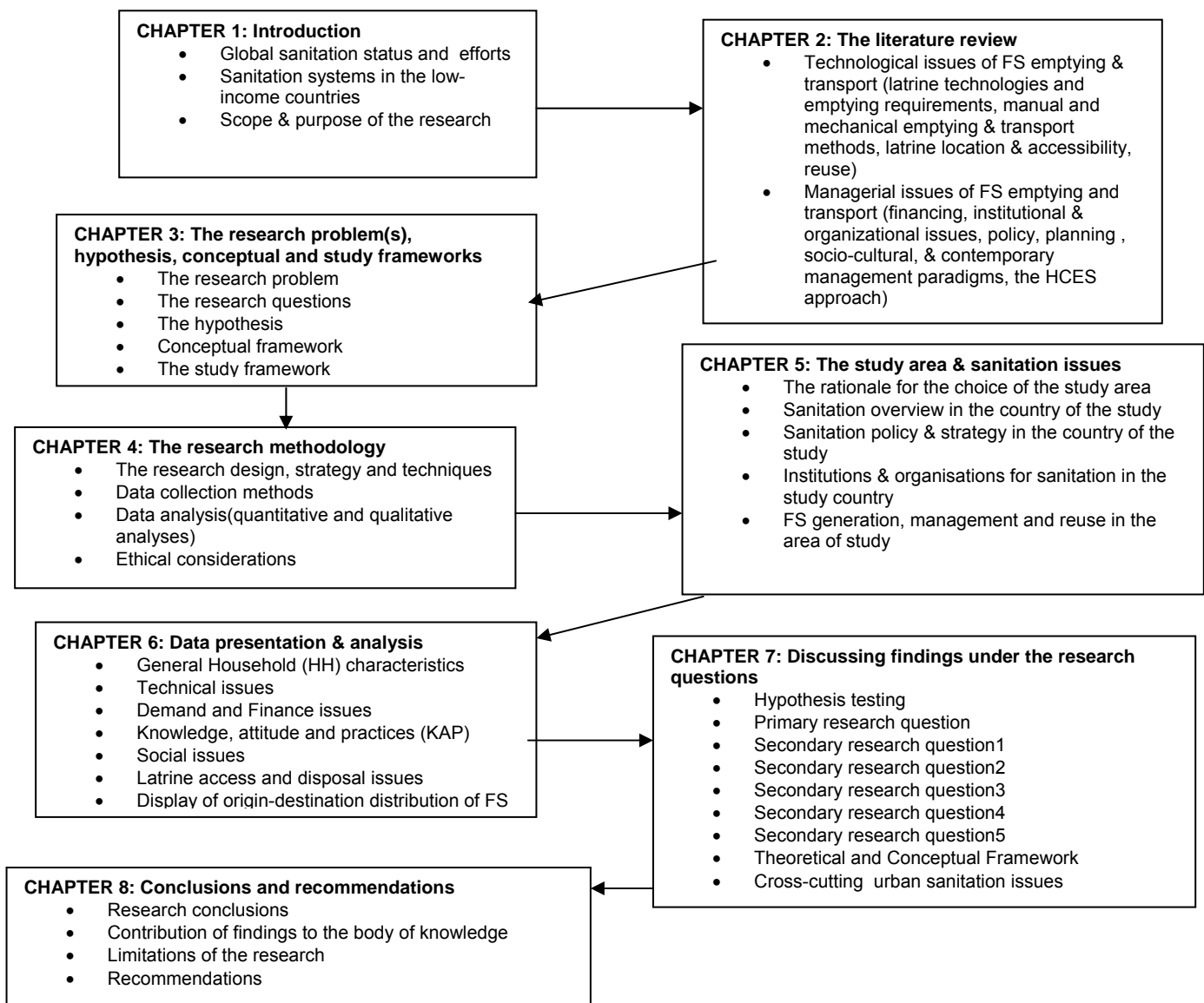
Although, the survey strategy chosen for the study can be used to predict socio-cultural attributes such as attitude, opinions, values and behaviour that are based on what people say (Fink, 1995b), survey is mainly a quantitative strategy and therefore might ignore the qualitative aspects about households' perceptions and attitudes which are essential for the study. Moreover, urban FS emptying and transport services in the low-income countries entail

contemporary and practical issues that are both scientific and social. Therefore, there is the need for this research to employ both quantitative and qualitative techniques to obtain information that can cover all the issues that quantitative techniques alone cannot sufficiently address.

4.6 The Research process

According to Reinard (2001), the research process has a number of steps geared towards the development of the research. As a research, this thesis has followed a logical process which is outlined in Figure 4.2 below.

Figure 4.2: The thesis process



The thesis is structured so as to present a logical process or order to the research investigation, findings and conclusions. Thus, the study begins with Chapter One which serves as an introduction to the subject; discusses the on-plot disposal systems in the developing world and states the scope and purpose of the research. This is followed by Chapter Two which reviewed grey, published and unpublished literature on the urban pit emptying, excreta or FS transport and disposal mechanisms. The literature review led to the

identification of the main gaps; as well some specific knowledge gaps, which this research is seeking to address. Based on the gaps in knowledge, Chapter Three then sets the conceptual and study frameworks as well as the questions and the hypothesis for the research. Chapter Four discusses the research methods adopted for the study. The background to the research location in terms of sanitation issues are detailed in Chapter Five. Data presentation and analyses of the findings are established in Chapter Six, while Chapter Seven expounds the analysis and its implications. Chapter Eight concludes the thesis with a summary of major insights into the understanding FS emptying, transport and disposal in the urban setting. This is accompanied by recommendations arising from the research.

4.7 The survey design for the study

As has been pointed out in Section 4.5, a survey strategy has been adopted for this study due to its advantages over the other strategies. A survey design can be cross-sectional with data collected at one point in time, or longitudinal with data collected over time (Babbie, 1990). This study used a cross-sectional survey design to collect data from the urban households using on-plot latrines. The cross-sectional survey was used because of its advantages in terms of the rapid turnaround in data collection, economy of the design, and its ability to identify attributes of a population from a sample (Babbie, 1990; Cresswell, 2003).

4.7.1 Survey sampling procedures

Sampling is defined as a selection of units to represent an entire population (Grinnell, 1997). The primary purpose of sampling is to collect data about specific events, cases or actions that can clarify and deepen understanding of what is being studied (Neuman, 1997). There are two main sampling methods: probability and non-probability sampling (Doherty, 1994). In a probability sampling method, each member of the population has a known non-zero probability of being selected. Probability methods include random

sampling, systematic sampling, and stratified sampling. In non-probability sampling, members are selected from the population in non-random manner. These include convenience sampling, judgment (purposive) sampling, quota sampling, and snowball sampling (Patton 2002; Grinnell, 1997; Hancock *et al*, 2007). The advantage of probability sampling is that sampling error can be calculated. In non-probability sampling, however, the degree to which the sample differs from the population remains unknown. Nevertheless non-probability sampling, such as convenience or purposive sampling, yields considerable data that is specific to the research topic (Grinnell, 1997). Besides, the researcher uses his own judgement in selecting the sample in purposive sampling (Grinnell, 1997).

The sampling procedure used for this study is purposive sampling combined with random sampling (in the case of the households' survey). The basis for selecting such a sampling technique is that it can yield useful data that is specific to the research topic as suggested by Grinnel (1997). After purposefully choosing the communities for the household survey, a random sampling of the individual households within the communities was carried out. In a situation where a household was absent or unwilling to answer the questions, this was noted and the interview was conducted with the next available and willing-to-answer household. In each of the areas visited, house numbers of the area were used for identification purposes and, in this way, sampled houses were recorded. Apart from interviewing some household interviewees himself, the researcher joined the interviewing teams, from time to time as an observer. A survey orientation for the enumerators and procedure is attached in Appendix 3. In terms of selecting the key informant interviews, a snow-balling sampling technique was adopted to get more key informants.

4.7.1.1 The sample size

As a rough rule of thumb, Perry (2002) recommends that PhD research requires at least 350 respondents in a quantitative survey. Based on this recommendation and convenience, this research aimed at a sample size of

600, with a sample size of 200 coming from each of the three communities. The household survey pre-testing phase was based on 10% of the 600 sample size.

4.7.1.2 The sample errors and their corrections

In order to mitigate the following bulleted and italicized sampling errors and ensure reliability and validity of the data collected, the following measures recommended by Bickman and Rog (1998) were taken to address these potential errors in the study:

- *Sample selection bias*:- This is where the basis for drawing a list for sampling may be incomplete or faulty. The research communities and enumerators were selected after exhaustive consultations and discussions with local municipal sanitation officers had been made in order to ensure that the enumerators and the selected areas for the research could fulfil the objectives of the study.
- *Item non-response error*:- This is where the respondent fails to answer an individual question in the questionnaire. Two measures were taken to reduce this error as much as possible. These were: i) questions in the questionnaire were made as simple as possible to encourage response from the households, and ii) with the help of the enumerators who were very conversant with the socio-cultural situation of the communities, the questions in the questionnaire were improved after the pre-survey to avoid controversial wording or phraseology.
- *Response error*:- This refers to a situation where the respondents misunderstood the wording of the questions as presented. Therefore attention was paid to providing the assistant interviewers with orientation towards the research and the questionnaire questions prior to field work. Furthermore, 5% post survey was conducted and the reliability of responses cross-checked for the purposes of verification, reliability and validity.

4.7.2 The data collection methods

A number of research data collection methods exist for survey design and these include focus group discussions; questionnaires; interviews (structured, unstructured and semi-structured); record reviews (including literature); and observations (Fink, 1995a; Denscombe, 2007). In this study, the researcher used questionnaires, semi-structured interviews, focus group discussions, and field observations to obtain the data for the research due to the nature of the research questions, financial and time constraints.

Below is a table (Table 4.3) showing the relationships that exist between the research questions, the types of data collected and the research data collection methods used to obtain the data.

Table 4.3: Research questions, type of data collected and the research methods used

RESEARCH QUESTION	TYPE OF DATA COLLECTED	DATA COLLECTION METHODS USED
1) What are the cost elements of the emptying, transport and disposal of excreta or FS in the urban areas?	quantitative	questionnaire survey, interview, observation, focus group discussion
2) What are the main constraints to excreta/FS emptying and transport in the urban areas?	quantitative and qualitative	Questionnaire survey, interview, focus group discussion
3) How far is the excreta/FS transported from the Households to the disposal points?	quantitative and qualitative	questionnaire survey, interview, observation, focus group discussion
4) What are the perceptions of the users about the quality of the emptying, transport and disposal service provided by the emptiers?	quantitative and qualitative	Questionnaire survey, interview, focus group discussion
5) What opportunities exist for reuse in the communities after emptying and transport of faecal sludge?	quantitative and qualitative	questionnaire survey, interview, observation, focus group discussion

This sub-section has mentioned the data collection methods used for this study. The sub-sections that follow discuss in detail these data collection methods and how they were applied to this research.

4.7.2.1 Data collection through household questionnaires

De Vaus (2001) suggests that questionnaires can be administered through the survey strategy in a number of ways including: supervised face-to-face administration by trained interviewers; by telephone with or without trained interviewers; and unsupervised or self-administration where the questionnaire is normally received and returned through the mail by the respondent. In this study, supervised face-to-face administration of questionnaires by trained interviewers (enumerators) to households was adopted in order to ensure high response rate, quick return of response, and offer the trained interviewers the chance to explain the questionnaires, where necessary, to the households.

Although most of the questionnaires were close-ended for ease of response, some few questionnaire questions were open-ended to allow qualitative responses. The overarching aim of the household survey was to generate quantitative data about sanitation issues that relate to urban household FS emptying, transport and disposal as well as the management requirements needed for these in the urban context. Thus the household survey was designed to:

- gather baseline data about the financial and socio-cultural factors that affect FS emptying and transport; and to
- explore the main technical and management factors that enhance or constrain FS emptying and transport.

According to Bickman and Rog (1998), two checks in particular summarize the key elements of survey question design: one relates to what constitutes a good question in surveys; and the second is a general checklist for designing survey instruments. The same source therefore stipulates that the quality of data derived from a questionnaire survey depends on four critical elements, which are:

- the size and the representativeness of the sample,
- the techniques used for collection,
- the quality of interviewing, and

- the extent to which the questions used were good measures of the survey objectives.

The researcher used these checklists to alter content, phrasing and emphasis of pre-evaluated survey questions. Bickman and Rog (1998) further recommend characteristics that the questions in the questionnaire should possess in order to meet good measurement process of survey data. These are:

- Questions need to be consistently understood
- Questions need to be consistently administered or communicated to respondents
- What constitutes an adequate answer should be consistently communicated
- Unless measuring knowledge is the goal of the question, all respondents should have access to the information needed to answer the questions accurately,
- Respondents must be willing to provide the answers called for in the question.

In order to meet these recommendations and the similar ones recommended by Oppenheim (1992, 1993), the researcher adopted the following measures in order to enhance the validity of the data:

- The questionnaires were reviewed by peers and other sector professionals. These included some WEDC research students; Darren Saywell at the IWA office, London; Social scientists and Engineers from the Sanitation Department of Tamale Municipal Assembly.
- Loaded and leading questions were avoided.
- The use of jargon was avoided and simple and clearly understood terms were rather used in preference.
- Questions were phrased in such a way as to facilitate easy translation into the local language without losing their meaning
- The assistant interviewers (enumerators) were sufficiently trained for the exercise.

- The questionnaires were written in English and were administered by the assistant interviewers in either English or local dialect depending on the preference of the respondent. This was done to minimize errors due to misunderstanding or wrongful interpretation.
- A pre-test household survey was conducted with the questionnaire questions to ascertain the appropriateness of the questionnaires. This was done to ensure that respondents could understand the questions asked; to check for any ambiguity in the phraseology of the questionnaire questions; and to identify cultural sentiments or taboo words which might affect user responses.

4.7.2.2 Interviews

Interviews can be structured, unstructured or semi-structured (Hancock *et al*, 2007). In the structured interviews questions are prepared and presented to each interviewee in an identical way using a strict predetermined order; while in unstructured interviews, free-flowing conversation is the norm (Hancock *et al*, 2007). Gillham (2000) suggests that a semi-structure interview, which is in between the two interview extremes, offers the interviewees the opportunity to say their views in an unstructured manner that adds some new discoveries and understanding to the research investigators. Based on this recommendation, this study used semi-structured interviews to obtain data from the interviewees. The aim of the interview was to examine the views of experts and other key sanitation stakeholders on FS emptying and transport issues in the three leading cities of Ghana, particularly Tamale which was the chosen study urban area (Do refer to Chapter Five for the discussions on the choice of the study area). The questions asked evolved around the key research issues such as technology, finance, socio-culture, policy, planning and the overall management of urban FS emptying and transport services in the urban areas (refer to Table 4.4 below) for the aide memoire used as a guide to question the interviewees.

4.7.2.2.1 Selection of the interviewees and the interviewing process

Focusing on the interviewees who could provide relevant information about the research problems can enhance the credibility of the data collected (Babbie, 1979; Patton, 2002). Therefore, in this study, the interviewees who had knowledge about or were involved in, one way or the other, the urban FS emptying and transport issues, as well as other areas of urban sanitation, were selected. Due to the huge amount of work involved in the interview methodology in terms of time, financial and travelling constraints (Gillham, 2002), the researcher selected and interviewed some households and twenty-nine interviewees from the sanitation institutions, organisations and NGOs as well as other relevant stakeholders who have knowledge about or were involved in urban sanitation issues. The selection of the interviewees was initially done through consultation with the Sanitation Department of the Tamale Municipal Assembly followed by snowballing to get more interviewees. As stated above, most of the interviewees were from Tamale, as compared to the other two urban areas in the country, Accra and Kumasi, which had fewer interviewees. Out of the twenty-nine interviewees, nineteen were key informants with professional and academic knowledge or experience in urban sanitation; six were conservancy labourers involved with urban FS emptying and transport in Tamale; and four were farmers from Tamale who use FS as a soil improver on their farms.

Each interview usually started with an exciting introductory conversation on issues such as sports, entertainment and an amusing topic of the day. This was an ice-breaking technique to pave the way for the actual interview. Interviews lasted between thirty minutes and one hour in duration and were guided by an aide-memoire of questions displayed in Table 4.4 below. The contents of the aide-memoire were not rigidly applied, as there was flexibility to ask follow-up questions to obtain particular answers with the progression of the interview.

Table 4.4: Aide memoire used during key informant interviews

AIDE MEMOIRE USED DURING KEY INFORMANT INTERVIEWS	
Technology related Issues	Management related issues
Latrine Technology	Socio-cultural Issues
Types of latrines and reasons for latrine choice in locality/settlement	Knowledge, attitude and perceptions about latrine use and FS management
Latrine use, anal cleansing material and other materials filling the vault or pits	The issues of gender in FS emptying and transport
Latrine size	
	Institutional & Organisational issues
Emptying and Transport issues	Key actors for FS emptying, transport disposal and reuse. Organizational issues regarding emptying, transport and reuse. Monitoring, coordination and networking
	Policy Issues
Disposal practices in the communities	Effectiveness and relevance of byelaws regarding FS handling and management
Existing emptying and transport demand and practices	
Types, conditions and efficacy of tools and equipment used for emptying and transport	Financing
Cost implications of emptying and transport	Funding for sanitation, particularly emptying and transport.
Emptying and transport problems	
Faecal sludge Reuse issues	Planning
	How the FS emptying and transport services are organized and executed within the communities and the metropolis
Demand and interest for FS reuse in the municipality	
Socio-cultural and health problems of reuse	
Opportunities for reuse	

Interviews were recorded using a hand-held recording device after permission had been sought from respondents to use it. Or else, an interview was hand written by the researcher. The recorded interviews were then transcribed at a later date. Some of the interviewees, especially the conservancy labourers

(scavengers) and farmers, requested for anonymity. Besides, strict research etiquette was followed as advised by Neuman (1997) and Punch (1998) who argue that research protocol should include privacy, anonymity, and confidentiality. This research therefore took measures to protect respondents' privacy and anonymity; and encouraged their confidentiality. Therefore prior to the commencement of the interview, interviewees were informed about:

- 1) Purpose of interview and wider research;
- 2) Estimated length of interview;
- 3) Use of tape recorder
- 4) Anonymity (if needed)

Details of informants, interviewed during the research, their responses and respective organizations and institutions are tabulated and attached as Appendix 2.

4.7.2.2 Selection and training of the assistant interviewers

The researcher sought the help of assistant interviewers (enumerators) to assist in administering the household questionnaires. The researcher discussed his need for the enumerators with the Tamale Municipal Assembly (TMA) sanitation authorities, who helped to select the enumerators with the following criteria. Enumerators who:

- were conversant with the local community and sanitation issues,
- had experience with administering questionnaires,
- could speak both English and the local dialect fluently,
- were on leave or could be granted leave in order to have ample time for the data collection.

In order to train the enumerators to prepare them adequately for the task ahead, a four-day orientation course was organized for the enumerators to provide general guidance on the purpose of the research, general survey administration, the research protocol, challenges that could be encountered

and specific guidance in relation to particular questions arising in the survey. In particular, the following issues were discussed:

- the aim of the research
- the nature of the task involved and the tactfulness required
- the challenges and conditions expected
- the remuneration involved
- the nature of the questions and their significance for the research
- how to deal with the hostile and or uncooperative respondents
- the need for self introduction and the explanation for the purpose of the survey
- the need to keep focus on the questions and ignore any interruptions.

In all, ten enumerators were selected to go through four days of an intensive training programme. Each day of the training lasted for approximately four hours. Four out of the ten enumerators were chosen as a reserve to replace any of the six who, for one reason or the other, might fail to attend to duty. The first two days of the training programme discussed the above points thoroughly together with other essential issues as they emerged. The third day of the training programme was used for mock questionnaire administration by the enumerators in order to get some practical experience required for the actual work. Then on the fourth day, the enumerators were sent to all the selected communities to administer sample questioners to the households within the communities. Each of the ten enumerators was to administer six questionnaires to six households at random without following any strict sampling procedure. This led to a pre-test sample size of 60. The main idea behind this exercise was to have the enumerators familiarize themselves with the actual administering of the questionnaires and ticking boxes or taking down responses and or complaints from the households. Thus, the enumerators were tasked to note any problems or difficulties experienced when conducting the field pre-test and to summarize these in a report sent to the researcher. Following the pre-testing, the appropriate amendments to the survey questionnaire questions were made.

4.7.3 *Direct observations*

According to Gillham (2000:49), there are two main kinds of observation: participant observation which is mainly descriptive; and direct observation which involves watching from outside in a carefully specified way, which is mainly qualitative. The researcher opted for the direct observation for this study because it is relatively less time-consuming and helps to discover things that people may not wish to reveal in interviews or may not be asked about in surveys (Roche, 1999:128). Besides, it could offer the researcher an opportunity to gain first-hand experience as well as insights into the various events and actions regarding urban FS emptying and transport as well as disposal issues, which would enrich and triangulate the data that would be collected. One major weakness in the direct observation method, however, is that reasons for behaviour tend to be less obvious (Cavill, 2005). Therefore in this study, direct observation would be done to supplement, complement and triangulate the other research methods. The direct observation by the researcher was intended to be carried on the following issues:

- A number of urban on-plot latrines
- FS emptying and transport mechanisms
- FS disposal and reuse mechanisms

Besides the researcher's direct observations made, the enumerators were also assigned to directly observe the household latrine types and estimate their volumes as instructed to do in the household questionnaires.

4.7.4 *Focus group discussion*

Powell *et al.* (1996:499) define a focus group as a group of individuals selected and assembled by researchers to discuss and comment on the topic that is the subject of the research, from their own personal experience. Focus group discussion, however, goes beyond merely interviewing a group of people to include the interactions within the group based on topics that are supplied by the researcher (Morgan 1997: 12). Kitzinger (1994, 1995) argues

that the interaction within the focus group discussion is a good feature because it highlights the views of the participants about an issue and their values and beliefs about a situation.

According to the literature, there are several ways a focus group discussion can be used. For example:

- It can be used in its own right or at the preliminary stages of a study (Kreuger, 1988; Morgan, 1988).
- It can be used during study to help explore and generate hypotheses as well as triangulate the results of other research methods (Race *et al*, 1994; Powell and Single, 1996; Morgan, 1988; Morgan and Spanish, 1984), or
- It can be used to develop questions or concepts for questionnaires and interview guides (Hoppe et al, 1995; Lankshear, 1993).

As compared to individual interviews, which aim to obtain individual responses regarding their attitudes, beliefs and feelings, focus group discussions seek to elicit a multiplicity of views within a group context (Krueger, 1988; Kitzinger, 1994). This, in the view of the researcher, augurs well for community managed projects. Compared to direct observation, a focus group could help the researcher to gain a larger amount of information in a relatively shorter period of time. Based on the above views, the researcher adopted focus group discussion as part of the research methodology due to the following deductive reasons:

- to gain more insight into the study as well as triangulate the results of the other research methods, and
- to draw upon respondents' attitudes, feelings, beliefs, experiences and reactions in a way in which would not be feasible using the other methods.

In spite of the benefits that focus group discussion can offer, there are certain limitations that can be associated with focus group discussion methodology as explained in the following points:

- A researcher, or moderator, has less control over the data produced (Morgan,1988) than in either quantitative studies or one-to-one interviewing, since the moderator could allow participants to talk to each other, ask questions and express doubts and opinions, while having very little control over the interaction other than generally keeping participants focused on the topic.
- If a group is homogenous with regard to specific characteristics such as households with same latrines, etc., then diverse opinions and experiences may not be revealed.
- There could be discomfort between members who are perceived to be different in terms of political, educational and other socio-cultural or economic backgrounds (Morgan, 1988).
- Sensitive and confidential information may not be made available by the participants (Morgan, 1988).
- Sometimes, there is difficulty in assembling the groups (Addo-Yobo, 2005).

The researcher attempted to overcome some of these limitations through careful selection procedure to obtain the focus groups participants and moderators as stated in the section below.

4.7.4.1 *Selection of the focus groups and moderators*

The choice and selection of focus groups and moderators for this research depended on three decisions. Firstly, a decision was made concerning the gender of participants within each focus group. Secondly, a decision was made as to the type (communities, conservancy labourers, etc), size and the number of groups to be used. Thirdly, three moderators, one from each focus group setting, were chosen to assist the researcher to conduct the focus group discussions. The moderators selected were individuals who could speak the local dialect and English language proficiently, so that where there was a need for interpretation they could do so with ease and precision. The researcher, as the leader of the moderators' team, tape recorded and jotted down the salient points captured in the discussions.

Even though the number of members in a focus group varies, the recommended number of people per group is usually six to ten (MacIntosh, 1981). Some researchers have also used up to fifteen people (Goss and Leinbach, 1996) or as few as four (Kitzinger, 1995). Morgan (1997) also has the following rule of thumb for focus group projects that researchers can consider:

- six to ten participants;
- a total of three to five groups per project;
- rely on relatively structured interview with a high moderator involvement.

Considering these experts' comments, the researcher decided to conduct the focus group discussions within all the three communities where the research was undertaken through the assistance of the Unit Committee leaders (The community leaders). These helped to select focus group members from the households comprising both men and women (refer to Table 4.6 below for the details).

Table 4.6: Composition of the focus group communities

Community	No. of men	No. of women	Total
Sakasaka quarters	5	5	10
Changni	6	5	11
Kakpagyili	6	3	9

Besides the focus groups displayed in the above table, another focus group discussion was held for six conservancy labourers organised with the help of technicians of the Sanitation Department of the Municipal Assembly. In all, four focus group discussions were held with each discussion lasting from one to two hours. The aide memoire designed in Table 4.4 in Section 4.7.2.2.1 for the interviewees was also used as a guide to open the discussions. Some of the issues that came up helped in the subsequent interviews and questionnaire design. It also offered the researcher the opportunity to understand more issues concerning users' attitudes regarding latrines as well

as FS emptying and transport. The summary of responses from the focus group discussion is attached as Appendix 8.

Three moderators were chosen with the help of the Sanitation Department of TMA based on the following criteria:

- Persons who had lived in Tamale for a relatively long time;
- Persons who were conversant with the socio-culture of Tamale
- Persons who understood and wrote English language and the local dialect (Dagwani) very well.
- Persons who had previous experience as moderators for focus group discussion.

Before the focus groups' meetings, the moderators were briefed about what was to be discussed and thereafter given the following instructions to make the discussions viable, valid and reliable:

- Moderators should help keep the session focused by sometimes steering the conversation back on course.
- Moderators also have to ensure that everyone participates and gets a chance to speak.
- At the same time moderators are encouraged not to show too much approval (Kreuger,1988), so as to avoid favouring particular participants.
- They must avoid giving personal opinions so as not to influence participants towards any particular position or opinion.

The Table 4.7 below depicts the matrix of the data collection methods used for the study and the issues on which they were triangulated for data validity and reliability.

Table 4.7: Triangulation matrix

ITEM	HOUSEHOLD (HH) SURVEY	SEMI-STRUCTURED INTERVIEW	FIELD OBSERVATIONS	FOCUS GROUP DISCUSSION
Presence or absence of latrine	x	X	X	X
Latrine technology	x	X	X	X
Reason for choice of particular latrine technology	x	X		X
Access to latrine facility for emptying and transport	x	X	X	X
Those responsible for FS removal and transport	x	X	X	X
Income sources of the FS emptiers and transporters		X	X	
Cost of emptying and transport by technology type	x	X	X	X
How emptying and transport is done	x	X	X	X
Contributions to filling rate of latrine vaults	x	X	X	X
Types of anal cleansing materials used and their placement after use	x	X	X	X
Emptying and transport problems	x	X	X	X
HHs' attitude & knowledge towards latrine use & emptying	x	X		X
HHs satisfaction with emptying and transport services	x		X	X
Gender issues	x	X		X
Disposal points, and distances	x	X	X	X
Interest in and popularity of reuse	x	X	X	X
Potential problems of reuse		X	X	X
Reuse influence on transport		X	X	

4.8 The research validity and reliability

The previous section has discussed the research strategy and data collection methods employed for the study. Following that, this section discusses how the data collected would be valid and reliable. This is necessary because any credible research design should attempt to maximize both validity and reliability (Bickman and Rog, 1998).

Below are four types of validity that are commonly implied (Yin, 1994; Cook and Campell, 1979):

- a) *Construct validity*:- the extent to which the constructs developed from the research can be measured and reasonable conclusions made in the research study successfully.
- b) *Internal validity*:- the extent to which the sections (chapters and sub chapters) in the study allow systematic conclusions to be made.
- c) *External validity*:- the extent to which generalizations can be inferred from the data and local context to wider populations and settings.
- d) *Statistical conclusion validity*:-the extent to which the study has used design and statistical methods appropriately to detect the effects that are present.

Reliability is the degree to which a measurement procedure yields consistent answers irrespective of the number of times the procedure is adopted (Bickman and Rog, 1998). In the view of Mariampolski (2001), reliability is the adoption of a logical and consistent approach to data gathering and analysis, so that meanings inferred from the data are unambiguous.

As a result of the explanations offered to the research reliability and validity, this study employed a number of procedural strategies recommended by Burgess (1984) and Bickman and Rog (1998) in order to improve the validity and reliability of the research. These are:

- Triangulation strategies (refer to Section 4.4.3):- When one data collection method is used, distortion may ensue; therefore to address this potential problem, the researcher used triangulation strategy which

involved the use of additional methods to verify the research findings. Triangulation measures taken in this study included using more than one method to ask the same question; combination of qualitative and quantitative techniques and analyses; interviewing more than one person about the same issues; focus group discussions; and direct field observations.

- Multiple sources of evidence:-These are pieces of information gathered from various sources for the research. In this study these sources included evidence from government official reports, sanitation management boards, NGOs and direct field observation. Such multiple sources helped clear doubts about reliability and validity of the data collected.
- Use of rich data gathering:- Bickman and Rog (1998) refer to rich data as being detailed and complete sources of information that provide a full and comprehensive picture of a phenomenon, which thus reduces the opportunity for respondent duplicity or observer bias. To achieve this, the researcher ensured that due research protocol involving good and credible research design was followed to obtain valid and reliable data for the study.
- Analysis of discrepant evidence and negative cases:- Rich data gathering helps to minimize contradictions and discrepancies (Bickman and Rog, 1998). In this study, the researcher decided to reinvestigate any contradictory and discrepant responses that would emerge by the use of multiple sources of evidence and triangulation strategies or direct observation as the case might demand.
- Peer review:- Research bias can be tested with the help from sector professionals as well as from fieldwork project partners. The researcher therefore consulted his peers at WEDC and the IWA London Office, as well as the officials at the Sanitation Department of Tamale Municipal Assembly, about the relevance and validity of the questionnaires.
- Use of pilot studies and post-survey tests are recommended to reinforce data reliability and validity (Kervin, 1992; Punch, 1998;

Babbie, 1979, 1990). The researcher therefore did a pilot study on the households with his questionnaires with the help of enumerators. This enabled the researcher to make the appropriate adjustments and corrections to the research questions before embarking on the full-scale household survey. After the survey, a post-survey test which was about 5% of the main survey, was carried out to verify the reliability of the data collected during the main survey.

- Use of quantitative and qualitative techniques (Sections 4.4.1 and 4.4.2):- Mixtures of quantitative and qualitative techniques help to adequately cover research issues which none of the techniques can resolve alone (Denzin and Lincoln, 2005). So the researcher employed the two techniques during the research to obtain and analyze the research data.

4.9 Data analyses

Sections 4.0-4.7 dealt with the research design and methodology that resulted in collection of large amount of quantitative and qualitative data relating to urban FS emptying, transport and disposal issues. Although a synthesis of the information on the data collected is provided in subsequent sections, the bulk of the raw data is not presented in this thesis but is available for public accessibility. The synthesis of the data captured for the study is stated in Table 4.8 below:

Table 4.8: Summary of information available in research database

INFORMATION ITEM	QUANTITY
Household survey questionnaires	428
Four Focus Group Discussions with communities and scavengers	36 members with between 6 to 11 members in a group
Semi-structured interviews with key informants	29
Direct observations to sites, systems and people	10
Documents reviewed comprising journals, articles, books, Theses, administrative documents	300
Other informal contacts made for information	4

A description of the data analyses for both the quantitative and qualitative data is presented below.

4.9.1 Qualitative data analysis

The object of analyzing qualitative data is to determine the categories, relationships and assumptions that inform the respondents' view of the world in general and of the topic in particular (McCracken, 1988). Unfortunately, qualitative data analysis (QDA) is the most difficult, time consuming and crucial aspect of qualitative research (Bisit, 2003). This is because in qualitative data analysis, the researcher needs to be able to organize, manage, and retrieve the most meaningful bits of the qualitative data (Coffey and Atkinson, 1996).

Coding is one of the significant steps taken during analysis to organize and make sense of textual data, since it allows the qualitative researcher to find all the pieces of information regarding variables of interest to the research and improves reliability (Schneider, 2005). Coding is a process that involves scanning the data for categories of phenomena and for relationships among the categories (Goetz and LeCompte, 1981; Dey, 1993; Silverman, 2001; Patton, 2002).

Most QDA programmes require that the data be specially formatted before analysing them (La Pelle, 2004). Multifunction programmes for managing the codes and analyzing texts such as NUD*IST and Atlas.ti and Microsoft Word exist (La Pelle, 2004). Key to using any of these QDA programmes successfully to analyze data, is to understand and be familiarized with the programme. Therefore the researcher resorted to using Microsoft Word which has been successfully used for QDA before, due to its simplicity and ease of availability (La Pelle, 2004; Ryan, 2004; Miles and Huberman, 1994). Some researchers have, however, expressed scepticism about the use of word processors for doing the QDA (Seale, 2002; Richards and Richards, 1994) due to issues like complexity involved in handling large number of codes and many references from codes to text; and capturing data that may not be part

of the texts themselves but rather facts about the study informants, documents, or organizations under study. In spite of these concerns, La Pelle (2004) has successfully used Microsoft Word Processor to code and retrieve qualitative data using seven steps (italics) listed below. The researcher followed these steps to code, organize and retrieve his data for analysis. By so doing the researcher fitted into each step his measures (non-italics) used to follow the step as explained below:

- 1) *Formatting the data into tables including participant identification (ID) information and utterance sequence numbers:-* The field notes were reviewed, corrected and written out using Microsoft 2003 word processor. Audio tape recorded words from the focus group discussions and other interviewees were also transcribed and edited. In each case, interviewees were identified with identification numbers (IDs). By so doing the data was formatted into tables using the Microsoft Word. All the write-ups were saved in the computer file as a word document.
- 2) *Developing a theme codebook in tabular format to define linkages between numeric codes and theme categories:-* The researcher went through the data looking for things pertinent to answering the research questions by writing paraphrases, phrases, headings and labels that describe the key concerns raised as well as new observations and insights made. The primary coding categories for the study were socio-cultural, financial, institutional, organizational, policy, planning and gender issues that concern urban FS emptying and transport. Sub codes were created under the primary codes based on emerging issues from the data. Then logically these were organized into the codebook.
- 3) *Determining face-sheet (sheet containing the concise relevant points) data categories on which retrieval will be done and adding columns to the data tables to accommodate coding for these:-* The researcher followed this principle by categorizing the data into face-sheets saved for easy retrieval.
- 4) *Doing the thematic coding in the theme code column and modifying the table as needed to handle the text that should be coded with multiple*

themes:- The coded themes mentioned by respondents were tabulated and where necessary extra columns and rows were added to accommodate multiple themes raised by respondents.

- 5) *Sorting the data by desired face-sheet data and the theme code categories to look for patterns:-* The coded data were sorted out according to themes in such a way that the data that had the same labels or closely related labels were put in the same topic categories and clusters.
- 6) *Validating the coding within a data table, correcting, and re-sorting:-* The categorized data were examined rigorously by the researcher in the light of the original data to either confirm, reject or modify the coded and tabulated data.
- 7) *Merging appropriate data tables for validation and analysis:-* The categorised data were developed into themes and analysed to identify emerging trends. Then a conceptual scheme was drawn that tied the data together in a systematic manner that answers the research question coherently. This step enabled the researcher to make an original contribution to the study

4.9.2 Quantitative data analysis

The quantitative data was generated mainly through the household questionnaires. Both bivariate and univariate data analyses were used. The univariate analyses yielded descriptive statistics for various data items. Bivariate analyses were used to examine relationships between pairs of data items. Bryman and Cramer (2005) recommend a rule of thumb statistical approach to apply for types of data variables that are paired up for bivariate analysis. These are explained below:

- *Nominal-nominal or nominal-ordinal data:-* Contingency-table analysis in conjunction with chi-square analysis as a test of statistical significance is recommended for this data pair. Chi-square does not convey information about the strength of the relationship. It rather tells how confident a relationship between the two variables can be

achieved. Therefore to test for strength of association, Cramer's V which varies between 0 and +1 can be used.

- *Ordinal-ordinal data*:- Rank correlation employing Spearman's rho or Kendall's tau and their associated significance tests are used.
- *Interval-interval data*:- Correlation and regression analysis are used to analyse interval-interval data in order to estimate the strength and character (i.e. the precision and prediction) of relationships that exist between the data pair. Correlation helps to indicate both the strength and the direction of relationship between the pair of variables.
- *Dichotomous-dichotomous data*:- This is also nominal-nominal relationship except that phi (varies between 0 and +1 or -1) is used instead of Cramer's V.
- *Interval-ordinal data*:- If the ordinal variable assumes quite a large number of categories, it will probably be best to use Spearman's rho(ρ) and Kendall's tau(τ) rank correlation. Contingency-table analysis may be used if there are few categories in both the ordinal and interval variables.
- *Interval-nominal or interval-dichotomous data*:- Contingency-table analysis and chi-square may be used if the interval variable can be sensibly collapsed into categories. This approach is only applicable if it is not meaningful to talk about which is dependent and which is independent variable. If the interval variable can be identified as dependent variable, then the means procedure and its associated statistics can be used.

Looking at the nature of the quantitative data gathered, the researcher used mainly chi-square and cross tabulation analyses. All the statistical analyses were carried out using the Statistical Package for Social Scientist (SPSS) version 15. The quantitative analyses used for the data analyses are described below.

4.9.2.1 Descriptive statistics

The main descriptive statistics used for the data analysis were frequency distribution tables and pie charts. These were used to display the data graphically for easy inspection and interpretation.

4.9.2.2 Chi-Square test

Chi-Square tests are used to verify whether two variables are independent of each other or not. The results of interest are the levels of significance associated with the Pearson chi-square. This value, which is the probability that the results were produced by random chance, can range from 0.00000 to 1.0000. The lower the significance value, the less likely that the results were produced by random chance (Brace *et al*, 2006). The degree of freedom in chi-square is calculated as $(r-1) \times (c-1)$, where r is the number of rows and c , the number of columns in the cross tabulation (Denscombe, 2007).

Chi-square value is calculated by summing over all the cells and the squared residuals divided by the expected frequencies (Denscombe, 2007). i.e.:

$$X^2 = \sum_{ij} \sum_{ij} (O_{ij} - E_{ij})^2 / E_{ij}$$
, where X^2 is the chi-square; O and E are observed and expected frequencies respectively. The calculated chi-square is compared to the critical points of the theoretical chi-square distribution to produce an estimate of how likely or unlikely the calculated value is if the variables are independent or not. If the two variables are independent, the probability that a random sample would result in a chi-square value of at least that magnitude is low. Such probability is known as observed level of significance. If the probability is small enough (i.e. less than 0.05 or 0.01), then the hypothesis that the two variables are independent (null hypothesis) is rejected. More explanations of the chi-square are attached as Appendix 4.

4.10 Ethical considerations

Ethical considerations are essential for most methods of social research (Homan, 1991) because there are certain procedures which are either morally unacceptable or politically difficult or impossible (Babbie, 1979). Ethical

issues are the socio-cultural and psychological concerns, dilemmas and conflicts that need to be considered during the conduct of the research; and these may include privacy, anonymity, and confidentiality (Neuman 1997; Punch 1998).

This research therefore took measures to protect respondents' privacy and anonymity; and encouraged their confidentiality by adopting the following measures:

- Permission was sought from the community authorities before data were collected from the households within the communities' areas of jurisdiction.
- Respect and due recognition were given to the cultural and religious beliefs of the interviewees and participants.
- All responses were treated as confidential and the anonymity of the respondents was guaranteed by identifying respondents by codes instead of names.
- All recorded interviews, done as well as pictures taken, were done with the prior consent of the interviewees.
- When selecting and involving participants for the focus group discussions, the researcher ensured that full information about the purpose and uses of participants' contributions was explained.
- The researcher did not pressure moderators or respondents into participating in the research.
- Participants in the focus group were encouraged to keep confidential what they heard during the meetings.

4.11 Chapter conclusion and summary

This chapter has discussed the research design, strategy and methodologies used to collect the data. The chapter also re-emphasizes the hypothesis, objectives and key research questions that have guided the research work. Methodologies involving, direct observations, semi-structured interviews, household surveys and focus group discussions adopted to improve reliability

and validity of data are presented. Both quantitative and qualitative techniques adopted to analyze the data as well as the ethical considerations for the data collection are also discussed.

The next chapter is devoted to describing the study area chosen for the research by discussing the general sanitation issues at the national (macro), city (meso) and the community (micro) levels.

5. The study area

5.1 *Introduction to the chapter*

The previous chapter dealt with the research methodologies that underpin this study. This chapter discusses the choice of the study area and the general sanitation issues at the national and city level where the study takes place.

5.2 *The choice of the study area*

The choice of the study area was made through three choice levels referred to in this study as macro (country), meso (city) and micro (community) levels. The basis for the choice of these levels is also explained in the proceedings below:

5.2.1 Macro level

At the macro level, Ghana was chosen for data collection based on the following reasons:

- Low-income country with low per capita income.
- Rapid urbanization and increasing number of informal high-density communities plus other numerous challenges for sanitation delivery typical of a low-income country.
- Existence of inadequate sanitation policy and programmes with regard to pit and bucket emptying; human excreta disposal and FS transport.
- Existence of governmental and NGO activities on sanitation which offer the opportunity for the implementation of the research findings.
- Many urban household on-plot sanitation facilities offering the opportunity to study issues of latrine emptying and FS transport problems.

5.2.2 Meso level

At the meso-level, Tamale city was selected mainly because its municipality is the largest settlement in the northern part of Ghana with the highest level of poverty and an estimated population of about 342,000 (Ghana Statistical Service, 2001). There is strong socio-cultural diversity with Islam as the dominant faith mixed with significant populations of Christians and other faiths. FS reuse is widely practised by Tamale farmers (Asare *et al*, 2003). Other reasons for choosing Tamale as the study area include:

- It is the third largest city of Ghana with a reputation of being one of the fastest growing cities in West Africa. It also serves as a node of convergence as well as the commercial capital of the three northern regions of Ghana.
- Its sanitation system is mainly on-plot
- It is the poorest among the three leading cities in Ghana with significant levels of NGO (both local and international) activity for water supply and sanitation.

5.2.3 Micro level

At the micro level three communities were selected within Tamale metropolis for the detailed household study. These were *Sakasaka quarters*; *Changni*; and *Kakpagyili*. The selection of the communities was done after extensive consultation with the Sanitation Department of Tamale Metropolitan Assembly and personal reconnaissance visits had been paid to these communities to ascertain the factual realities on the ground. Factors that were considered in selecting these communities were population density, socio-economic status of the populace, latrine technologies, ease of obtaining information, and absence of disputes and potentially volatile situations. The latter factor is essential as Tamale is noted for sporadic violence in some communities due to chieftaincy disputes. Some specific descriptions of the communities selected are as follows:

- 1) Sakasaka quarters are relatively well planned and occupied by senior and junior civil servants. There is extended family dependency and

therefore population density here is relatively high due to the high number of white collar workers who support other relatives. The main latrine system here is bucket latrine. There is also some level of open defecation. This area will help the researcher to ascertain how the bucket latrine system is collected and disposed of.

- 2) Changni is an environmentally sensitive community due to an existing spring well which supplies water to the community. This makes the sanitation issue very important as indiscriminate excreta disposal could create epidemics. This community has a variety of latrine systems; therefore the study in this community will help to identify various emptying and transport services pertaining to the different latrine systems individually and severally.
- 3) Kakpacyili is a peri-urban community with a large number of poor residents. Study of sanitation in this community will help understand the sanitary conditions in the peri-urban settlements with lot of poor settlers and how human excreta is generally handled in terms of defecation and excreta disposal, including latrine emptying and FS transport.

The above descriptions reveal that each community offers a particular comparative advantage, which enhances the overall richness of the data. Thus, viewing from the technical and socio-economic points, the communities were selected based on the fact that there are:

- range of latrine types in operation for several years,
- range of housing densities,
- mixture of formal and informal settlements,
- range of incomes operated in the various communities,
- variety of pit and bucket emptying, FS transport and disposal practices occurring within the communities.

It must be stated that the data from the communities were combined for analysis rather than treating them as individual cases. This is because, as it can be seen from Table 5.3 in Section 5.3.4 below, there are few household latrines in Tamale, so the latrines in the communities were combined in order

to generate relatively large household latrine number required for the survey strategy adopted for this study.

The next section is devoted to giving an overview of sanitation and FS emptying and transport issues in the country (Ghana) and the selected city (Tamale) where the study took place.

5.3 Sanitation overview in Ghana

5.3.1 General

Ghana is a West African country that covers an area of approximately 238,500 square kilometres (Boateng, 1970). It is bordered in the south by the Gulf of Guinea coastline; in the north by Burkina Faso; in the east by Togo; and in the west by La Cote D'Ivoire (Ivory Coast). The total population of the country is estimated at about 20 million with annual population growth rate of 2.6%. Out of this population of 20 million, about 44% of them reside in urban areas (Ghana Statistical Service, 2001). The climate is tropical with characteristically hot and humid temperatures. The mean annual rainfall ranges from about 1,000 mm in the north to 2,000 mm in the south (Dickson and Benneh, 1988).

Sanitation coverage in Ghana is generally low as is depicted in the Table 5.1 below.

Table 5.1: Trends in water and sanitation provision in Ghana

WATER AND SANITATION PROVISION IN GHANA	YEAR 2000	YEAR 2003
Rural population with safe water	40%	46%
Rural population with safe household latrines	15%	20%
Urban population with safe water	70%	70%
Urban population with safe household latrines	40%	45%

Sources: Ghana Ministry of Works and Housing, 2004; Republic of Ghana, 2002

This sanitation statistics shown in the above table agree fairly well with the urban-rural disparities in sanitation coverage report by UNICEF and WHO for Sub-Sahara Africa in 2006 as shown in the Table 5.2 below.

Table 5.2: Urban-rural disparities in sanitation coverage for Sub-Sahara Africa for 2006

URBAN COVERAGE	RURAL COVERAGE
42%	24%

Source: UNICEF and WHO, 2008

It is estimated that to meet the Millennium Development Goals (MDGs) on water and sanitation, Ghana needs to spend about \$1.6 billion towards supplying 85% of the urban population and 80% of the rural population with water by 2015; and \$1.1 billion towards providing 84% of the urban population and 76% of the rural population with adequate sanitation by 2020 (Ghana Ministry of Works and Housing, 2004). Unfortunately, the current GDP growth of about 5.8% is not strong enough for the attainment of these Millennium Development Goals (UNDP, 2005). This scenario depicts the economic and financial challenges confronting water and sanitation as well as other development projects in Ghana, given the economic status of the country. This therefore makes the statement by Aryee and Crook (2003:iii), ‘that *the provision of reasonable sanitation facilities (in Ghana) may require full public provision of basic infrastructure*’ a daunting task for the Ghana government.

5.3.2. Sanitation policy and strategy in Ghana

The Government of Ghana started making serious efforts towards sanitation in the 1990s where it embarked on restructuring the water and sanitation sector (Yakubu, 2003). Thus in 1999, the sanitation policy for Ghana was formulated with the aim of ensuring that development and sustainability of the sanitation facilities and services was provided mainly through a demand responsive approach. This was a shift from the dependence on government towards greater self-reliance by the user communities.

For the sanitation sub-sector, the policy aimed at achieving simple sewerage systems for urban areas and single household dry on-site systems for small towns and rural areas, with the following strategies developed to promote acceleration of sanitation delivery (Ghana Ministry of Local Government and Rural Development, 1999):

- Formal establishment of environmental sanitation as a sub-sector within the national development programmes;
- Rationalization of institutional objectives and functions at all levels;
- Establishment of a National Environmental Sanitation Policy Coordination Council within the Ministry of Local Government and Rural Development (MLGRD);
- Establishment of a National Environmental Sanitation Day;
- Development and strengthening of the community's role in environmental sanitation;
- Development of human resources and strengthening institutional structures for managing environmental sanitation;
- Assigning delivery of a major proportion of environmental sanitation services to the private sector through contract, franchise, concession and other arrangements;
- Development of a strong legislative and regulatory framework, and capacity for supervising environmental sanitation activities and enforcing standards;
- Promotion of research to review sanitation technologies;
- Identification and dissemination of cost-effective, appropriate, affordable and environmentally friendly technologies;
- Adoption of the cost recovery principle in the planning and management of environmental sanitation services.

The above strategies were developed with the intention that the following would have been achieved by the year 2020:

- National Environmental Sanitation Day is established by legislation and observed regularly;

- The national Environmental Sanitation Policy Co-ordination Council is established within the Ministry of Local Government and Rural Development;
- Environmental sanitation technologies are under regular review and continuous improvement;
- All solid wastes generated in urban areas are regularly collected and disposed of in adequately controlled landfills or by other environmentally acceptable means;
- *All excreta are disposed of either in hygienic on-site disposal systems or by hygienic collection, treatment and off-site disposal systems;*
- *All pan latrines are phased out (by 2010);*
- *At least 90% of the population has access to an acceptable domestic toilet and the remaining 10% has access to hygienic public toilets;*
- *Hygienic public toilets are provided for the transient population in all areas of intense public activity;*
- Active sanitary inspection and vector control programmes are in place and the incidence of malaria, bilharzia and other vector-borne diseases is falling;
- Environmental standards and sanitary regulations are strictly observed and enforced;
- The majority of environmental sanitation services are provided by the private sector.

The policy document has failed to meet many of the above-mentioned expectations (Larbi, 2006). To date, the on-plot sanitation systems still dominate the urban environment, while few of the strategic objectives have been achieved. Bucket and pit emptying has been unhygienic (Van der Geest, 2002). Some of the factors attributable to the failure of sanitation services have been identified as (WaterAid-Ghana, 2005; Larbi, 2006):

- Lack of a comprehensive policy assigning responsibilities for environmental sanitation to the relevant Ministries and agencies, resulting in overlaps, gaps and poor co-ordination in the management of programmes and services ;

- Lack of technical capacity in MLGRD to orient and support the District Assemblies in the provision of environmental sanitation services ;
- Attempts to transfer to the Assemblies environmental sanitation functions performed by Ministries and central Government agencies, without transferring the accompanying budgets, personnel and equipment ;
- Weak and/or outdated and poorly enforced environmental sanitation legislation ;
- Inertia and lack of political will to address sanitation issues with the sense of urgency and priority.
- Inadequate allocation of resources for environmental sanitation services, both nationally and at district level ;
- Lack of adequate professional manpower including engineers, planners and administrators, for planning, management, policy formulation and research.

In a nutshell, Ghana has a sanitation policy but it has so far not been effective in addressing the pertinent sanitation problems, including urban excreta or FS emptying, transport and disposal to places of safety, due to confusion of specified roles, inadequate policy instruments, and institutional and organizational weaknesses. The next section therefore addresses the institutions and organisations which are the custodians and implementers of the government directives and policy for sanitation.

5.3.3 Institutions and organizations for sanitation and FS management in Ghana

The sanitation policy issues addressed above ought to be implemented and supervised by appropriate mandated institutions and organizations. Basically, there are principal and allied sector institutions that deal with the sanitation issues in Ghana. Below are the principal sector institutions and their functions spelt out in the Ghana Sanitation Policy document:

- 1) *The Ministry of Local Government and Rural Development (MLGRD):-*
The ministry is the lead sector agency whose functions include : co-ordination and formulation of environmental sanitation policy; developing and issuing technical guidelines on environmental sanitation services and their management; promulgation of national legislation and model bye-laws ;and direction and supervision of the National Environmental Sanitation Policy Co-ordination Council (NESpoCC).
- 2) *The Community Water and Sanitation Agency (CWSA):-* This is responsible for sanitation issues in the small towns and the rural areas.
- 3) *The Metropolitan, Municipal and District Assemblies:-* These carry out waste management; public health management; environmental planning and monitoring.

The allied sector institutions and their functions are as follows:

- 1) *The Ministry of Environment, Science and Technology:-* It is responsible for setting standards and guidelines for environmental quality.
- 2) *Educational Institutions:-* These are responsible for hygiene education in schools, universities and technical institutions.
- 3) *Ministry of Health:-*It is responsible for managing and providing health data, supporting hygiene education activities, and contributing to regulations and standard-setting for environmental sanitation services.

The policy document also mentions that the bulk of environmental sanitation services shall be provided by the private sector, including NGOs and the community based organizations under the supervision of the public sector organizations such as the Metropolitan, Municipal and District Assemblies. Specifically, the role of the community should be to:

- establish community environmental sanitation norms in line with the national sanitation policy ;
- undertake community sanitation and hygiene education to create awareness of environmental sanitation issues ;

- maintain a clean, safe and pleasant physical environment in their settlement ;

Then individuals or households should be responsible for:

- temporary storage of wastes within the property and disposal thereof outside the property, as may be directed by the competent authority;
- cleansing within and in the immediate environments of the property they occupy;
- taking measures to prevent the breeding of disease vectors within and in the immediate environments of the property they occupy;
- ensuring that the wider environment is not polluted or otherwise adversely affected by their activities;
- hygienically disposing of all wastes they generate in public areas by use of an authorized public toilet or solid waste container as appropriate;
- participating in all communal environmental sanitation exercises organized by the community or its representatives.

Thus, there exist institutions and guidelines for managing both urban and rural sanitation problems in Ghana. However, these are marred by pertinent institutional problems which include, lack of coordination; and lack of coherence of purpose and actions. These have led to fragmentation in monitoring and evaluation of sanitation activities in the country (Larbi, 2006). The National Environmental Sanitation Policy Coordinating Council (NESPoC) formed in 2000 as a coordinating body to expedite the implementation of the national sanitation policy became dormant in 2002 only to be revived recently (Water-Aid, 2005). The Community Water and Sanitation Agency (CWSA) which is responsible for sanitation issues falls under the Ministry of Works and Housing (MWH), whereas national sanitation issues fall under the ministry of Local Government and Rural Development (MLGRD) (Ghana Ministry of Local Government and Rural Development, 1999), thus creating confusion as to who is specifically responsible for what at national, regional and district levels.

All this has created problems in sanitation project planning, implementation, supervision, monitoring and evaluation.

When it comes to FS emptying and transport, which is the focus of this research, there are three main actors or service operators whose actions count in Ghana. These are the municipal assemblies, the official private operators and the unofficial private operators often called conservancy labourers or scavengers (Boot, 2007). The municipal assemblies and the official private operators use relatively large vacuum tankers, while the unofficial private operators use manual rudimentary tools (Boot, 2007). Apart from the Larsen Dung Beetle equipment which is used to siphon faecal contents of bucket latrines in Accra (See Picture 5.1 below), intermediate technologies are generally not popular among the service providers in Ghana.

Picture 5.1: Larsen Dung Beetle for Emptying Bucket Latrines in Accra



Source: Boots, 2007

As far as bucket latrines are concerned, collection and transporting have been purely manual with or without gloves.

5.3.4 Tamale municipality

Tamale city (See Figures 5.1 and 5.2 below), where the research took place, is the capital of the Northern Region of Ghana. This is the largest region in Ghana in terms of land area, occupying about 70,383 square kilometres (Ghana Statistical Service, 2005). In fact, Tamale is the leading economic hub for all the three regions occupying the northern section of the country viz: the Northern, Upper East and Upper West Regions (see map of Ghana below). In spite of this, Tamale still remains one of the poorest urban settlements in Ghana (Coulombe, 2004; Ghana Statistical Service, 2000), signifying how the whole of the northern sector of Ghana is lagging behind their southern counterparts in socio-economic development. Though the region is drained by two very important rivers, The Black and White Volta, it is relatively dry with almost equal split in the year between rainy and dry seasons (Ghana Statistical Service, 2005). The very low humidity combined with very high diurnal temperatures increase the desiccation properties of the weather, a condition which is good for sludge dewatering and dehydrating purposes.



Figure 5.1: Map of Ghana showing Tamale

Source: Laryea-Adjei, 2006

The municipality has a population of about 342,000 with an annual growth rate of 3.5% which is much faster than the national average of 2.6% per annum (Ghana Statistical Service, 2005). The population density is 318.6 persons per square kilometre. The dominant religion in the region is Islam (about 56.2%), followed by the African Traditional Belief (about 21.3%) and Christian Religion (about 19.3%), while the rest belong to other religious groups (Ghana Statistical Service, 2005).

According to the 2000 Population and Housing Census (Ghana Statistical Service 2005), household sanitation coverage is very low in Tamale district, with about 35% of the inhabitants resorting to open defecation due to lack of household latrines and low use (See Table 5.3 below).

Table 5.3: Percentage use of latrine facilities by the populace in Tamale district.

DISTRICT	WC(%)	PIT LATRINE (%)	KVIP (%)	BUCKET/PAN (%)	FACILITY IN ANOTHER HOUSE(%)	PUBLIC TOILET (%)	NO FACILITY (%)	OTHER (%)
Tamale	8.3	1.4	5.3	6.2	1.4	41.6	35.6	0.2
All districts in Northern Region	2.5	2	2.3	1.6	1	14.5	75.9	0.2

Source: Ghana Statistical Service, 2005

5.3.5 FS generated and reuse opportunities

On the average, a volume of about 31m³ faecal sludge (FS) is reported to be generated annually from on-plot latrines in Tamale (Asare *et al*, 2003). A significant portion of this amount is used for farming to improve crop production. For instance, it is reported that farmers request for the faecal sludge to be discharged on their lands during the dry season so that they can be sanitized to be reused by the farmers. Agriculture, commerce and small-scale industries are the backbone of the local economy. Chief among the crops grown are maize, sorghum, rice, beans and groundnuts, some of which are fertilized with the FS (Laryea-Adjei, 2006).

Apart from the farm reuse of the FS, the rest which is not reused should be well transported and managed to prevent environmental contamination and spread of diseases.

Chapter Five has provided the reasons for the choice for the study area and given background information of the sanitation status in the study area. It has, in particular, highlighted the sanitation problems in terms of finance, policy, institutions and organizations tasked for the sanitation issues. The chapter also provides brief information about the socio-economy, religious and cultural issues that may enhance or constrain sanitation practices in the study area of the city. It then ends on the FS generation, reuse possibilities and opportunities as well the challenges that face effective management of the FS generated in the city.

6. Presentation of results and data analysis

6.1 *Chapter outline*

This chapter presents the quantitative and qualitative results from the household survey, interviews with the sample group of households and other key informants as well as field observations. Data obtained from these sources are presented with the purpose of providing the evidence needed to address the hypothesis and the key research questions posed in the study. The quantitative data analysis is mainly based on household survey results, whilst the qualitative data analysis is based on the focus group discussions, direct observations and interview results from key informants. The qualitative data are not presented in isolation from the quantitative data but are combined in such a way as to triangulate, complement, supplement and buttress the quantitative data.

The chapter is divided into eight main sections deduced from the study framework which include: Background data about the households; Technological issues; Finance issues; Knowledge, attitude and practices issues; Social issues; Latrine access and disposal issues; Display of FS origin-disposal concentrations in the study area; and Reuse issues. With the exception of the section that deals with the 'Background data about the households', at the end of each section there is a box that highlights the main points raised in the section. The extra statistical outputs generated from SPSS 15 which could not be included in the data analyses are attached in the appendix 5.

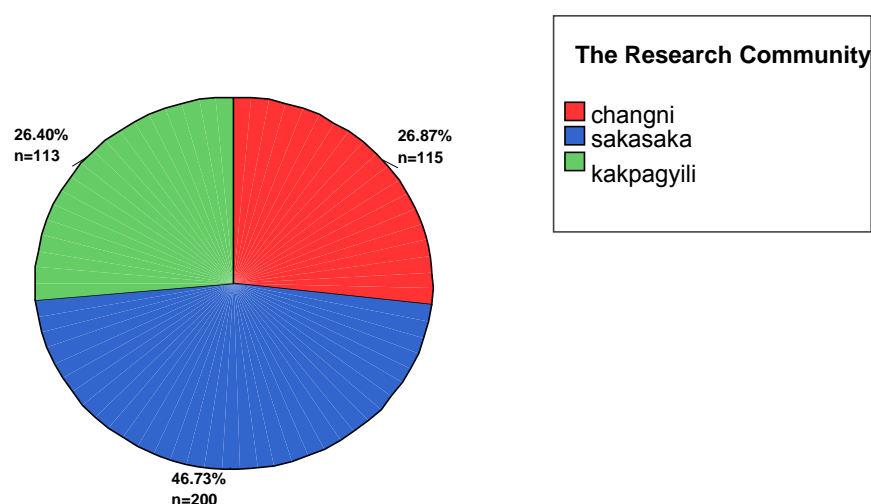
6.2 *Background data about the households*

6.2.1 Household responses

The occupants of the households interviewed were the heads of the households who were either the tenants or landlords. Out of the 600 targeted household responses, 428 responses were found useful for the analysis. 172

households had no latrines to provide emptying and transport data for analysis or the responses provided were not credible enough to be used for the analysis. Notwithstanding this, the responses offered helped to provide enough quantitative data for analysis. Below is a pie chart depicting the responses from the communities surveyed.

Figure 6.1: Percentage of households' responses to the research questions



6.2.2 Socio-economic characteristics

Source of income for the occupants of the households interviewed is displayed in Table 6.1 below. From the table, only 2.8% are farmers; 21.1% traders while 74.7% are civil servants or clerks; 8.9% do miscellaneous jobs for a living. Only 1.4% was unemployed.

Table 6.1: Households' occupation

Job status	Frequency	Percent
unemployed	6	1.4
Civil service	301	70.3
Clerk	19	4.4
business/trader	52	12.1
farmer	12	2.8
miscellaneous	38	8.9
Total	428	100.0

The government is the single biggest employer in the official employment pattern in low-income urban areas (Budhwar and Debrah, 2001). The low-unemployment rate found is consistent with the latest Ghana Living Standard Survey (GLSS) where the average unemployment rate was stated as 3.5% (see Table 6.2 below).

Table 6.2: Ghana national occupational breakdown for population aged 15 to 64, 2005/06

Employment Status	Percentage number of Workers
Private Wage in small firm	6.7
Private Wage in medium firm	1.9
Private Wage in large firm	0.3
Civil servant	4.3
State firm	0.2
Other wage job	0.1
Wage in Agriculture	0.3
Self-employment with no employees	16.6
Self-employment with employees	2.0
Farmer	37.3
Unemployed	3.5
Apprentices	5.5
Out of the labour force (a)**	5.7
Students	12.4
Total	100

Source: Nsowah-Nuamah and Awoonor-Williams (2009).

(a)** Out of the Labour Force excludes students. A small firm is defined as one employing less than 11, a medium size is defined as one employing from 11 to 99 and a large firm as one employing 100 or more. Other wage jobs are a residual category.

Nevertheless these unemployment rates (from the study and that of the GLSS) are inconsistent with the general perception of unemployment rate in the country which is perceived to be higher. The discrepancy may be due to the fact that in Ghana people are shy of being called unemployed and so may not want to be seen as unemployed when interviewed.

If the households' occupations in Table 6.1 above are compared with the occupational monthly income figures in Table 6.3 below, it is evident that income levels in Ghana are relatively low.

Table 6.3: Ghana National Median Earnings (Monthly) in Principal Job for Population aged 15 to 64, 2005/06

Employment status	US\$
Private wage in small firm	55
Private wage in medium firm	77
Private wage in large firm	101
Civil servant	121
State firm	109
Other (e.g. Business)	166
Wage in agriculture	50
Self-employment no employees	48
Self-employment with employees	95
Farmers	21
Apprentices	33

Source: Nsowah-Nuamah and Awoonor-Williams (2009).

6.2.3 Gender

About 97% of the household responses were obtained from males with only 3% of the responses obtained from females. This data reflects the lack of gender balance in the survey. The households' interviews targeted either the owners or the custodians of the households. In the study area, there is strong belief and adherence to cultural and religious beliefs where women are rarely leaders of households. This therefore reflected in the gender data obtained.

Since much of the data collected from the household interviews was used for quantitative analyses which were male biased due to the socio-culture of the community, the researcher interviewed more women for the qualitative analyses to balance gender views.

6.3 Technological issues

This section presents the results and analysis of the technological issues about the latrines and the emptying methods used for emptying the latrines.

6.3.1 Appropriateness of the household (HH) latrines

6.3.1.1 Household latrine technologies

Table 6.4 below is a frequency table that shows the numbers of households using a particular latrine technology.

Table 6.4: Households and their latrine technologies

Latrine Technology	No. of HHs (Frequency)	Percent
Bucket latrine	213	49.8
Simple pit	53	12.4
Double pit	67	15.7
VIP	39	9.1
WC to septic tank	56	13.1
Total	428	100.0

From the frequency distribution table above, 62.2% have bucket and simple pit latrines. 24.8% have single and double VIP latrines, while only 13.1% have WC to septic tanks. This implies that unimproved latrines are significant in the on-plot sanitation system in the study area. Even though there is large number of Muslims in the study area pour flush latrine was not among the latrines surveyed. This may be due to the fact that generally Muslims in the study area use the same anal cleansing materials as the non-Muslims to clean the anus first before using water to finish off cleansing. When asked

why this practice, the response given was that it was difficult to get enough water to clean the anal area completely after defecation and urination and so the ordinary anal cleansing material, such as paper and piece of cloth, is used to assist in cleansing so as to reduce the amount of water needed for the anal cleansing. From the field observations, most of the unimproved latrines were not hygienic (see picture 6.7) because of the way they were built, used and emptied. This therefore has hygienic implications for the communities concerned.

In spite of the above statistics, most of the bucket and simple pit latrine owners preferred the WCs, double pits and the VIPs to the bucket and simple latrines because the latter were perceived as unhygienic. When asked about the popularity of the bucket latrines in the community even though they were not hygienic, one respondent remarked, *“These bucket latrines had been there since colonial times. We were not involved in selecting them. We only came to inherit them after independence (March 6, 1957)”*.

Most of the bungalows with bucket latrines were government owned. According to the local sanitation authorities, the bucket latrine system is to be phased out by the year 2010 in all communities. Therefore all bucket latrine owners should replace them with more improved forms of latrines such as the WCs or VIPs. It was observed that some bucket latrines at the official and institutional buildings were being replaced with WC to septic tanks. However the rate of replacement was very slow since, according to the municipal authorities, there was lack of funding from the government. As for the individual households, only very few were observed to have been converted from bucket latrines to WCs and VIPs.

6.3.1.2: Latrine locations and associated problems

Users were asked about the problems associated with their latrines in terms of their locations. The results are displayed in table 6.5 below.

Table 6.5: Frequency table with expressed problems with latrine location

Expressed Problem with Location	Frequency	Percent
None	332	77.6
Accessibility problem	43	10.0
Latrine close to disposal point***	53	12.4
Total	428	100.0

*****Latrine close to disposal point as a problem to the households means that the relative position of the household's latrine to the disposal point is too close for comfort.**

12.4% of the respondents expressed problems with closeness to disposal points while 10% expressed problems with accessibility. A significant number of respondents (77%), however, said they did not have problems with accessibility or closeness to the disposal point.

Though fewer respondents expressed problems with closeness to disposal points and accessibility, field observation revealed that many of the disposal points for the bucket latrines, in particular, were quite close to the households. Most of the disposal points, though close, were at interfaces (no-man's-lands) which were not within the jurisdictions of the households; and this may explain why not many residents expressed problems with the disposal points which were quite close to them.

6.3.1.3: Expressed satisfaction with the location of the latrines

It was observed that all the WCs and most of the double and single VIP latrines were located within the houses. The bucket latrines were semi-detached from the houses; while the simple pits were a bit distant from the houses but within the household yard. Thus with the degree of proximity to the households, WC latrines> VIPs>Bucket latrines>Simple pits.

Households were therefore asked about their satisfaction with the locations of their latrines with respect to proximity to dwelling place and use. Their responses are reflected in the frequency table below.

Table 6.6: Frequency table for levels of satisfaction with latrine position

	Frequency	Percent
Indifferent	103	24.1
satisfied	203	47.4
dissatisfied	122	28.5
Total	428	100.0

From the Table 6.6 above, 47.4% of the respondents were satisfied with the places where their latrines had been positioned; but 28.5% were dissatisfied; while 24.1% were indifferent.

When these satisfaction levels were cross tabulated with the latrine technology in Table 6.7 below, it emerged that, within the latrine technology, those with improved forms of latrines were more satisfied: i.e. 96.4% of respondents who had WCs in their households were satisfied with the positions of their latrines, followed by those with single VIP (79.5%); and Double pits (70.1%). Within the latrine technology in the cross tabulation, relatively few respondents of 30.2% and 25.8% with simple pits and bucket latrines respectively were satisfied. Thus, as far as dissatisfaction was concerned, those with bucket and simple pit latrines were the most dissatisfied.

Some residents were unhappy with the position of their bucket latrines which were close to the main entrance to their houses. Besides, the level of dissatisfaction tends to follow the degree of distance of the latrine from the dwelling place. This may stem from convenience and security. As one female user in a household with detached simple pit explained, “ *During late night, I do it (defecate) into a plastic bag and then throw it into the pit early in the morning because I am afraid to get out of my room and visit the latrine alone* ”. Another female also added that she was afraid to visit their detached simple pit latrine alone in the night because of possible encounter with snakes which prey on the mice.

Table 6.7: Levels of satisfaction with latrine location * Latrine technology cross tabulation

			Latrine Technology					
			Bucket latrine	Simple pit	Double pit	VIP	WC to septic tank	Total
Levels of satisfaction with latrine location	Indifferent	Count	77	17	7	2	0	103
		Expected Count	51.3	12.8	16.1	9.4	13.5	103.0
		% within Levels of satisfaction with latrine location ***	74.8%	16.5%	6.8%	1.9%	.0%	100.0%
		% within Latrine Technology***	36.2%	32.1%	10.4%	5.1%	.0%	
		% of Total	18.0%	4.0%	1.6%	.5%	.0%	24.1%
	satisfied	Count	55	16	47	31	54	203
		Expected Count	101.0	25.1	31.8	18.5	26.6	203.0
		% within Levels of satisfaction with latrine location	27.1%	7.9%	23.2%	15.3%	26.6%	100.0%
		% within Latrine Technology	25.8%	30.2%	70.1%	79.5%	96.4%	
		% of Total	12.9%	3.7%	11.0%	7.2%	12.6%	47.4%
	dissatisfied	Count	81	20	13	6	2	122
		Expected Count	60.7	15.1	19.1	11.1	16.0	122.0
		% within Levels of satisfaction with latrine location	66.4%	16.4%	10.7%	4.9%	1.6%	100.0%
		% within Latrine Technology	38.0%	37.7%	19.4%	15.4%	3.6%	

		% of Total	18.9%	4.7%	3.0%	1.4%	.5%	28.5%
Total	Count		213	53	67	39	56	428
	Expected Count		213.0	53.0	67.0	39.0	56.0	428.0
	% within Levels of satisfaction with latrine location		49.8%	12.4%	15.7%	9.1%	13.1%	100.0%
	% within Latrine Technology		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	% of Total		49.8%	12.4%	15.7%	9.1%	13.1%	100.0%

Note *** The SPSS 15 calculates ‘within levels of satisfaction’ figures by expressing the individual counts in the row against the total in the row to obtain the respective percentages. Similarly, the ‘within technology’ calculation is done by expressing the individual counts in the column against the total column count to obtain the respective percentages. **These calculations happen in all the SPSS cross tabulations in the other tables..**

6.3.1.4 Reasons for latrine choice

A response from Section 6.3.1.1 suggests that some users were not involved in choosing their latrines. They inherited them. Further investigation revealed that those who inherited the latrines, and therefore were not involved in choosing the latrines, were family heads who were tenants.

From Table 6.8 below 39.5% of respondents (who were tenants) did not choose to build the latrines that they were using, leaving 60.5% of respondents who were landlords to make a choice of their latrines. With the landlords, the majority stated convenience (27.1%) as a reason for their choice. This is followed by affordability with 17.3%; hygiene, 6.8%; security, 5.4% and prestige, 4%. These figures highlight convenience and affordability as good sensitization tools to encourage latrine construction in the communities.

Table 6.8: Frequency table showing reasons for latrine choice

Reasons for Latrine choice	Frequency	Percent
prestige	17	4.0
convenience	116	27.1
security	23	5.4
affordability	74	17.3
did not choose	169	39.5
hygiene	29	6.8
Total	428	100.0

When the users' (both the tenants and the landlords) reasons for preference of a particular latrine technology were cross tabulated with the latrine types in chi-square analysis (See Table 6.9 below. The reading of the values in the table follows that of Table 6.7 in Section 6.3.1.3), the results (see Appendix 5) showed that within the latrine technology, the affordability reason was mostly assigned to simple pit (49.1%) and bucket latrines (18.3%); whereas convenience was the most reason assigned to double pits (61.2%), WC to septic tanks (60.7%) and VIP (48.7%). The bucket latrine was the least

convenient (3.3%) followed by the simple pit latrine with (28.3%). This implies that convenience and affordability could play important roles in the choice of latrine technology.

It is noted in the statistical figures that the double pit is slightly more convenient to users than the WC. The reason for this could be ascribed to the explanation given by one respondent who said that: *"Sometimes the WC is not flushed off after use because of lack of water....and the presence of the excreta in the WC bowl is not pleasant to look at all"*. This gives an impression that even the most improved form of latrine might become less convenient if it does not function properly. In another development, a wife of one landlord disagreed with the husband choice of convenience for WC instead of VIP. According to her, she had to work hard to find sufficient water for the flushing of the WC latrine daily. Therefore she did not find the WC as convenient, in this case, as the VIP which does not require water to flush.

Table 6.9: Reasons for choice of latrine technology

			Latrine Technology					
			Bucket latrine	Simple pit	Double pit	VIP	WC to septic tank	Total
Reason for Latrine tech choice	prestige	Count	2	1	3	2	9	17
		Expected Count	8.5	2.1	2.7	1.5	2.2	17.0
		% within Reason for Latrine tech choice	11.8%	5.9%	17.6%	11.8%	52.9%	100.0%
		% within Latrine Technology	.9%	1.9%	4.5%	5.1%	16.1%	
		% of Total	.5%	.2%	.7%	.5%	2.1%	4.0%
	convenience	Count	7	15	41	19	34	116
		Expected Count	57.7	14.4	18.2	10.6	15.2	116.0
		% within Reason for Latrine tech choice	6.0%	12.9%	35.3%	16.4%	29.3%	100.0%
		% within Latrine Technology	3.3%	28.3%	61.2%	48.7%	60.7%	
		% of Total	1.6%	3.5%	9.6%	4.4%	7.9%	27.1%
	security	Count	7	5	3	3	5	23
		Expected Count	11.4	2.8	3.6	2.1	3.0	23.0
		% within Reason for Latrine tech choice	30.4%	21.7%	13.0%	13.0%	21.7%	100.0%
		% within Latrine Technology	3.3%	9.4%	4.5%	7.7%	8.9%	
		% of Total	1.6%	1.2%	.7%	.7%	1.2%	5.4%
	affordability	Count	39	26	4	1	4	74

	Expected Count	36.8	9.2	11.6	6.7	9.7	74.0
	% within Reason for Latrine tech choice	52.7%	35.1%	5.4%	1.4%	5.4%	100.0%
	% within Latrine Technology	18.3%	49.1%	6.0%	2.6%	7.1%	
	% of Total	9.1%	6.1%	.9%	.2%	.9%	17.3%
did not choose	Count	157	2	4	3	3	169
	Expected Count	84.1	20.9	26.5	15.4	22.1	169.0
	% within Reason for Latrine tech choice	92.9%	1.2%	2.4%	1.8%	1.8%	100.0%
	% within Latrine Technology	73.7%	3.8%	6.0%	7.7%	5.4%	
	% of Total	36.7%	.5%	.9%	.7%	.7%	39.5%
hygiene	Count	1	4	12	11	1	29
	Expected Count	14.4	3.6	4.5	2.6	3.8	29.0
	% within Reason for Latrine tech choice	3.4%	13.8%	41.4%	37.9%	3.4%	100.0%
	% within Latrine Technology	.5%	7.5%	17.9%	28.2%	1.8%	
	% of Total	.2%	.9%	2.8%	2.6%	.2%	6.8%
Total	Count	213	53	67	39	56	428
	Expected Count	213.0	53.0	67.0	39.0	56.0	428.0
	% within Reason for Latrine tech choice	49.8%	12.4%	15.7%	9.1%	13.1%	100.0%
	% within Latrine Technology	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	% of Total	49.8%	12.4%	15.7%	9.1%	13.1%	100.0%

6.3.1.5 Inappropriate latrines, uses and open defecation

Field observation revealed that some double pit latrines were improperly used because all the pits were being used concurrently which created mess and manual emptying problems (See Picture 6.1 below).

Picture 6.1: Double pits being used concurrently



- Double alternating VIP used concurrently
- Urine mixed with anal cleansing papers

(Source: Author's field work, 2007)

In another observation, a single VIP latrine was found inappropriate in terms of the size of the cubicle, ventilation system and use (see Picture 6.2 below).

Picture 6.2 : Inappropriate latrine cubicle with excreta and phlegm smeared walls and floor



Note the following about this latrine:

- smallness of the cubicle size that could not allow use of anal cleansing bin.
- the way the anal cleansing materials are dropped into the pits and spread around
- the wall smeared with shit (shooting diarrhoea) and sputum

(Source: Author's field work, 2007)

The cubicle size in Picture 6.2 was so small that when the researcher tried to use the latrine, his shoulders touched the dirty walls smeared with excreta and sputum. This raises hygienic concerns for the users of this latrine. Besides, the stench and the heat in the latrine were unbearable due to the lack of ventilation.

The smelly cubicles combined with lack of hygiene and proper ventilation encouraged some users to go for open defecation. This is confirmed by one respondent who remarked, *“Those who practise open defecation think that it allows free air circulation and avoids stench and heat that is experienced in the latrine cubicles without much ventilation”*. He added, *“Open defecation is even practised by the elites who want to escape the heat and the smell from the latrines”*. This underscores the need to develop latrines well to encourage proper use. It also depicts the scale of the open defecation problem in certain communities in the study area where even the elites are to blame for the open defecation practice. Also from picture 6.3 below, it could be inferred that large scale open defecation is tantamount to indiscriminate excreta or FS dumping in the community.

Picture 6.3 : Large scale open defecation in Tamale



(Source: Author's field work, 2007)

It is evident from Pictures 6.1 and 6.2 that anal cleansing materials were not disposed off into anal cleansing bins. They were rather found inside and outside the pits. When asked why there was an absence of anal cleansing bins on the latrines, the response was that there was no need for the bins

because the anal cleansing materials were daily swept and burnt outside the latrines. But it was observed that the wet papers were not properly burnt and so were scattered around the vicinity of the latrines creating hygienic and aesthetic mess. Besides, the cubicle in Picture 6.2 was too small to allow space for an anal cleansing bin.

6.3.2 Number of users per latrine

Number of users per latrine in the household is displayed in Table 6.10 below.

Table 6.10: Number of residents using Latrine * Latrine technology cross tabulation*****

		Latrine Technology					
		Bucket latrine	Simple pit	Double pit	VIP	WC to septic tank	Total
No. of residents using Latrine	4	4	0	0	0	2	6
	5	12	6	5	0	1	24
	6	32	4	15	9	4	64
	7	59	2	4	4	11	80
	8	64	12	15	15	15	121
	9	41	9	10	3	11	74
	10	1	9	13	3	9	35
	11	0	5	2	0	3	10
	12	0	2	1	5	0	8
	13	0	3	2	0	0	5
	14	0	1	0	0	0	1
	Total	213	53	67	39	56	428

***** The numbers in the table are actual numbers, not percentages

Table 6.10 above shows that 8 users per latrine occurred as the most frequent number in all the latrines. This number is followed by 7 and 9 users per latrine respectively. Further investigation revealed that there was shared use of some latrines by neighbours. This, together with regular visitors, as one respondent explained, could put strain on the latrine use in the households with access to only one latrine. One respondent added, "When many people in the

household are using one latrine, it is uncomfortable because household members can wait for long time before gaining access to the latrine, especially during the morning. Also some people mess up the latrine with their urine, phlegm and faeces when they use the latrine, making it uncomfortable to use it after them". This implies that the relatively high number of users per latrine in the study area should be considered for planning purposes as far as household latrine size and use are concerned.

6.3.3 Pit/Tank emptying and bucket collection times

6.3.3.1: Pit and tank emptying times

Pits and WC to septic tanks were cross tabulated with their re-emptying times and the results are as displayed in Table 6.11 below.

Table 6.11: Pit or tank re-emptying times in cross tabulation

			Latrine Technology				
			Simple pit	Double pit	VIP	WC to septic tank	Total
Pit or Tank reemptying Time	Unknown	Count	0	2	2	9	13
		Expected Count	3.2	4.1	2.4	3.4	13.0
		% within Pit or Tank reemptying Time	.0%	15.4%	15.4%	69.2%	100.0%
		% within Latrine Technology	.0%	3.0%	5.1%	16.1%	
		% of Total	.0%	.9%	.9%	4.2%	6.0%
1-2years		Count	8	5	1	3	17
		Expected Count	4.2	5.3	3.1	4.4	17.0
		% within Pit or Tank reemptying Time	47.1%	29.4%	5.9%	17.6%	100.0%
		% within Latrine Technology	15.1%	7.5%	2.6%	5.4%	
		% of Total	3.7%	2.3%	.5%	1.4%	7.9%
>2-3years		Count	2	6	5	5	18
		Expected Count	4.4	5.6	3.3	4.7	18.0

	% within Pit or Tank reemptying Time	11.1%	33.3%	27.8%	27.8%	100.0%
	% within Latrine Technology	3.8%	9.0%	12.8%	8.9%	
	% of Total	.9%	2.8%	2.3%	2.3%	8.4%
>3-4years	Count	39	47	24	38	148
	Expected Count	36.5	46.1	26.8	38.5	148.0
	% within Pit or Tank reemptying Time	26.4%	31.8%	16.2%	25.7%	100.0%
	% within Latrine Technology	73.6%	70.1%	61.5%	67.9%	
	% of Total	18.1%	21.9%	11.2%	17.7%	68.8%
5-6years	Count	4	7	7	1	19
	Expected Count	4.7	5.9	3.4	4.9	19.0
	% within Pit or Tank reemptying Time	21.1%	36.8%	36.8%	5.3%	100.0%
	% within Latrine Technology	7.5%	10.4%	17.9%	1.8%	
	% of Total	1.9%	3.3%	3.3%	.5%	8.8%
Total	Count	53	67	39	56	215
	Expected Count	53.0	67.0	39.0	56.0	215.0
	% within Pit or Tank reemptying Time	24.7%	31.2%	18.1%	26.0%	100.0%
	% within Latrine Technology	100.0%	100.0%	100.0%	100.0%	100.0%
	% of Total	24.7%	31.2%	18.1%	26.0%	100.0%

The cross-tabulation shows that the mode for re-emptying time for all the pits and the septic tanks is 3-4 years. All things being equal, this information could be used by the households to plan and budget for re-emptying of their pits. However, the municipal technical officer in charge of solid and liquid wastes in the study area stated that some of the pits got filled up more quickly during the rainy season because rain and flood water got inside the pits. Field observation revealed a scenario of broken slab covers of some pits which could allow rain or flood water to get inside the pits. This scenario, together with FS accumulation, could affect the re-emptying time and possible destruction of the latrines.

There are two seasons in the study area: the rainy and dry seasons. During the dry season the demand for FS is high because more farmers need FS to dry and sanitize in preparation for reuse during the rainy season. Thus, in the rainy season less fresh FS is required by farmers. But according to the principal sanitary engineer, much more FS is emptied during the rainy season than during the dry season because of the rain and flood water infiltrating into the poorly constructed pits. This implies that poor design of latrines could lead to the increase in the rate of excreta emptyings and disposals in the city. Users interviewed confirmed that a great deal of pit emptying went on during the rainy season.

6.3.3.2: Bucket latrine collection times

Bucket latrines were separated from the other latrines in the previous section because bucket latrines are collected and emptied within days and not years. Below is the table depicting the re-emptying times for the bucket latrine system.

Table 6.12: Number of times bucket is collected/wk from the households

		Number of times Pan or bucket is collected/wk		
		Once	Twice	Total
Latrine Technology	Bucket latrine	25	188	213
	Total	25 (11.7%)	188(88.3%)	213(100%)

From the Table 6.12 above, more buckets are collected twice a week (88.3%) than once a week (11.7%). Therefore, both households and emptiers should expect an average of twice a week emptying requirements of the bucket latrines. The bucket latrine system could be a health hazard if the filled-up buckets are not handled and transported efficiently. For example, Picture 6.4 below from the field studies reveals how poorly some buckets latrines were designed and handled in the study area. Ordinary metal buckets of about 18 litres were used. Some buckets filled up and spilled over and so made it unhygienic to carry them. The spill over could spread around the vicinity of the

buckets (see Picture 6.4 below). As one respondent remarked, *“Sometimes the bucket latrines fill-up completely and spill over before they are emptied”*.

The buckets lacked handles and so, in a situation where the emptiers had to lift them with both hands without hand gloves, there is possibility of direct contact with the excreta which could lead to infection of the emptiers and spread of diseases in the neighbourhood. All this has implications for health and safety issues for the households, the bucket collectors, as well as the neighbourhood. One medical doctor interviewed confirmed this suspicion by remarking that there was high rate of diarrhoeal and stomach ache cases in the community where bucket latrines were prevalent.

Picture 6.4: Unhygienic bucket latrine system in Tamale



Note the spill around that could serve as breeding haven for germs and mosquitoes

(Source: Author's research field work, 2007)

6.3.3.2.1 User and collection frequency of buckets

When the users were matched against the bucket filling and collection times the results are as displayed in table 6.13 below.

Table 6.13: Users and collection frequency of buckets' cross tabulation

No of residents using bucket latrine	Number of times bucket is collected/wk		
	once	twice	Total
4	2	2	4
5	1	11	12
6	14	18	32
7	2	57	59
8	5	59	64
9	1	40	41
10	0	1	1
Total	25	188	213

In the majority of cases, twice a week emptying occurs with households of more than 6 users. Thus, assuming that the same bucket sizes are used in the households and other things being equal, emptiers and households should expect twice-weekly emptying in the households with 7 or more users. Respondents remarked that apart from the regular users, some visitors and neighbours patronize in their latrines and this contributed to the filling rate of the bucket latrines.

6.3.4: Latrine volumes emptied per given time

The depth of the pits and tanks were measured with stick and this was multiplied by the cross section of the pit or tank to obtain the volumes of the pits and tanks. Then the volumes were used as proxy for the amount of FS collected per emptying or collection period. This is because there were no statistical records to ascertain how much FS was emptied by the emptiers per emptying or collection period. The volumes of the buckets and pits/tanks were calculated as follows (See appendix 6 for further information):

a) For a bucket latrine:

The average volume collection per year in a household = (Number of collections done in a household per week) x (52 weeks/year x volume of the household bucket).

b) For a pit latrine or tank:

The average volume emptied per year in a household = Volume of pit or tank emptied per re-emptying period /the number of years in the re-emptying period

When the above formulae were applied on the latrines, it was found out that volume of FS emptied in 70% of all pits and septic tanks was 1.3m³ per household per year (See Table 6.14 below). With an average of 8 persons per household, this translates into a sludge collection rate of 162.5l/p/y. This figure is close to Harvey's (2007) solid sludge accumulation rate of 182.5l/p/y in emergency situations cited in the literature (Section 2.4.3).

Also in the case of the bucket latrines, the average volume emptied from 87.8% of bucket latrines was 1.8m³ per household per year (See Table 6.15 below). With 8 persons in a household, this translates into 225l/p/y. This figure is close to Harvey's (2007) emergency solids plus urine accumulation rate of 292l/p/y. The difference between the volume emptied from pits and septic tanks on one hand, and that of the bucket latrines on the other, may be due to seepage, drainage, decomposition and solidification processes which could occur in the pits and septic tanks with time. This implies that much more excreta is expected to be emptied from buckets per given period than from the pits since excreta in the buckets are fresh and undigested with more liquid stuff without seepage or drainage.

Table 6.14: Pit/Tank volumes emptied per yr

Vol.(M ³) emptied/yr	Latrine Technology				
	Simple pit	Double pit	VIP	WC to septic tank	Total
0.5	1	0	0	0	1
0.7	5	0	1	0	6
0.8	3	4	4	0	11

1.0	2	1	4	2	9
1.3	33	48	26	43	150(69.8%)
1.7	6	3	1	2	12
1.8	0	6	3	6	15
3.0	3	5	0	3	11
Total	53	67	39	56	215

Table 6.15: Average volume collection of bucket per year in households

Lat Vol. emptied per yr (M ³)	Bucket Latrine	
	Number	Total
0.9	25	25(11.7%)
1.0	1	1(0.5%)
1.8	187	187(87.8%)
Total	213	213

6.3.5: Latrine emptiers and their emptying practices

This section specifies who do the emptying services in the study area and their modus operandi.

6.3.5.1: The latrine emptiers

The Table 6.16 below shows which latrine is emptied by which type of emptier.

Table 6.16: Emptiers for the pits and septic tanks

The Latrine Emptiers	The Latrine Technology				
	Simple pit	Double pit	VIP	WC to septic tank	Total
Conservancy labourer(scavenger)	52	38	23	0	113(52.6%)
Municipality	1	11	8	27	47(21.9%)
Private service operators	0	18	8	29	55(25.6%)
Total	53	67	39	56	215

From the table, the conservancy or informal manual emptiers (also called scavengers in this study) dominate the pit emptying services (52.6%), while the municipality and the private service operators (which are state institutions but double as private operators) are significantly involved in the septic tanks with some participation in the pit emptying as well. All the WC to septic tanks were mechanically emptied. The bucket latrine collectors and manual pit emptiers have mainly come from the Frafra tribe in the upper-east region of Ghana (Van der Geest, 2002) where the poverty level is relatively high. The mechanical emptiers interviewed mentioned that two people were usually involved in the mechanical emptying: the driver, and the helper who carried the siphoning tube into the pits for siphoning the excreta. All the institutional emptying drivers and their helpers were employees who were paid by their respective institutions. Therefore the monies collected from emptying were offered to the institutions.

The manual emptying of pit latrines was done by a team, consisting of at least two men in an ad hoc team which was informally organized. The size of the team depended on the size of the pit and the amount of work involved. One manual emptier told the researcher that before they embarked on manual emptying of pits, they ate heavily to fill their bellies since they could not eat in between the process. Some also, in addition, drank relatively cheap locally manufactured hard liquor called, "akpeteshie" to overcome the strong stench and stigma attached to their work. One manual emptier sang a derogatory song about excreta emptying (See Box 6.1 below) which people sing with derision.

Box 6.1 A derogatory song about the manual emptiers

"I have been emptying all kinds of shit everyday"

"I have been emptying all kinds of shit everyday"

Chorus

Men's shit! Women's shit!!

Boys' shit! Girls' shit!!

All the emptying and transport business for cash was carried out by men who were not necessarily residents of the households. Some respondents complained about the unreliability of the municipal service operators to respond to the call for duty. They also had bureaucratic problems reaching the formal private institutional service operators for service. They however expressed that it was relatively easier getting access to the manual operators for duty through mobile phones and personal one-on-one contact.

6.3.5.2: Means of emptying pits or collecting excreta/FS

The means of emptying the pits or collecting the excreta or FS were found to be both manual and mechanical.

6.3.5.2.1 Means of emptying pits

The proportion of means of emptying pit latrines is displayed in Table 6.17 below.

Table 6.17: Means and tools of emptying pit latrines

How emptying is done	Latrine Technology			
	Simple pit	Double pit	VIP	Total
Manual with simple hand tools	52	37	23	112(70.4%)
Mechanical with suction equipment	1	30	16	47(29.6%)
Total	53	67	39	159

From Table 6.17 above, 70.4% of the pits were manually emptied, while only 29.6% of the pits were mechanically emptied. This implies that manual emptying was dominant in the pit latrines. All the septic tanks (100%) were mechanically emptied. From the table it seen that all the manual emptying was done with the manual tools whereas all the mechanical emptying was done with the suction equipment.

Whilst the suction equipment was imported, the simple hand tools were mainly locally manufactured tools. The manual emptiers were not content with their emptying tools as they said the tools made them get too close to the excreta. The emptiers with the suction equipment were however mostly happy with their emptying equipment. Those that were not completely happy were the municipal emptiers who complained about the frequent breakdown of the municipal emptying trucks.

6.3.5.2.2 Means of collecting excreta/FS

All the bucket latrines (100%) were manually collected. The means of collecting bucket latrine was significantly different from the other manual emptying operations in terms of operational tools and times of emptying. Bucket collection was done with hands which could be bare or gloved. Brooms were used to assist in clearing the leftovers in the buckets after disposing of the contents. While pit latrines were emptied during the day, bucket latrines were collected at dawn. The bucket emptiers interviewed said they preferred the dawn collection because it helped them to avoid walking through the crowd and therefore public stigma. As one emptier puts it, *“ When people see you carrying their excreta, instead of greeting you, they rather move away from you in reproach as if you are the same as the excreta you are carrying. To me, this is very painful”*.

The following observation made by the researcher in Box 6.2 below depicts the modus operandi of the bucket emptiers:

Box 6.2: Observed modus operandi of bucket latrine collector in

Tamale

' I (the researcher) met Zeba at about 1 a.m. at a designated meeting place. He was carrying on his head an empty pan while holding in his hand a torch light. He was wearing a pair of sandals, shorts and some tattered shirt. Upon reaching his first bucket to be emptied, he put down the bucket he was carrying, lit the torch light in the direction of the bucket latrine and opened the door leading to the bucket filled with human excreta. Immediately he opened the door the obnoxious smell of the excreta was very intense. I (the researcher) spat several times while Zeba did not show any sign of abhorring the stench. He then put the torch still lit down so that he could use the two hands without gloves to pull the bucket out. He poured the content of the bucket into his own pan, and walked to a distance of about 50 metres from the collection point and dumped the shit into a shallow trench. I (the researcher) asked whether he would cover it and he said he would do so after adding few more shit from the neighbourhood".

(Source: Authors Field Observation, 2007)

Significance of the findings here are that:

- Manual simple hand tools dominate pit and bucket emptying.
- Bucket emptying takes place at dawn.

6.3.9: Emptying problems and satisfaction

This section has two sub-sections. Sub-section 6.3.9.1 deals with the problems enlisted by the households about emptying of their latrines, while In the study area, only men were involved in the bucket collection. Women were involved in cleaning the latrines, disposed of anal cleansing materials and the excreta of infants (with or without nappies) as well as that of the vulnerable. They did this for free as part of their household chores. The following is an observation made about a mother collecting her child's excreta in the study area:

"A child had defecated watery stool (possibly suffering from diarrhoea) amidst houseflies hovering all over the vicinity and landing to and fro on the stool. After defecation, the mother came to sweep the stool with a broom and a flat metal piece to help collect the stool. Due to the nature of the stool, the mother

put onto the stool some amount of dust, apparently to solidify the stool to make it easier to sweep. After sweeping, the tip of the broom was full of nodules made up of mixture of dust and the stool. The swept stool was disposed off into household garbage bin which was a laminated basket, whilst the 'contaminated' broom was put at a corner"

Deductions from this observation are that, the broom left in the household with the stool nodules at the tips of the broom can act as multiple sites for germs which could potentially spread diarrhoeal diseases. Besides, the container into which the collected stool was dumped could also act as a source of attraction for flies and further increase the multiplication sites for germs which could increase the rate of incidence of diseases. This means that there is the need to assist women, particularly mothers, in the low-income communities to properly handle and move the faecal matter of their children to safe disposal points in order to uphold hygienic principles in the households.

6.3.6 Emptying problems and users' satisfaction

6.3.6.1 List of emptying problems

From the Table 6.18 below, The key problems mentioned in decreasing order by respondents were mess (22%), cost (5.9%) accessibility to trucks (10%) and frequency of emptying (5.8%). One female interviewee remarked that:

" It is very disgusting to clean up so much mess after the manual emptiers have emptied the latrines and left. This makes us work as assistant emptiers but without pay from the emptiers" The mess could be a source of infection to households and pollution to the environment. This means that emptiers and their modus operandi play a key role in health and safety issues of households.

Table 6.18: List of emptying problems

Emptying problems	Frequency	Percent
None	198	46.3
Frequency	25	5.8
Cost	68	15.9
Access to truck	43	10.0
Mess	94	22.0
Total	428	100.0

When these problems were linked with the latrines in a cross tabulation (See Table 6.19 below), the results showed that, within the latrine technology, bucket latrines scored the highest problems in terms of frequency (11.3%) and mess (34.3%). The simple pit latrine was next messy (22.6%) after the bucket latrine. The mess was mainly due to lack of cleaning after emptying and the manual means of emptying the pits or collecting the excreta from the bucket latrines. Manual emptying and collection was therefore messier.

From the cost figures in the cross tabulation, most households expressed that other latrines, with the exception of WC to septic tanks, were more costly to empty than the bucket latrine system. Also WC to septic tanks which were mainly mechanically emptied were seen as more cost effective than the other latrines which enjoyed both manual and mechanical emptying. Access problem for trucks affected to a large extent the simple pits and to a lesser extent the double pits, single VIPs and bucket latrines respectively. According to the users, WC to septic tanks did not suffer any accessibility problems.

Table 6.19: List of emptying problems on the latrine technology

List of emptying and Transport problems	Latrine Technology					
	Bucket latrine	Simple pit	Double pit	VIP	WC to septic tank	Total
None	102	2	21	19	54	198
Frequency ***	24 (11.3%)	0	0	1	0	25

Cost	7	23	28	8	2	68
Access to truck	7	16	12	8	0	43
Mess ***	73 (34.3%)	12 (22.6%)	6	3	0	94
Total	213	53	67	39	56	428

*** The percentages expressed in the table are based on comparing a value with the corresponding column total within the latrine technology.

6.3.6.2: Satisfaction with the emptying method

When users were asked about their satisfaction levels with the emptying method, their responses were analysed in a chi-square analysis which yielded the following results in Table 6.20 below:

The chi-square tests showed significant relationship between the satisfaction levels and the method of emptying in the study area at $p < 0.005$ (see Appendix 5). Within the emptying method 98% of respondents who had their latrines mechanically emptied stated they were either very happy or happy with the practice. On the other hand, 56.7% of the respondents expressed that they were either unhappy or very unhappy with the manual method, while 24% of respondents were indifferent to the manual method. Thus, mechanical emptying was highly favoured. Although manual emptying was not very much liked, there were others who might not mind (see the indifferent figure) going for it, especially when it is properly conducted. Qualitative interviews also confirmed that many of the respondents were in favour of the mechanical emptying because it was less messy and more efficient. For example one respondent remarked: *" Manual emptiers are slow. They work with very simple tools which make their emptying messy. And when they are emptying, the residents leave the house to avoid the strong stench and the flies that the emptied excreta attract. The whole scene is really bad to look at! But the mechanical emptiers do empty faster with none or minimal mess. We watch them as they empty"*

Table 6.20: Satisfaction levels with emptying methods/means

Emptying method/means		Satisfaction with Emptying method					
		Indifferent	Very happy	Happy	Unhappy	Very unhappy	Total
Manual	Count	78	1	62	138	46	325
	Expected Count	60.0	49.4	75.2	105.5	34.9	325.0
	% within emptying method	24.0%	.3%	19.1%	42.5%	14.2%	100.0%
	% within Happiness with Emptying method	98.7%	1.5%	62.6%	99.3%	100.0%	
	% of Total	18.2%	.2%	14.5%	32.2%	10.7%	75.9%
Mechanical	Count	1	64	37	1	0	103
	Expected Count	19.0	15.6	23.8	33.5	11.1	103.0
	% within emptying method	1.0%	62.1%	35.9%	1.0%	.0%	100.0%
	% within Happiness with Emptying method	1.3%	98.5%	37.4%	.7%	.0%	
	% of Total	.2%	15.0%	8.6%	.2%	.0%	24.1%
Total	Count	79	65	99	139	46	428
	Expected Count	79.0	65.0	99.0	139.0	46.0	428.0
	% within emptying method	18.5%	15.2%	23.1%	32.5%	10.7%	100.0%
	% within Happiness with Emptying method	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	% of Total	18.5%	15.2%	23.1%	32.5%	10.7%	100.0%

Box 6.3: Key emptying and disposal findings from the technological issues

- Mere presence of household latrines does not stop indiscriminate disposals unless the latrines are in good condition and users are willing to use them.
- Simple pit latrines in the study area are the most inaccessible to mechanical emptying.
- Mechanical emptying was preferred because it was effective and not messy
- Instead of hygiene, convenience and affordability were the leading factors for choice of latrine technologies for landlords.
- Manual emptying was informal, unregulated and messy
- Informal excreta collection and disposal within the households by women could result in hygiene and health problems.

6.4 Finance issues

This section discusses the finance issues regarding the emptying and transport services for the FS. The issues raised are about the prices charged for bucket and pit/tank emptying per period and the user or customer satisfaction for the charges.

6.4.1: Prices for emptying and collection services

The prices are divided into pit emptying and collection of bucket latrines

6.4.1.1 Prices for pit emptying

With the entire pit latrines surveyed (See table 6.21 below), 53% were emptied at a price range of GHC250-GHC300 per emptying operation. This is followed by a price range of GHC20-GHC30 (24.2%) per emptying operation; and GHC10-GHC15 range (22.8%) respectively. The highest price range, GHC250-GHC300, for pit emptying was charged by the private manual

emptiers. This compares well with the pit emptying figure in South Africa mentioned in the literature (Section 2.7.2.1) which could go as high as about \$243. The next higher price ranges, i.e. GHC20-GHC30 were charged by the other two institutional emptiers (The prison Services and the University of Development Studies) who doubled as private operators, while the lowest charge range, GHC10-GHC15, was charged by the municipal emptiers.

Table 6.21: Price range for pit/tank emptying per time

Price range ***	Latrine Technology				
	Simple pit	Double pit	VIP	WC to septic tank	Total
10-15Gh cedis	1	12	8	28	49(22.8%)
20-30Gh cedis	0	16	8	28	52(24.2%)
250-300Gh cedis	52	39	23	0	114(53%)
Total	53	67	39	56	215

*** As at the time of the research (2007), 1GHC = 1\$

It must be stated that all the institutional emptying (the municipal, the prison services and the University of the Development Studies) subsidized the price of emptying since they were not operating at the real market rate. It emerged from the users interviewed that prices for emptying the pits varied according to one's negotiation skills and familiarity with the emptier. However, according to the emptiers interviewed, they charged according to the difficulty of emptying and size of the pits. For instance, in pits where large amounts of non-faecal stuff, such as metal and wooden pieces, were found that posed danger to the manual emptiers, they charged more than when no known obstructive and injurious objects were found. When asked whether any subsidy was offered to them, the manual emptiers said that they did not receive subsidy from anyone. When asked in the focus group discussion, why they used only simple hand tools for emptying, the manual emptiers remarked that the price for buying the conventional or advanced emptying equipment was too expensive for them. *"It is impossible for us to buy one of these machines (emptying trucks) even if we put our lifetime earnings together as a group"*, retorted one conservancy (informal manual emptier) focus group member. Neither the municipality nor the institutional emptying operators bought their emptying equipments. They were supplied by the government.

6.4.1.2 Prices for collecting bucket latrines

From the Table 6.22 below, most of the bucket latrines were collected at a fee range of GHC0.50-GHC0.55 per collection time.

Table 6.22: Cost range for collecting bucket at a time

Price range/ collection period	Latrine Technology	
	Bucket latrine	Total
50-55p***	179	179(84%)
60-65p	34	34(16%)
Total	213	213

*** 100 pesewa (p)= 1GHC= 1\$ (at 2007)

The collection periods of bucket latrines were within a week. As explained before, bucket latrines were either collected once or twice a week depending on rate of use and anal cleansing material input.

In the entire pit emptying and the bucket collection services, the landlord or the caretaker of the household was responsible for the payment of the service rendered. Some residents interviewed remarked that their landlord used part of their rent fee to pay for the emptying service, while others said that they made contribution, besides their rent, towards paying for the emptying service.

Key emptying price finding issue here is that:

- Emptying prices vary widely depending on a wide range of issues including subsidy, negotiation skills of the users, familiarity with emptiers, pit size, and objects dropped into the pits.

6.4.2: Average price of emptying FS and collection of excreta per year

The previous section discusses the emptying or collection price per emptying or collection period. In this section, all the price ranges for emptying were compared per year basis for the purposes of standardization and comparisons.

In the first place, a frequency distribution table was generated to find out which price range was dominant-i.e. the mode. Average price ranges of emptying latrines per year were computed for all the latrines for analysis in the frequency distribution table (Table 6.23 below). The results showed that the mean price range of GHC21-GHC40 was more prevalent (51.4%), followed by that of GHC2-GHC20 (23.4%) and GHC41-GHC60 (18%).

Table 6.23: Average price range for emptying latrine/yr

Average annual price range	Frequency	Percent
2-20	100	23.4
21-40	220	51.4
41-60	77	18.0
61-80	17	4.0
81-111	14	3.3
Total	428	100.0

When these were checked against the latrines in Table 6.24 below, the price for emptying all the WC to septic tanks per year as well as significant number of Double pit and VIP latrines falls within the price range of GHC2-GHC20, whereas that of all the bucket latrine system falls within the price range of GHC21-GHC40.

Table 6.24: Average emptying price range for emptying all latrines/yr

Cost range (GHC)	Latrine Technology					
	Bucket latrine	Simple pit	Double pit	VIP	WC to septic tank	Total
2-20	0	1	28	15	56	100
21-40	213	2	2	3	0	220
41-60	0	31	33	13	0	77
61-80	0	6	4	7	0	17
81-111	0	13	0	1	0	14
Total	213	53	67	39	56	428

The skewed price figures for the bucket latrines, the pits and the septic tanks in the Table 6.24 are due to the fact that the manual bucket latrine collections

and pit latrine emptying were done without subsidy. Whereas the bucket latrines were collected by individuals, manual pit emptying was done by group of two or more emptiers who charged more for their collective labour. In the case of the septic tanks, they were all emptied mechanically using vacuum tankers of the institutions whose services were subsidised. All these contributed to the wide range of emptying prices in the study area besides the bargaining skills, familiarity with emptiers and objects dropped into the pits (refer to Sub-section 6.4.1.1).

The emptying prices in the Table 6.24 above seem to contrast with the results found in Section 6.3.6.1 that, apart from the WC to septic tanks, users were more satisfied with the emptying price for bucket latrines than the other latrine types even though the price figures for collecting the bucket latrine system here are higher in some cases than the pit latrines emptied.

By proxy, the computations from Table 6.2 in Section 6.22 reveal that civil servants (the majority of the household interviewees) earned about \$1452 (GHC1452) annually. This compared with the prevalent price ranges (GHC2-GHC20; and GHC21-GHC40) means that civil servants who are the heads of households and or owners of the property may end up paying between 0.14% and 1.4% of their income for the pit emptying and 1.4% and 2.8% for bucket latrine collection if they are not assisted by dependants or residents. With the same analogy, a farmer who is a household head or landlord and earns an annual income of \$252 could pay between 0.8% and 7.9% of his income on pit emptying and between 8.3% and 15.9% on bucket latrine collection. Comparing this against the recommended maximum percentage (3-5% in Section 2.7.1) of income to be spent on sanitation, the cost of collecting bucket latrines could be too much for the urban poor households where only one person would end up paying the emptying service bills. However, in Section 6.3.6.1, users expressed that they had more problems with cost of emptying other latrines than collecting bucket latrines. This implies that users found paying by bits per relatively short time more convenient than paying a big bulk sum once in a long time.

6.4.3: The prices associated with the emptying methods

This sub-section addresses the methods of emptying the pits and the associated price implications.

The price ranges for emptying the pits were matched against the methods of emptying and the results are displayed in the Table 6.25 below.

Table 6.25: Cross tabulation of methods of emptying and average price range of emptying/year

			Average emptying cost of latrine per year					
			2-20	21-40	41-60	61-80	81-111	Total
Emptying methods	Manual	Count	0	219	76	16	14	325
		% within emptying method	.0%	67.4%	23.4%	4.9%	4.3%	100.0%
		% within AvCost	.0%	99.5%	98.7%	94.1%	100.0%	
		Range of LatVol/yr						
		% of Total	.0%	51.2%	17.8%	3.7%	3.3%	75.9%
	Mechanical	Count	100	1	1	1	0	103
		% within emptying method	97.1%	1.0%	1.0%	1.0%	.0%	100.0%
		% within AvCost	100.0%	.5%	1.3%	5.9%	.0%	
		Range of LatVol/yr						
		% of Total	23.4%	.2%	.2%	.2%	.0%	24.1%
	Total	Count	100	220	77	17	14	428
		% within emptying method	23.4%	51.4%	18.0%	4.0%	3.3%	100.0%
		% within AvCost	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		Range of LatVol/yr						
		% of Total	23.4%	51.4%	18.0%	4.0%	3.3%	100.0%

Almost all the mechanical emptying (97.1%), within the emptying method, is done within a price range of GHC2-GHC20 per year. Considering the cost of the vehicle, the fuel used and the salary of the emptying staff, this amount is too small for full cost recovery. Therefore the state institutions provided

subsidy (Section 6.4.1.1) for the emptying of pits and tanks with the municipality offering the highest subsidy.

The manual emptying is mainly found within the price ranges of GHC21-40 (67.4%) and GHC41-GHC60 (23.4%). Thus, manual emptying are seen in this analysis as more expensive due to lack of subsidy for the manual emptying service. The price ranges for the manual emptying are also wider.

6.4.4: Satisfaction for the price of emptying and transport

This sub-section deals with households' satisfaction levels with the price of emptying their latrines. The idea is to know whether households were happy with what they were paying for the quality of emptying service that they received.

The results of the responses are displayed in the frequency table in Table 6.26 below. Whereas 31.5% were satisfied with what they were paying for the emptying services, about 41% were not. However, 27.6 % were indifferent to the price mechanisms for emptying their latrines. The research found from both the households and the emptiers that payment for service was prompt after emptying. One manual emptier remarked in anonymity (refer to Appendix 7) that households which refused to pay for services were made to pay by the emptiers through a punitive measure by pouring excreta in front of the defaulters' houses. Doing that forced the debtor to pay double: Firstly, payment for the cleaning up of the disposed excreta (the mess); and secondly, transferring the cleaned up excreta for safe disposal away from the precincts of the household. Or in a milder form of punishment emptiers will refuse to come for emptying the defaulter's latrine when it is full. One resident confirmed this by stating that: *" I will never forget the day a bucket latrine emptier scattered the excreta almost everywhere around our household after several attempts to demand payment for his service had not been successful. Everyone in the household was very uncomfortable at the sight and smell of the excreta. It was so bad!"*. Because of these, no household wanted to default in payment after the excreta in the pit or bucket had been emptied.

This form of organized punishment stems from the fact that the manual emptiers, though not formally registered as companies, could communicate effectively among themselves.

Table 6.26: Satisfaction with price of emptying and transport

Satisfaction Levels	Frequency	Percent
Indifferent	118	27.6
Dissatisfied	175	40.9
Satisfied	135	31.5
Total	428	100.0

It was also discovered from one respondent that some users were willing to pay more than what they were already paying if better and improved services were offered to them. This is reflected in his statement that: “ *I will not mind paying higher price if I get the emptying service that I want*”.

Box 6.4: Key finance findings

- Price for the emptying and transport services varied over a wide range due to subsidy, negotiation skills, inputs into the pits, emptier-user relationship, pit size and means of emptying and transport.
- Mechanical emptying was subsidized but the manual emptying was not.

6.5 Users knowledge, attitude and practices (KAP)

This section addresses households' knowledge, attitude, and perceptions about FS emptying and transport in their communities

6.5.1: Knowledge & perception issues

When households' opinions were sought about safe disposals in their communities, about 42% of the respondents were of the opinion that FS disposal in their community was not safe (see Table 6.27 below).

Table 6.27: Household opinion of FS safe disposal in the community

Opinion of Safe Disposal	Frequency	Percent	Cumulative Percent
No	249	58.2	58.2
Yes	179	41.8	100.0
Total	428	100.0	

Most of the respondents who had the opinion that FS disposal in their community was not safe came from households where bucket and simple latrines were used (see Table 6.28 below).

Table 6.28: Type of Latrine used and opinions of FS safe disposal

		Latrine Technology					
		Bucket latrine	Simple pit	Double pit	VIP	WC to septic tank	Total
Opinion that FS is safe	No	154	33	28	19	15	249
	Yes	59	20	39	20	41	179
	Total	213	53	67	39	56	428

Respondents were worried about burial of the excreta in their community that did not go deep enough. They complained that papers, plastics and other light objects sometimes got mixed up with the disposed excreta and wind blew them towards their households. They also complained about animal scavengers such as rodents, chicken and dogs which scattered pieces of excreta around. One woman expressed, " *It is disgusting to see some faeces*

attached to the feet of chicken after they had used their feet to scavenge for feed. It makes me dislike chicken meat”.

When asked about what households understood about what safe disposal was (see Table 6.29 below), 41.6% respondents did not know what safe disposal meant. 20.8% mentioned burial as safe disposal, while 16.1% stated dumping at official disposal site as safe disposal. 15.7% explained safe disposal as sending the FS far into the bush, while relatively few respondents (5.6%) cited farm reuse to mean safe disposal.

Table 6.29: Households’ understanding of safe disposal

Households’ understanding about safe disposal	Frequency	Percent	Cumulative Percent
Unknown	179	41.8	41.8
Buried	89	20.8	62.6
farm reuse	24	5.6	68.2
sent to official disposal disposal site	69	16.1	84.3
Sent far into bush	67	15.7	100.0
Total	428	100.0	

These findings highlight the need to broaden users’ understanding about safe disposal in their communities since misunderstanding about safe disposal could promote indiscriminate dumping and spread of diseases in the communities.

6.5.2: Users attitude and behaviour towards latrine use.

This sub-section deals with users’ behaviour and attitude regarding use and dropping of anal cleansing materials as well as other objects into the latrines and how these affect pit emptying.

6.5.2.1: Anal cleansing materials used

When users were asked whether they dropped anal cleansing materials into

the latrines, the majority of households (58.6%) said they dropped their anal cleansing material into the latrines after use; while 41.4% said they did not. Thus, in all the latrines, except the WCs to septic tanks, those who dropped their anal cleansing materials into the latrines after use were more than those who did not (see Table 6.30 below).

Table 6.30: Placement of anal cleansing materials into the latrine

		Latrine Technology					
		Bucket latrine	Simple pit	Double pit	VIP	WC to septic tank	Total
Placement of AnaCM into pit?	No	70	18	34	19	36	177(41.4%)
	Yes	143	35	33	20	20	251(58.6%)
	Total	213	53	67	39	56	428

When the anal cleansing materials were analysed in a cross-tabulation, it was discovered from Table 6.31 below that the order of use of anal cleansing materials in decreasing order of use was: ordinary paper (32.5%); Miscellaneous (mix use of papers, rags, twigs, corn cobs etc) (29.4%); water (26.2%); Tissue paper (7.5%); Rags (2.8%); and sticks (1.6%). Within the latrine technology, tissue paper was mostly used for the WCs (25%) ordinary paper was popularly used in all the latrines, especially in the simple pits (47.2%); Miscellaneous was also popularly used in all the latrines but was more popular with the Double pits and the VIPs. Water was largely used for bucket latrines (37.6%). This could be one of the reasons why the average volume of latrines emptied per year for the bucket latrines (1,8m³) was higher than that for the pits and the septic tanks which was 1.3m³ (see Sub-section 6.3.4).

Table 6.31: Anal cleansing materials dropped into the latrines

			Latrine Technology					
			Bucket latrine	Simple pit	Double pit	VIP	WC to septic tank	Total
Anal Cleansing material	Tissue paper	Count	15	0	0	3	14	32
		% within Anal Cleansing material	46.9%	.0%	.0%	9.4%	43.8%	100.0%
		% within Latrine Technology	7.0%	.0%	.0%	7.7%	25.0%	
		% of Total	3.5%	.0%	.0%	.7%	3.3%	7.5%
	Ordinary paper	Count	62	25	21	14	17	139
		% within Anal Cleansing material	44.6%	18.0%	15.1%	10.1%	12.2%	100.0%
		% within Latrine Technology	29.1%	47.2%	31.3%	35.9%	30.4%	
		% of Total	14.5%	5.8%	4.9%	3.3%	4.0%	32.5%
	Water	Count	80	9	13	1	9	112
		% within Anal Cleansing material	71.4%	8.0%	11.6%	.9%	8.0%	100.0%
		% within Latrine Technology	37.6%	17.0%	19.4%	2.6%	16.1%	
		% of Total	18.7%	2.1%	3.0%	.2%	2.1%	26.2%
	Stick	Count	4	2	0	1	0	7

	% within Anal Cleansing material	57.1%	28.6%	.0%	14.3%	.0%	100.0%
	% within Latrine Technology	1.9%	3.8%	.0%	2.6%	.0%	
	% of Total	.9%	.5%	.0%	.2%	.0%	1.6%
Rag	Count	4	4	3	1	0	12
	% within Anal Cleansing material	33.3%	33.3%	25.0%	8.3%	.0%	100.0%
	% within Latrine Technology	1.9%	7.5%	4.5%	2.6%	.0%	
	% of Total	.9%	.9%	.7%	.2%	.0%	2.8%
miscellaneous	Count	48	13	30	19	16	126
	% within Anal Cleansing material	38.1%	10.3%	23.8%	15.1%	12.7%	100.0%
	% within Latrine Technology	22.5%	24.5%	44.8%	48.7%	28.6%	
	% of Total	11.2%	3.0%	7.0%	4.4%	3.7%	29.4%
Total	Count	213	53	67	39	56	428
	% within Anal Cleansing material	49.8%	12.4%	15.7%	9.1%	13.1%	100.0%
	% within Latrine Technology	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	% of Total	49.8%	12.4%	15.7%	9.1%	13.1%	100.0%

Some interviewees mentioned that apart from the anal cleansing materials listed, other objects such as rubber, metals, pieces of wood and rags were also thrown into the pits. In another development an informant expressed that users sometimes abused their latrines by putting in a lot of stuff that prevented mechanical siphoning of sludge by the vacuum tankers. Asked why they did that, the informant replied that it was done out of ignorance since users did not understand the implication of their actions. The mechanical emptiers confirmed this by complaining about the suction problems and the fact that these 'unusual' objects found in the pits interfered with operations and sometimes destroyed their suction equipment. The manual operators were also concerned about the unusual objects dropped into the latrines as they were injured by them during emptying operations.

Field observation also confirmed that users put into the pits not only human excreta but other objects such as pieces of wood, plastic bags, sandals, shoes and bottles (see Picture 6.5 below). From Section 6.3.1.3, a woman commented about defecating into a plastic bag during the night and later dropping it into the pit because of fear of going out alone during the night. Her statement also confirms the fact that inappropriate objects were dropped into the latrines by users.

Picture 6.5: Various objects dropped into pit latrines by users



(Source: Author's field work, 2007)

Box 6.5: Key KAP Findings

- **Bucket and simple latrine users were of the view that their excreta was not safely disposed of.**
- **Many users could not express what safe disposal is.**
- **Users' perceptions about safe disposal varied: burial, farm reuse, official disposal site, far in the bush.**
- **Majority of users dropped their anal cleansing materials into the pits.**
- **Other bulky non-anal cleansing materials were also dropped into the latrines; and these disrupted emptying as well as injured emptiers.**

6.6: Social factors

In this sub-section, household social issues, such as their motivation for getting their latrines emptied, and other social issues that often bother them regarding FS emptying and transport are analyzed.

6.6.1: Motivational factors

When households were asked about what motivates them to get their latrines emptied, the following motivation factors in decreasing order were cited (see Table 6.32 below): Hygiene (32.9%); Odour (28.7%), Flies and nuisance (18.7%); convenience (15.9%) and affordability (3.7%).

Table 6.32: Motivation factors for emptying latrines

Motivation Factors	Frequency	Percent
Hygiene	141	32.9
convenience	68	15.9
affordability	16	3.7
avoidance of flies and nuisance	80	18.7
Avoidance of odour	123	28.7
Total	428	100.0

The above findings imply that affordability is the least motivational factor to get latrines emptied, while hygiene is the strongest motivational factor followed by odour, and avoidance of flies and nuisance.

When these motivational issues were cross-tabulated with the latrine technologies to ascertain which motivational factor is linked with which latrine technology, the results are as displayed in Table 6.33 below:

Table 6.33: Cross tabulation of motivational factors and latrine technology

			Latrine Technology					
			Bucket latrine	Simple pit	Double pit	VIP	WC to septic tank	Total
Motivation for emptying	hygiene	Count	79	19	16	12	15	141
		% within Motivation for emptying	56.0%	13.5%	11.3%	8.5%	10.6%	100.0%
		% within Latrine Technology	37.1%	35.8%	23.9%	30.8%	26.8%	
		% of Total	18.5%	4.4%	3.7%	2.8%	3.5%	32.9%
	convenience	Count	22	10	17	3	16	68
		% within Motivation for emptying	32.4%	14.7%	25.0%	4.4%	23.5%	100.0%
		% within Latrine Technology	10.3%	18.9%	25.4%	7.7%	28.6%	
		% of Total	5.1%	2.3%	4.0%	.7%	3.7%	15.9%
	affordability	Count	13	0	1	1	1	16
		% within Motivation for emptying	81.2%	.0%	6.2%	6.2%	6.2%	100.0%
		% within Latrine Technology	6.1%	.0%	1.5%	2.6%	1.8%	
		% of Total	3.0%	.0%	.2%	.2%	.2%	3.7%
	avoidance of flies and	Count	48	12	11	5	4	80
		% within Motivation for emptying						
		% within Latrine Technology						
		% of Total						

nuisance	% within Motivation for emptying	60.0%	15.0%	13.8%	6.2%	5.0%	100.0%
	% within Latrine Technology	22.5%	22.6%	16.4%	12.8%	7.1%	
	% of Total	11.2%	2.8%	2.6%	1.2%	.9%	18.7%
Avoidance of odour	Count	51	12	22	18	20	123
	% within Motivation for emptying	41.5%	9.8%	17.9%	14.6%	16.3%	100.0%
	% within Latrine Technology	23.9%	22.6%	32.8%	46.2%	35.7%	
	% of Total	11.9%	2.8%	5.1%	4.2%	4.7%	28.7%
Total	Count	213	53	67	39	56	428
	% within Motivation for emptying	49.8%	12.4%	15.7%	9.1%	13.1%	100.0%
	% within Latrine Technology	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	% of Total	49.8%	12.4%	15.7%	9.1%	13.1%	100.0%

From Table 6.33, it emerges that within the latrine technology, hygiene was cited more frequently among the users of the bucket (37.1%) and simple pit (35.8%). latrines. Convenience was more mentioned by those using WCs (28.6%) and double pits (25.4%). Flies and nuisance were cited by users of simple pits (22.6%) and bucket latrines (22.5%) more than other latrine users. Odour was cited more by improved latrine users (Double pits-32.8%; VIP-46.2%; and WC-35.7%). The significance of this finding is that hygienic factors (hygiene, flies and nuisance) were motivational factors more associated with bucket and simple pit latrines to be emptied, whilst 'luxury' factors such as convenience and odour were more associated with the more improved form of latrines.

Qualitative findings also confirmed that households with bucket latrines and simple pits do not like the unhygienic issues as well as odour, flies and nuisance associated with them. They expressed that bucket latrines smelt very badly and were both aesthetically and hygienically awful under two conditions:

- a) when they were filled up to the brim and spilling over,
and
- b) when they are freshly emptied, because of the mess left behind.

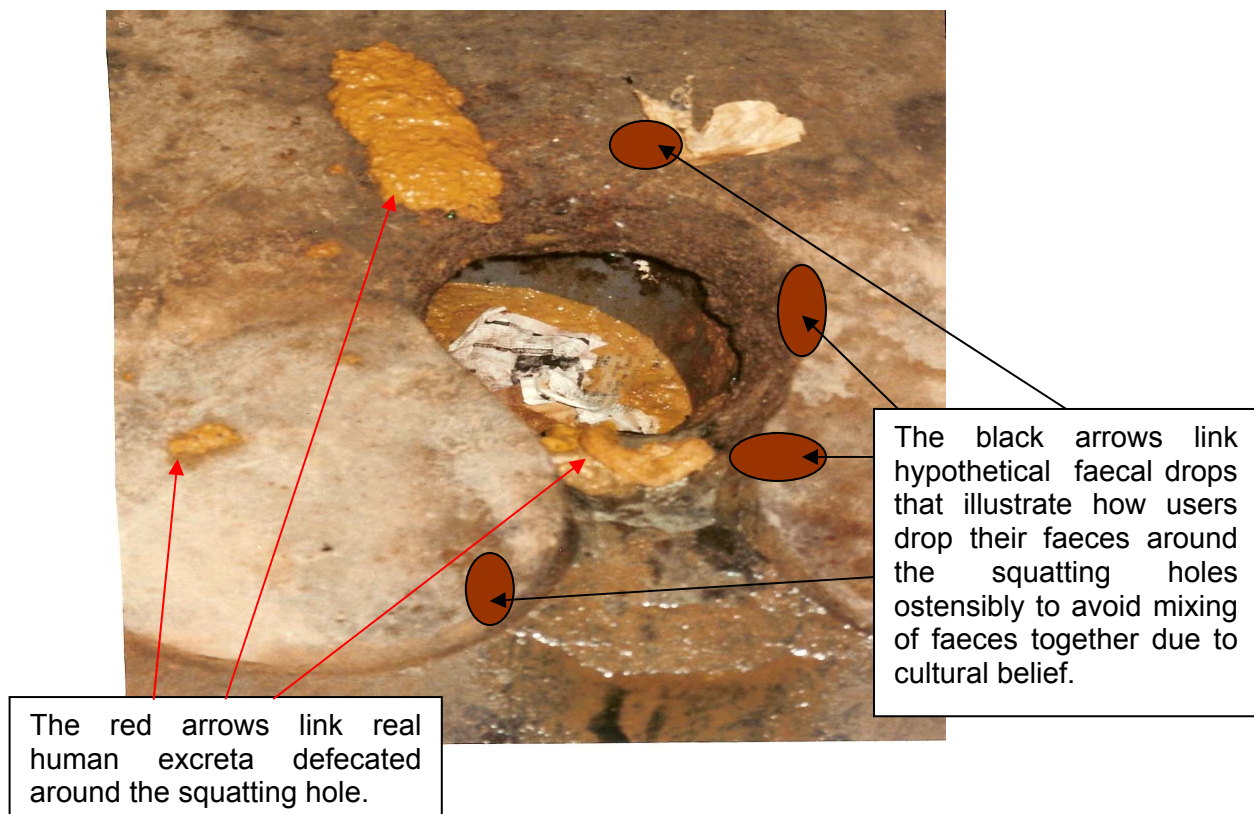
It is important to note that whereas hygiene was not an important consideration for users to get latrine infrastructure in place (see Section 6.3.1.4), it is an important consideration when it comes to pit or bucket emptying. This is an understanding gap that sanitation educators can fill by emphasizing to the households the need to have good latrines that will present less excreta emptying or collection problems

6.6.2: Beliefs and culture

In spite of the fact that hygiene was one of the motivational factors mentioned in Sub-section 6.6.1 above to get latrines, especially bucket and simple latrines, emptied the key informants responses indicated that understanding and appreciation of good hygiene was still a problem in the communities. For

example Mr Kumi (the real name withheld) remarked that, *"My wife believes so much in tradition that when our two month old toddler defecated into our food she refused to throw the food away. She ate it believing that the toddler would be sick if the food was thrown away"*. Another key informant commented that in some communities, users defecated in circles around the squatting hole in order to avoid their discomfort at sitting on top of each other's excreta (See Picture 6. 6 below). However, doing that makes the squatting slabs unhygienic and for that matter puts the users, cleaners of the latrine as well as emptiers at risk of being contaminated.

Picture 6.6: Defecating in circles



(Researcher's field observation, 2007)

The manual operators in the focus group discussion stated that the society looked down upon them when they saw them carry the excreta-filled buckets on their heads and especially when some excreta spilled on them. The stigma associated with carrying the excreta in public made them feel uncomfortable

to carry the buckets during the day. According to them they chose to carry the buckets when people were asleep, preferably at dawn, to escape meeting with people and to avoid flies. This confirms the derogatory song in Box 6.1 in Section 6.3.5 as well as the observation made by the researcher shown in Box 6.2 at Sub-section 6.3.5.2.2 about the modus operandi of the bucket latrine emptier. It also confirms the observation made in the literature about when pits were emptied in Kibera in Kenya (Section 2.6.2.1.1).

6.6.3: Users' frequent complaint issues

When users were asked about what they frequently complained about, they cited the following common complaints:

- service providers' reaction time to service call,
- cost for service delivery,
- poor service delivery,
- improper disposal within neighbourhood and
- unhygienic way of emptying.

The frequency table in Table 6.34 details these issues as: reaction time for emptying operation (46%); cost (27.8%); improper disposal (12.4%), poor service (7.2%), and poor hygiene (6.5%).

Table 6.34: The most frequent complaints with service providers

The most frequent user complaints with service providers	Frequency	Percent
reaction time for emptying	197	46.0
cost	119	27.8
poor hygiene	28	6.5
poor service	31	7.2
improper disposal	53	12.4
Total	428	100.0

When these complaints were matched with the latrines in a cross tabulation in Table 6.35 below, it was observed that the reaction time for emptying the latrines was a persistent problem for almost all the latrines, particularly the improved latrines and bucket latrines. Cost problem was particularly persistent among users with the double pit (44.8%), bucket (29.1%), and VIP (28.2%) latrines. Problems of improper disposal were mostly associated with bucket and simple pit latrine users.

Table 6.35: The most frequent complaints lodged with service providers about the latrine technology cross tabulation

			Latrine Technology					
			Bucket latrine	Simple pit	Double pit	VIP	WC to septic tank	Total
The most frequent dispute with service providers	reaction time for emptying	Count	94	15	34	23	31	197
		% within The most frequent dispute with service providers	47.7%	7.6%	17.3%	11.7%	15.7%	100.0%
		% within Latrine Technology	44.1%	28.3%	50.7%	59.0%	55.4%	
		% of Total	22.0%	3.5%	7.9%	5.4%	7.2%	46.0%
	cost	Count	62	7	30	11	9	119
		% within The most frequent dispute with service providers	52.1%	5.9%	25.2%	9.2%	7.6%	100.0%
		% within Latrine Technology	29.1%	13.2%	44.8%	28.2%	16.1%	
		% of Total	14.5%	1.6%	7.0%	2.6%	2.1%	27.8%
	hygiene	Count	15	6	1	3	3	28
		% within The most frequent dispute with service providers	53.6%	21.4%	3.6%	10.7%	10.7%	100.0%

	% within Latrine Technology	7.0%	11.3%	1.5%	7.7%	5.4%	
	% of Total	3.5%	1.4%	.2%	.7%	.7%	6.5%
poor service	Count	5	9	2	2	13	31
	% within The most frequent dispute with service providers	16.1%	29.0%	6.5%	6.5%	41.9%	100.0%
	% within Latrine Technology	2.3%	17.0%	3.0%	5.1%	23.2%	
	% of Total	1.2%	2.1%	.5%	.5%	3.0%	7.2%
improper disposal	Count	37	16	0	0	0	53
	% within The most frequent dispute with service providers	69.8%	30.2%	.0%	.0%	.0%	100.0%
	% within Latrine Technology	17.4%	30.2%	.0%	.0%	.0%	
	% of Total	8.6%	3.7%	.0%	.0%	.0%	12.4%
Total	Count	213	53	67	39	56	428
	% within The most frequent dispute with service providers	49.8%	12.4%	15.7%	9.1%	13.1%	100.0%

% within Latrine Technology	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
% of Total	49.8%	12.4%	15.7%	9.1%	13.1%	100.0%

Both the households and the focus groups interviewed were also particularly concerned about the poor reaction times to service calls. The municipal service providers were blamed the most. The municipal service providers rather complained about the fact that they did not have many vehicles and the few vehicles they had were in poor condition which suffered frequent breakdowns (see Picture 6.7 below). They also lacked money to buy new ones and also repair the broken down vehicles. This may be due to the fact that the municipality offers the highest subsidy among the other institutions in providing emptying service (see Section 6.4.1.1)

Picture 6.7: A Broken down Municipal FS emptying truck



(Source: Researcher's Field work, 2007)

The institutional emptiers, who acted as private service providers, stated that they were duty-bound to give priority to emptying their own latrines first. Therefore, when a request for emptying a household latrine coincided with their emptying schedule, preference was given to the latter. This combined with the fewer and unreliable municipal vacuum tankers may explain why manual emptying is so popular in the study area. When asked whether any partnership existed between them and the informal manual operators, both the municipal and the other institutional emptiers said that there was not any.

The manual emptiers said that some of them had to do other jobs besides excreta emptying in order to be able to meet their socio-economic commitments. This implies that when the need to work as a team arose, they had to organize themselves in such a way that it did not conflict with their other jobs. It also highlights the need to assist the manual emptiers to meet their financial needs through emptying services.

Whereas the households blamed manual emptiers for poor emptying services and being too expensive, the manual emptiers (especially the bucket emptiers) complained about the fact that some of the buckets were allowed to fill to the brim and sometimes spilled over before they were informed for emptying. This makes bucket emptying messy. The bucket emptiers also said that they could not carry their stuff too far away from the household so they had to find any convenient place around to deposit the excreta. When asked what they meant by disposal at 'convenient' places. They replied that the disposal at the convenient place was termed as "No man's land". This implies a disposal at interfacial areas in the neighbourhoods.

Box 6.5: Key social factors

- In descending order of importance, the motivational factors for emptying the latrines were: Hygiene, Odour, Flies, Convenience, and Affordability
- Users of bucket and simple pit latrines were mainly motivated by hygiene, flies and nuisance issues to empty their latrines, while those using the more improved latrines were motivated by odour and convenience to empty their latrines
- Manual emptiers were stigmatized for the way they handled and transported human excreta.
- Frequent user complaints were: Emptiers reaction times to service, cost for emptying, poor service delivery, and improper disposal and hygiene problems.

6.7 Latrine access and disposal issues

Latrine access in this section addresses how far the household latrines are from access or motor routes and disposal points. In the end the latrine distances from the disposal points are assessed to ascertain whether the distance has anything to do with the cost of emptying and transport. The disposal issues also consider the fate of the sludge after emptying and the implications for the environment.

6.7.1: Latrine access

When the distances of the on-plot latrines from the access or motor routes were assessed, it emerged from Table 6.36 below that within the latrine technology, more WC to septic tanks (46.4%) and bucket latrines (34.7%) were closer to motor (access) routes than the other latrines. But comparing all the latrines, 58.7% of bucket latrines and 20.6% of the WCs were between 0-50m of the motor routes. The relatively large percentage of bucket latrines in this comparison is due to the fact that almost 50% (213 bucket latrines/ 428 of

all latrines) of all the latrines surveyed were bucket latrines. The relatively short distance to motor routes for WCs and bucket latrines here may add further explanation (in the technology section, Sub-section 6.3.6) as to why users of WCs and many users of bucket latrines did not have accessibility problems. Most of the latrines were sited 60-100m from the motor routes. More simple pits (17.0%) were quite distant from the motor routes.

Vending kiosks and electric poles narrowed access routes. Some interviewees also complained about petty traders and hawkers mounting structures which narrowed access routes. Inaccessibility could increase emptying cost as was shown in the remarks of the Prisons Services' driver that:

"Some pits are too difficult to be accessed and reached for emptying. To reach such remote places several hoses have to be attached in order to reach the pits for emptying. As this requires the use of more energy, more than usual emptying price is charged"

Table 6.36: Latrine distance from motor (access) route cross tabulation

			Latrine Technology					
			Bucket latrine	Simple pit	Double pit	VIP	WC to septic tank	Total
Latrine distance from motorable route	0-50m	Count	74	10	10	6	26	126
		% within Latrine distance from motorable route	58.7%	7.9%	7.9%	4.8%	20.6%	100.0%
		% within Latrine Technology	34.7%	18.9%	14.9%	15.4%	46.4%	
		% of Total	17.3%	2.3%	2.3%	1.4%	6.1%	29.4%
	60-100m	Count	134	34	57	33	29	287
		% within Latrine distance from motorable route	46.7%	11.8%	19.9%	11.5%	10.1%	100.0%
		% within Latrine Technology	62.9%	64.2%	85.1%	84.6%	51.8%	
		% of Total	31.3%	7.9%	13.3%	7.7%	6.8%	67.1%
	110-200m	Count	5	9	0	0	1	15
		% within Latrine distance from motorable route	33.3%	60.0%	.0%	.0%	6.7%	100.0%
		% within Latrine Technology	2.3%	17.0%	.0%	.0%	1.8%	
		% of Total	1.2%	2.1%	.0%	.0%	.2%	3.5%
	Total	Count	213	53	67	39	56	428

	% within Latrine distance from motorable route	49.8%	12.4%	15.7%	9.1%	13.1%	100.0%
	% within Latrine Technology	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	% of Total	49.8%	12.4%	15.7%	9.1%	13.1%	100.0%

In the study area there was only one formal disposal site situated at a distance of about 13 km from the city centre. All the other disposals including the ones done on the farms were informal.

Households were asked about how far their latrine was from any known disposal sites to ascertain how far away from the household their FS emptied could be disposed of. The results as reflected in table 6.37 below indicate that in 39.5% of the households' latrines it could not be ascertained how far they were from any disposal point. But 39.3% of the households had their latrines within 500m from informal disposal point. Only 9.8% of the households could relate their latrines to be equal to or more than 7km from the disposal point; and 11.4% of households had their latrines located within 100m of informal disposal points.

Table 6.37: Distance of disposal site from the households

Distance of disposal site from the Household	Frequency	Percent
Unknown	169	39.5
<100m	49	11.4
<500	168	39.3
7-20km	42	9.8
Total	428	100.0

When the distances were tied with the latrine technologies available in a cross tabulation in Table 6.38 below, it became evident that about 77% of households with bucket latrines and 58.4% of those with simple pits were close by <500m to the disposal point. More households with WCs (53.6%) had expressed their disposal distance of 7-20km from their households. Those with Double and VIPs were within disposal distances fairly distributed between <500m and between 7-20km. This seems to confirm with personal observation where disposal mechanisms were found to be more concentrated near the sources of generation and reduce in concentration as one leaves the sources of generation of the faecal wastes towards the suburbs of the city.

Table 6.38: Distance of disposal site from household latrines

			Latrine Technology					
			Bucket latrine	Simple pit	Double pit	VIP	WC to septic tank	Total
Distance of Disposal site from HH	Unknown	Count	49	20	45	30	25	169
		% within Distance of Disposal site from HH	29.0%	11.8%	26.6%	17.8%	14.8%	100.0%
		% within Latrine Technology	23.0%	37.7%	67.2%	76.9%	44.6%	
		% of Total	11.4%	4.7%	10.5%	7.0%	5.8%	39.5%
	<100m	Count	45	4	0	0	0	49
		% within Distance of Disposal site from HH	91.8%	8.2%	.0%	.0%	.0%	100.0%
		% within Latrine Technology	21.1%	7.5%	.0%	.0%	.0%	
		% of Total	10.5%	.9%	.0%	.0%	.0%	11.4%
	<500	Count	119	27	14	7	1	168
		% within Distance of Disposal site from HH	70.8%	16.1%	8.3%	4.2%	.6%	100.0%
		% within Latrine Technology	55.9%	50.9%	20.9%	17.9%	1.8%	
		% of Total	27.8%	6.3%	3.3%	1.6%	.2%	39.3%
	7-20km	Count	0	2	8	2	30	42

	% within Distance of Disposal site from HH	.0%	4.8%	19.0%	4.8%	71.4%	100.0%
	% within Latrine Technology	.0%	3.8%	11.9%	5.1%	53.6%	
	% of Total	.0%	.5%	1.9%	.5%	7.0%	9.8%
Total	Count	213	53	67	39	56	428
	% within Distance of Disposal site from HH	49.8%	12.4%	15.7%	9.1%	13.1%	100.0%
	% within Latrine Technology	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	% of Total	49.8%	12.4%	15.7%	9.1%	13.1%	100.0%

6.7.1.1: The Price of emptying and transport compared with the distance to disposal points

The distances between the latrines and the disposal sites were matched against the price for emptying and transport in Table 6.39 below to see if price increases with distance to disposal sites. From the results, more emptiers who charge, for instance, GHC2-GHC20 travel quite far to dispose of their FS whereas good number of emptiers who do not travel far enough to dispose of their FS charge more. For example, within the distance of disposal site from the household, more than 90% of the cheapest price range (GHC 2-GHC20) had the farthest disposal distances. However most of the relatively high price ranges (>GHC 40) had the disposal distance relatively shorter-i.e. <500m. The likely explanation to this phenomenon is that the conventional emptying trucks which travel far to dispose of the FS belong to institutions which, as already explained, offer subsidy to emptying and transport services in the municipality. The manual emptiers, on the other hand, who do not get any subsidy, charge at unsubsidized rate for emptying. Also they cannot move the FS far enough for disposal manually.

Table 6.39: Distances to the disposal sites and cost for emptying and transport

GHC			Distance of Disposal site from HH				
			Unknown	<100m	<500	7-20km	Total
*** AvCost Range 2-20 of LatVol/yr	Count		59	0	3	38	100
	% within AvCost Range of LatVol/yr		59.0%	.0%	3.0%	38.0%	100.0%
	% within Distance of Disposal site from HH		49.2%	.0%	6.1%	90.5%	
	% of Total		27.4%	.0%	1.4%	17.7%	46.5%
21-40	Count		3	0	4	0	7
	% within AvCost Range of LatVol/yr		42.9%	.0%	57.1%	.0%	100.0%

	% within Distance of Disposal site from HH	2.5%	.0%	8.2%	.0%	
	% of Total	1.4%	.0%	1.9%	.0%	3.3%
41-60	Count	45	4	25	3	77
	% within AvCost Range of LatVol/yr	58.4%	5.2%	32.5%	3.9%	100.0%
	% within Distance of Disposal site from HH	37.5%	100.0%	51.0%	7.1%	
	% of Total	20.9%	1.9%	11.6%	1.4%	35.8%
61-80	Count	8	0	9	0	17
	% within AvCost Range of LatVol/yr	47.1%	.0%	52.9%	.0%	100.0%
	% within Distance of Disposal site from HH	6.7%	.0%	18.4%	.0%	
	% of Total	3.7%	.0%	4.2%	.0%	7.9%
81-111	Count	5	0	8	1	14
	% within AvCost Range of LatVol/yr	35.7%	.0%	57.1%	7.1%	100.0%
	% within Distance of Disposal site from HH	4.2%	.0%	16.3%	2.4%	
	% of Total	2.3%	.0%	3.7%	.5%	6.5%
Total	Count	120	4	49	42	215
	% within AvCost Range of LatVol/yr	55.8%	1.9%	22.8%	19.5%	100.0%
	% within Distance of Disposal site from HH	100.0%	100.0%	100.0%	100.0%	100.0%
	% of Total	55.8%	1.9%	22.8%	19.5%	100.0%

*** AVcost= average cost; Latvol/yr=Latrine volume per year

6.7.2: The disposal issues

6.7.2.1 General

This section addresses the means of disposal after emptying. The frequency Table 6.40 below shows that basically there are three disposal means of the FS after emptying. These were:

- i) Burial within neighbourhood;
- ii) Dumping at official disposal site, and;
- iii) Farm disposal for reuse.

Table 6.40: Means of disposal after emptying

Means of Disposal after emptying	Frequency	Percent
Buried near site/neighbourhood	118	27.6
unknown	53	12.4
Dumped offsite officially	132	30.8
Reused	125	29.2
Total	428	100.0

6.7.2.2 Burial within neighbourhood

From Table 6.40 above, 27.6% of the FS was known to be dumped within the neighbourhood. Burial within the neighbourhood was poorly handled in some situations (See Picture 6.8 below). The disposal in the picture was at an interface between two settlements. This raises hygienic concerns that an interfacial disposal could bring hygiene problems to the settlements nearby.

Picture 6.8: Improperly buried excreta near settlement



(Source: Author's research field work, 2007)

Some users complained about the fact that some of the emptied FS was poorly buried (Section 6.5.1) or left around in a messy manner without being cleaned up by the emptiers. In some instances, manually emptied excreta were left to dry within the neighbourhoods (see Picture 6.9 below).

Picture 6.9: FS left to dry behind the latrine in Tamale



(Source: Author's research field work, 2007)

All such improper disposal mechanisms could create health, environmental and aesthetic concerns for the neighbourhood and the community at large; and discourage tourism.

6.7.2.3 Disposal in farms and the official site

From Table 6.40, 29.2% of the FS generated is dumped on the farm for reuse, while 30.8% is dumped at the official disposal site. As far as the farm disposal is concerned, the municipal authorities for sanitation complained about the fact that some FS transporters emptied their contents illegally on farms for an undisclosed fee. This allegation was confirmed from interview with farmers who said that they made some personal arrangement with the emptiers to dump the FS on their farms for cash. But they refused to give details of how much was paid to the emptiers. They disagreed with the municipal viewpoint that dumping FS on farm for reuse was illegal. To them it was an opportunity to get their lands fertilised. What they understood was illegal, was the arrangement they made with drivers to dump the FS on their farms for secret payment. They however considered it as the only available means to get the FS rerouted to their farms.

6.7.2.4 Means of disposal versus household latrines

When the means of sludge disposal after emptying was linked to the household latrines in a cross tabulation in Table 6.41 below, the following emerged:

FS from 11.3% of simple pits and 10.4% from double pits was more likely to be dumped within the neighbourhood. About 95% of FS from WC to septic tanks was dumped at the official dumping site. Similarly, a significant amount of FS from double and single VIP latrines (about 46% each) was disposed of at official disposal site. When it comes to farm reuse, much of the FS from simple pit latrines (66%) was reused; followed by that from single VIP (43.6%) and double pits (about 31.3%). With the bucket latrines, the excreta were buried within the neighbourhood, and after sometime some of the sludge was reused for either the neighbourhood gardens or peri-urban farms. Thus the tendency for indiscriminate dumping is more associated with the unimproved latrines such as bucket and simple pit latrines due to their manual emptying and disposal means.

******Table 6.41: Sludge Fate after emptying household latrines**

Sludge fate after emptying		Latrine Technology				
		Simple pit	Double pit	Single VIP	WC to septic tank	Total
Buried near site/neighbourhood	Count	6	7	1	0	14
	% within Sludge fate after emptying	42.9%	50.0%	7.1%	.0%	100.0%
	% within Latrine Technology	11.3%	10.4%	2.6%	.0%	
	% of Total	2.8%	3.3%	.5%	.0%	6.5%
unknown	Count	5	8	3	1	17
	% within Sludge fate after emptying	29.4%	47.1%	17.6%	5.9%	100.0%
	% within Latrine Technology	9.4%	11.9%	7.7%	1.8%	
	% of Total	2.3%	3.7%	1.4%	.5%	7.9%
Dumped offsite officially	Count	7	31	18	53	109
	% within Sludge fate after emptying	6.4%	28.4%	16.5%	48.6%	100.0%
	% within Latrine Technology	13.2%	46.3%	46.2%	94.6%	
	% of Total	3.3%	14.4%	8.4%	24.7%	50.7%
Reused	Count	35	21	17	2	75
	% within Sludge fate after emptying	46.7%	28.0%	22.7%	2.7%	100.0%
	% within Latrine Technology	66.0%	31.3%	43.6%	3.6%	
	% of Total	16.3%	9.8%	7.9%	.9%	34.9%
Total	Count	53	67	39	56	215
	% within Sludge fate after emptying	24.7%	31.2%	18.1%	26.0%	100.0%
	% within Latrine Technology	100.0%	100.0%	100.0%	100.0%	100.0%
	% of Total	24.7%	31.2%	18.1%	26.0%	100.0%

*** *This table excludes the bucket latrines because all the households interviewed had their bucket latrine contents buried near site or within the neighbourhood.*

6.7.2.5 Means of disposal versus emptying means

When means of disposal was compared with means of emptying in a cross-tabulation chi-square analysis in Table 6.42 below, it was found out that the relationship was significant at $p < 0.005$ (See Appendix 5).

Table 6.42: Means of disposal versus means of emptying Chi-square and cross tabulation

Means of emptying		Means of Disposal				
		Buried near site/neighbourhood	unknown	Dumped offsite officially	Reused	Total
Manual	Count	118	51	36	120	325
	% within means of emptying	36.3%	15.7%	11.1%	36.9%	100.0%
	% within means of disposal	100.0%	96.2%	27.3%	96.0%	
	% of Total	27.6%	11.9%	8.4%	28.0%	75.9%
Mechanical	Count	0	2	96	5	103
	% within means of emptying	.0%	1.9%	93.2%	4.9%	100.0%
	% within means of disposal	.0%	3.8%	72.7%	4.0%	
	% of Total	.0%	.5%	22.4%	1.2%	24.1%
Total	Count	118	53	132	125	428
	% within means of emptying	27.6%	12.4%	30.8%	29.2%	100.0%
	% within means of disposal	100.0%	100.0%	100.0%	100.0%	100.0%
	% of Total	27.6%	12.4%	30.8%	29.2%	100.0%

From the above table, it emerges that excreta or FS from manual emptying is more likely to be dumped within the neighbourhood (36.3%) or reused (36.9%) more than the other disposal means. On the other hand, Mechanical emptying has the greatest tendency of being disposed of at the official disposal site than any of the disposal means. The implication of these findings is that manual emptying is likely to contaminate the neighbourhood more than the mechanical emptying.

6.7.2.6 Display of various forms of FS disposal in the city

This sub-section takes the facts from Sections 6.7.1 and 6.7.2 about the distances to the disposal sites and the disposal means after emptying, in an attempt to paint a picture about the faecal sludge distribution in the city. The purpose for doing this is to create an understanding of the FS distribution and concentration in the city. This is necessary because it could enable the communities and municipal authorities to know the extent of inappropriate dumping in the communities and the city as a whole; and thus, help to manage FS properly. Thus, an origin-destination picture is designed out of the information from the disposal mechanisms: i.e that around the latrine, open defecation, within neighbourhood, on farm and at official site, together with the disposal distances as depicted in Figure 6.2 below.

Table 6.43: Colour key showing different levels of sludge contamination within the FS origin-destination model in the city due to different disposal practices





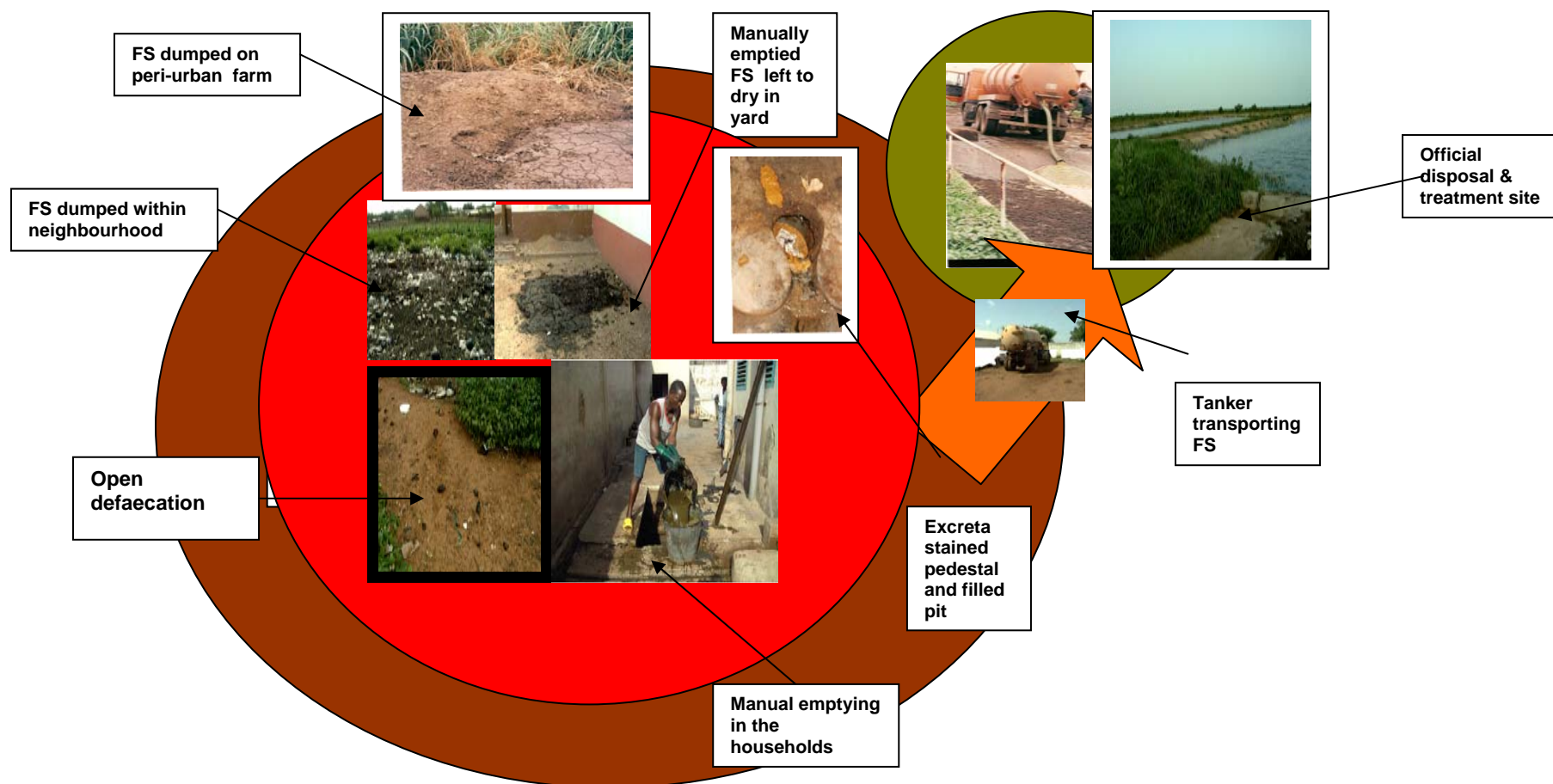
	Untreated excreta is highly concentrated through bucket and pit storage, open defecation, emptying mess, improper burial and storage.
	Spread of faecal sludge in the community through scavengers, garden and farm reuse. The brown colour also represents the fact that as one moves away from the city centre, contamination levels and population decrease.
	As vacuum tankers transport sludge to the official treatment site there is possibility of drips of sludge dropping along the route
	The treatment site where FS dumped is relatively well treated and thus kept safely

Figure 6.2: Model for origin- destination of FS emptying, transport and disposal in Tamale



Box 6.6: Key access and disposal issues

- Access for emptying and transport is not a problem for bucket and WC latrines. But simple pits were the most inaccessible.
- The contents of latrines from 50% of households were disposed of within 500m of the household.
- Disposal distance had no bearing on price of emptying and transport.
- Disposal of FS is through four ways: Open defecation; Burial within the neighbourhood; Official disposal site; On farm for reuse.
- FS from manual emptying is more likely to be dumped within the neighbourhood than that from mechanical emptying.
- Also the less the improvement in the latrine technology, the greater the tendency for its content to be emptied and disposed of closer to settlements.
- The origin-destination figure which paints a sensitization picture of disposal points in the city shows that excreta concentration is more in the city centre and reduces in concentration as one moves towards the outskirts of the city.

6.8 Reuse issues

The HCES approach encourages reuse to be as close to the source of waste generation as possible. This is done in order to achieve the following:

- close the nutrient loop in nature,
- increase the standard of living of the poor in the communities by creating jobs for them,
- boost food production, and
- reduce diseases and environmental pollution.

Unfortunately, not all societies would be happy with the concept of FS reuse. Therefore, the objective of this section is to assess the popularity of reuse

among the users in order to ascertain the degree of possibility of reuse and the potential dangers and advantages thereof.

When the households were asked about their awareness of FS reuse for farming, the overwhelming majority of more than 91% of respondents said they were aware of FS reuse (see Table 6.43 below). Further, when the researcher asked whether they were interested in the FS reuse, it emerged in that more than 58% of respondents were interested in FS reuse for farming (Table 6.44 below). Those who were indifferent about the reuse of FS were only about 15%.

Table 6.44: Knowledge about FS farm reuse

Knowledge about FS farm reuse	Frequency	Percent
No	37	8.6
Yes	391	91.4
Total	428	100.0

Table 6.45: Interest in FS farm reuse

Interest in Farm reuse	Frequency	Percent
Indifferent	63	14.7
Not interested	116	27.1
Interested	249	58.2
Total	428	100.0

These findings reveal that apart from the popularity of FS reuse, many households interviewed were interested in reuse or , at least, would not mind if FS is reused for agriculture. A high interest and acceptability among households for reuse is an indication of the possibility of reuse promotion and scale up in the communities. Unfortunately, it was observed that there were no appropriate marketing structures for the sale of FS (See also Section 6.7.2.3 above).

6.8.1: Dangers of handling and or using incompletely digested excreta

Key informants interviewed were concerned about the consequences of large scale reuse of human excreta in agriculture in terms of handling and processing of the excreta before reuse and the effects it will have on flora and fauna. This is because of the plethora of pathogens that the undigested human excreta could carry. According to the municipal chief engineer for water and sanitation, there are hygienic concerns regarding the FS dumped on the farms. This is because the FS is believed not to be adequately treated before reuse and therefore could be risky to both farmers and consumers of food produce from the FS reused farms.

Farmers interviewed by the researcher also confessed that they periodically suffered from vomiting, diarrhoea, skin diseases, foot rots and stomach ache. Although these findings do not conclude that these illnesses are associated with FS reuse practices, they raise concern about the health and safety issues for the farmers reusing excreta or FS. According to Keraita and Drechsel (2004) who worked for IWMI-Ghana, some enterobacteria and rotaviruses which are excreta-linked bacteria had been found on crops where wastewater and FS was reused for agriculture in Accra and Kumasi, the two leading Ghanaian cities. An IWMI-Ghana interviewee also said that they would be researching into the link between FS reuses practices and infection among farmers.

6.8.2: The benefits of FS reuse for farming

The farmers interviewed told the researcher that they sanitized the FS before reuse by allowing the fresh FS brought in by the emptiers to dry in the sun during the dry season (see Picture 6.10 below). They expressed satisfaction with the FS reuse because it improved the yield of their crops.

Picture 6.10: FS left to dry on the farm outskirts for reuse



Source: Researcher's field work, 2007)

It was observed from the treatment pond in Tamale that the pond was very clear. This could be an indication of reduced FS loading to the pond. Thus, in spite of the real and potential dangers associated with the FS handling and reuse mentioned in the Sub-section 6.8.1, it could be inferred from this section that appropriate reuse of FS on farms could help improve agriculture, the socio-economy, FS emptying and transport, as well as the environment. On the agricultural front, it could close the nutrient loop; enrich the soil; and increase food production. As far as the socio-economy is concerned, it could create jobs and increase income of emptiers, composters and farmers. When it comes to emptying and transport, it could enhance emptying and transport as reuse demand would exist. With the improvement in the environment, it could reduce FS load to treatment plants and thus reduce environmental pollution.

Box 6.7: Key findings for reuse

- **There is strong demand from farmers for FS as fertiliser. Therefore there is a potential for FS market.**
- **Reuse is popular and acceptable among the user population**
- **Poor reuse measures pose danger to health and safety of farmers, emptiers, and consumers of farm produce.**
- **Good reuse management could improve agriculture; local socio-economy; emptying and transport; and the overall environment.**

7. Discussion and implications of findings

7.1 Chapter outline

This chapter is divided into four sections comprising the discussions and implications of the findings under the hypothesis testing; research questions; and the HCES principles and conceptual framework. The last section of the chapter culminates in the implications of the findings for crosscutting issues of urban sanitation.

In addressing the above issues two things are done:

- i) To provide information from the research findings in Chapter Six that relate to the topic,
- ii) To comment on the critical issues of importance as well as the implications to the study and urban sanitation in general.

7.2 Hypothesis testing

The hypothesis set for the study is that: *The HCES management approach provides an effective management model for excreta and FS emptying, transport and disposal in the urban areas of low-income countries.*

This hypothesis guided the thesis into examining whether the HCES approach is workable in achieving effective management of the urban FS emptying, transport and disposal in the low-income countries. In view of this, the findings show that:

- Households are responsible for the decision-making and payment of emptying and transport of their FS which are done with different emptying methods and times. This fulfils the basic assumption of the HCES model.
- However, the transporting and the disposal of the FS are done by the emptiers who dispose of the FS indiscriminately within the neighbourhoods without being regulated, controlled, monitored or punished by the local authorities.

- There is lack of effective communication and consultation among the FS stakeholders as far emptying, transport and disposal are concerned. This and the antecedent point suggest that there is lack of consultation and consensus building which the HCES encourages for effective management of FS.
- There is demand for reuse but is not officially supported and marketed by the local authorities.

These findings in the light of the HCES principles and the basic model assumption in the HCES approach that households are the source of excreta generation and therefore take the basic decisions on hygiene and other environmental services at their places of residence is right. However when it comes to the neighbourhood, community and city wide levels, the households' decisions do not determine how the urban FS emptying, transport and disposal are regulated and managed. This shows that if the urban FS management emphasis is placed on the households as the current HCES approach suggest, then they (the households) can only provide very limited management opportunity for urban FS emptying, transport and disposal. Therefore the HCES management emphasis has to include the municipal and local authorities before it can be effective. Thus, the HCES approach needs more improvement in order to address the urban sanitation problems more effectively. In order to achieve this, the following actions could be recommended to the sanitation stakeholders within the HCES approach:

- pit or septic tank size should be based on the housing density in the area;
- on-plot latrines, and their emptying services and prices should be streamlined to increase emptying efficiency. .
- holding tanks (transfer stations) should be built within the communities for temporary storage of FS or fresh excreta that need more re-emptying in a relatively short period of time.
- community based disposal, treatment or reuse could be encouraged.
- check the site and house layout in respect of the building lines and plot boundaries in order to position the latrine facility in the compound or

yard in such a way as to allow access for emptying of the pit or the septic tank;

- to plan and budget for pit or septic tank emptying on regular basis
- to use the latrines appropriately in order that their contents could easily be emptied and disposed of to allow the latrines to be used more or less permanently.
- monitoring and coordination of the emptying, transport and disposal services should be broad enough to cover all the interfaces and regularly done to avoid indiscriminate disposal in the communities.

7.3 Discussion and implications of findings under the research questions

This section discusses the quantitative and qualitative findings under the research questions in a manner that relates the findings to wider sanitation issues. The appropriate research questions are restated to guide the discussions accordingly.

7.3.1 The primary research question

To what extent is the HCES approach applicable for effective management of the urban FS emptying, transport and disposal?

This section discusses the themes of technology; finance; knowledge, attitude and practice (KAP); service quality; disposal mechanisms; and reuse in an attempt to answer the primary research question.

Technological issues:- The HCES management approach encourages involvement of the key stakeholders, including the households, in the decision making for sanitation issues in the low-income urban communities. Since the landlords of the households in the study area take decision on the establishment of the appropriate latrines as well as the associated emptying,

transport and disposal, the HCES approach could help to involve them effectively in the urban FS emptying, transport and disposal management..

The conventional technologies for emptying are effective but too expensive and complex for the informal small scale manual emptiers who operate without financial assistance and any capacity development programme. The actual cost of emptying using the conventional equipment may be too high for the poor households. However, the findings do suggest that subsidising pit emptying operations without efficient profit and loss analysis might not be sustainable as it was evident with the municipal authorities who could not raise sufficient funds to maintain their broken down vehicles because of offering too much service subsidy. The small scale emptying equipment which could have provided affordable alternatives to conventional emptying tankers was not available for assessment and so its effectiveness could not be tested. These discussions point to the fact that putting up the right latrines and emptying, transport and disposal facilities requires capacity development in areas of finance; education, knowledge and skills acquisition which could be obtained beyond the city as recommended by the HCES principles..

Financing issues:- Pit emptying entails capital and operational costs. Therefore before emptying and transport could proceed successfully, profit and loss analysis should be done to ascertain profit and loss possibilities. The findings were limited mainly to the operational costs which showed that the price for emptying and transport services varied widely among the households due to the heterogeneities in latrine technologies and uses as well as the emptying methodologies. This makes it challenging for service operators to charge a standard emptying price for households within the same neighbourhoods. Therefore decision for emptying price mechanisms may require the involvement of the households, the emptiers and the local authorities with the requisite capacity to understand the implications of service pricing. The latter, though challenging, is encouraged by the HCES approach.

Knowledge, attitude and practice (KAP) issues:- The finding established that users' ignorance and behaviour towards latrine use influence emptying

prices and disposal tendencies. Therefore it is important that, within the HCES approach, municipal authorities or other sanitation institutions educate the households, the local artisans who build latrines and the emptiers to understand the inter-relationships between latrine technology, latrine use, emptying technology and methodology and their implications for price for emptying and transport.

Service quality:- In Section 6.6.3, users blamed the emptiers for their poor reaction times to service; cost for emptying, poor service delivery, improper and unhygienic way of disposing of the excreta. These, as well as the poor communication links between the users on one hand and the emptiers on the other, compound the services delivery problems. Therefore, the HCES approach could provide a forum for discussions and training for the service providers to understand what their customers require them to deliver. The forum for discussion and consultation can provide interaction and communication links between the service providers and their customers so that complaints and problems facing each other could be settled to the satisfaction of all.

Access and disposal issues:- The distance required for the excreta or the FS to move from the household depended on the type of the household latrine as well as the emptying technology and method used (Sections 6.3.1.2; 6.3.5; 6.3.6; 6.7). Four main disposal mechanisms were apparent from the findings: i) open defecation; ii) burial within the neighbourhood; iii) farm disposal; and iv) disposal at an official disposal site. These disposal mechanisms show that FS or excreta transport within the neighbourhood, community and the city takes many disposal routes. This haphazard disposal mechanisms should be discouraged and replaced by appropriate disposal measures. In order to be able to do this successfully, there is the need to engage all the key stakeholders such as the households, the neighbourhood, the community as well as the whole city through appropriate management approach such as the HCES. Controlling and managing urban excreta or FS disposal effectively should entail a continuum of activities or processes that involve appropriate byelaws, monitoring and reporting mechanisms with punitive measures. Mass

media like radio, TVs and posters could add to the effectiveness of communicating sanitation messages to the households and the public at large effectively.

Reuse issues:- The HCES approach encourages reuse. The findings showed that there was a high level of acceptability and practice of reuse in the study area. From the reuse findings, it was inferred that reuse could enhance emptying, transport, disposal and treatment efficiencies, but posed dangers to health and safety because it was improperly handled. This implies that there is the need for the municipal authorities to set up a division with clear roles and mandate to oversee reuse activities in the municipality. However doing that will also mean more responsibilities, skill development and funds which could serve as constraints. It would also mean organising training and education to farmers about safe reuse measures.

Discussing of the thematic issues under the primary question, shows that the HCES approach could provide effective management of the urban FS/excreta emptying, transport and disposal at the study area. Key within the HCES approach for the FS management is the need for education and skill training concerning appropriate latrine construction, its appropriate use and emptying requirements. Besides there is the need for financial assistance for acquisition of improved equipment by the informal manual emptiers; as well as good planning; communication; and improvement in customer-client relationship.

7.3.2 The Secondary questions

The secondary research questions are also discussed in the light of the findings and analysis to ascertain whether the questions are appropriately answered.

7.3.2.1 What are the cost elements of the emptying, transport and disposal of excreta or FS in the urban areas?

The objective is to investigate the cost of emptying, transport and disposal.

The findings indicate that the price for emptying pits varied widely due to several factors that included subsidy; the negotiation tactics of the users; the pit contents; familiarity relationship with the emptiers; and pit's size, access and means of emptying. These factors indicate that users' behaviour played a role in emptying prices. This confirms the literature in Section 2.9 that users' behaviour could affect sanitation services. Thus the appropriate change in user behaviour towards latrine use; users' price negotiation skills (Section 6.4.1.1); and appropriate finance arrangements such as surcharges and provision of subsidy (Section 2.7.3), as well as, could lead to reduction in cost of emptying and transport. This is necessary because affordability and willingness-to-pay is the key to sanitation sustainability.

From the findings, a farmer in the study area could pay between 0.8% and 7.9% of his income on pit emptying and between 8.3% and 15.9% on bucket latrine collection. This could be quite burdensome to the farmer and, for that matter, the poor in the urban areas. Nevertheless, it is also important to note that any payment arrangement should be such that it does not jeopardize the income earnings of the emptiers as their livelihoods and the sustainability of the emptying service depend on this. Thus it is not only the willingness-to-pay or ability-to-pay required of the users that determines sustainability of pit emptying price but also the willingness-to-empty by the emptiers at the users' willingness-to-pay price.

Besides, bit payment for bucket latrine was preferred by users to the relatively cheap bulk payment for pit emptying (Section 6.4.2). The implication here is that pit sizes could be reduced to increase the frequency of emptying that could allow for instalment payment by households

The implications of all the above discussions regarding emptying prices for the household latrines are that:

- Households are solely responsible for the payment of the emptying services and therefore their concerns and involvement regarding urban FS emptying and transport are necessary.
- Emptying prices can vary from household to household even within the same neighbourhood.
- From the findings, the prices households have to pay for their FS or excreta emptying depend on the type of latrines used; their behaviour towards latrine use and pit contents; their bargaining skills and good human relations with the emptier as well as subsidy. This implies that pure market forces that thrive on profit maximization may work in this case. Therefore there is the need to set up appropriate regulations by the local authorities on price mechanisms for emptying and transport services. It also implies there would be the need for education and sensitization of the households towards latrine choice and use as well as the emptying requirements. Households should also be educated about the need to establish good relations with their service providers to benefit from price reductions as well as good service provision. Besides, special attention should be paid by urban on-plot sanitation authorities and households regarding the type and size of pits and means used to empty them.
- There is also the need to involve the use of the small scale emptying and transport technologies to supplement the emptying services of the conventional vacuum tankers and rudimentary manual emptying tools in order to address the accessibility and other cost concerns.

7.3.2.2 What are the main constraints to the effective excreta/FS emptying, transport and disposal in the urban areas?

Objective: To investigate the main constraints to the effective urban FS emptying & transport and disposal.

The main constraints found in this study concerning the effective excreta/FS emptying, transport and disposal were about the issues of technology; finance; knowledge, attitude, and practice; and access for emptying.

The technological constraints concerned the latrine and the emptying technologies. The type of latrine technology influenced the disposal tendencies. Thus, the less improved the latrine technology, the greater the tendency for its content to be disposed of indiscriminately closer to settlements (Section 6.7.2.4). Poor latrine design prevented the placement of an anal cleansing bin and so bulky anal cleansing materials were put directly into the pits which affected both filling rate and mechanical emptying. It also contributed to the rapid filling of some pits through infiltration of rain or flood water.

The cost of buying conventional vacuum tankers was too high for the small scale informal manual emptiers. And since the small scale informal emptiers were not offered any subsidy or financial assistance they emptied at high prices (Sections 6.4.1.1; 6.4.2; and 6.4.3). On the other hand, the municipality, which was assisted by the government and so provided much subsidy to pit emptying, had problems getting enough funds for maintenance of their emptying equipment when it breaks down. This implies that, whereas it may be helpful to offer financial assistance to emptiers for the purchase of some emptying equipments, it may not be that helpful to subsidize the emptying price for the households as this may not be sustainable.

Lack of knowledge as well as poor attitude and behaviour towards latrine use (Sections 6.5.1 and 6.5.2) created accessibility, emptying, transport and disposal problems. For example double alternating pits being used concurrently by users (Section 6.3.1.5; Cotton *et al*,1995) meant that all the double pits could be filled up at the same time with significant amount of fresh excreta that could pose health threats to manual emptying. Some structures in the neighbourhood that blocked vehicular access for mechanical emptying increased the price of emptying (Section 6.7.1) as a number of siphoning hoses had to be joined in order to reach the pit from afar. This required more

energy for siphoning the sludge. Besides, the materials users put into the pit also compound the problem of emptying.

Looking at the above discussions, it could be inferred that technology; finance; as well as knowledge, attitude and practices could be key constraints to urban FS emptying, transport and disposal.

7.3.2.3 How far is the excreta/FS transported from the Households to the disposal points?

.The objective: To investigate how far excreta collected or emptied is transported away from the households

The findings established that about 50% of the households had their latrines situated between <100m and <500m from informal disposal points. Only about 10% had their latrines considered to be very far away from the disposal points. As a proxy, these were used to design the origin-destination figure in section 6.7.2.6, from which it emerges that the disposal mechanisms were more concentrated near the sources of generation and reduce in concentration as one leaves the sources of generation of the faecal wastes towards the suburbs of the city. This means that there is huge potential of human–faecal contact within the city and this could pose health and safety risks as well as environmental concerns. Thus, the households, neighbourhoods and communities living within and closer to the city centre should put more effort into managing their excreta more effectively in order to reduce faecal contamination in their environments.

7.3.2.4 What are the perceptions of the users (customers) about the quality of the emptying, transport and disposal service provided by the emptiers?

Objective: To investigate households satisfaction levels with the emptying and transport services they receive in their communities.

The research findings indicated that the conventional mechanical emptying and transport was more appealing to households than the manual emptying and transport (Section 6.3.6.2). But it was the manual emptying that featured prominently in the communities. Contemplating why mechanical emptying with all its advantages (efficiency and cost effectiveness) were not used to empty all the latrines, the following inferential issues from the findings come into focus:

- i) Majority of households interviewed used bucket latrines which lacked any mechanical emptying technology to empty them.
- ii) Mechanical technology was not used for all latrines not because of cost considerations but other issues such as lack of good and efficient communication channels between mechanical emptiers and households; mechanical breakdowns; accessibility problems; and obstructive objects in latrines that discouraged mechanical emptying.

The trend of satisfaction with price of emptying was not consistent among households (sections 6.4.1-6.4.2). Although the majority of households declared satisfaction with low emptying prices others would not mind relatively high emptying prices if services were satisfactory . The diverse satisfaction levels with the wide variation in price for emptying make it difficult to set a 'one size-fits-all' emptying service price for the city where households in the same neighbourhoods or communities have different latrine technologies, emptying requirements and abilities to pay.

Disposal mechanisms were far from satisfactory to the users as many of the excreta were improperly buried. In particular, the disposal of the contents of the bucket and simple pit latrines was least satisfactory (Section 6.5.1).as it was more messy. This means that the local authorities are not doing enough monitoring or instituting sufficient measures to prevent indecent disposal.

As far as the quality of service was concerned, most households had problems with the service providers' reaction time to duty. The reaction time

for emptying the latrines was a persistent problem for almost all the households.

The motivation factors for households to empty their latrines promptly could serve as sensitization factors to educate users to empty their latrines promptly. What has not been established is what can also motivate the behaviour of the service providers to offer prompt and efficient service to the satisfaction of the households. This implies that to improve the emptying, transport and disposal services, it is necessary to educate not only the households but also the service providers to act more responsibly.

The findings and explanations under this section provide the following noteworthy points for on-plot sanitation planning in a city:

- The service from mechanical emptying satisfy households more than that from manual emptying because of less mess and more efficiency.
- Households are not satisfied with the reaction time of service providers to duty and their overall service quality. Therefore there is the need for education and training for FS emptying service providers to improve their services to the satisfaction of the households.
- The disposal mechanisms in the communities are not satisfactory. Therefore disposal byelaws should be strengthened. At the same time, there is the need for strong monitoring of disposal mechanisms in the urban areas.
- The heterogeneity that exists in the households' latrine technologies, culture and socio-economy in the urban communities could be challenging for the service providers and urban authorities to arrive at a common emptying service price that satisfies everyone in a given city. It would therefore be more expedient to decentralize the emptying and transport services for effective management.

7.3.2.5 What opportunities exist for reuse in the communities after emptying and transport of faecal sludge?

Objective: To investigate the social acceptability of FS reuse in agriculture and how this may influence emptying and transport

The findings show high interest and demand for FS reuse. There is therefore opportunity for large scale market for FS in the area. More demand and the need for supply to meet the demand requires a good marketing strategy where actors within the industry should have the capacity to understand the market dynamics and also confront any challenges that exist or emerge.. With more demand for FS and the requisite supply to meet the demand, there are opportunities for more transport of the FS which in turn will affect emptying frequency and efficiency. Also jobs would be created; food production will increase; and less FS will go to the treatment plant.

7.4 Implications for the HCES principles and concepts

This section is subdivided into two parts which are discussed below as implications for the HCES principles and conceptual frameworks

7.4.1 Implications for the HCES principles

In terms of the principles and model of the HCES approach, the findings agree that households are responsible for their waste generation and emptying costs. In some cases they are also responsible for the emptying complications and high price for emptying through their inappropriate behaviour towards the latrines. But they were not involved in charging the fees for emptying or in regulating and monitoring the emptying services. The emptying, transport and disposal mechanisms in the study area were inconsistent with the descriptions of the known HCES model since they were ad hoc, fragmented and not coherent.

One of the principles of the HCES approach is that stakeholders belonging to particular zone act as members of that zone where decisions are reached through consultation with all stakeholders affected by the sanitation problem. But the findings reveal that the key stakeholders, which included the households and emptiers, did not live in the same settlement zone and also lacked effective communication and consultation regarding emptying, transport and disposal in the community. The implication is that practically on the ground, effective communication and consultation could be difficult in the HCES approach. It would therefore be necessary to study the factors that impede effective communication and consultation in the HCES management approach in order to make it effective on the ground. Another weakness of the HCES approach that this study has exposed is the fact that emptiers for urban excreta management need not necessarily belong to the same zone in the city before they could become members of that zone.

Another principle of the HCES approach was that waste should be seen as a resource and that sanitation problems should be solved as close to their source of generation as possible. The study confirmed that FS was seen as a resource by the community except that its use was not regulated and officially approved by the local sanitation authorities. Thus, although the FS reuse was popular, it was poorly practised devoid of any appropriate officially approved methods and measures. The implication is that the concept and practice of FS and, for that matter any waste, as a resource in the urban areas should be backed fully by the government and the local authorities before it could become effective. Reuse was more prevalent on peri-urban farms. Only a few examples of isolated reuse was found in the gardens and small farms inside the city. This against the backdrop of much more FS disposed within the city suggests that few solutions to the FS waste were found close to the source of generation. The implication is that solving waste, especially FS, close to its source of generation as suggested by the HCES approach may not be feasible in the city context.

7.4.2 The implications for the conceptual framework

One of the concepts developed for this study is the fact that households are mainly responsible for their sanitation and waste generation needs, and therefore they bear the brunt of the cost of emptying and transport of their FS sludge or excreta. The findings from the study proved that households are mainly responsible for payment for the emptying and transport services of their excreta or FS. The subsidized emptying services offered by the municipality do not target the poor per se, but affect anybody who requests the service, whether rich or poor. This raises a concern of the rich enjoying more of the municipal subsidy than the poor even though the study did not investigate this concern. The study also shows that households do not only bear the brunt of the cost of emptying but also do contribute towards the high cost of emptying due to their inappropriate use of the latrines.

Another concept developed was the fact that urban households in the low-income countries have fragmented and heterogeneous behaviour, economic status, latrine technology, and services. Therefore a unique strategy for serving the urban households with emptying and transport service should reflect these peculiar characteristics. The findings confirmed this concept. Households' behaviour towards latrine use differed from household to household due to differences in the latrine technologies as well as household knowledge, attitudes and practices. This also contributed to different emptying methods and technologies as well as emptying prices. This implies the need for education and sensitization programmes to assist households to induce behavioural change and understand the cost and emptying implications of their latrine choices and uses.

It was also conceived for the study that understanding the way FS is transported and disposed in the city is essential for its effective management. The findings proved that this was right concept. This is because the findings indicate that how far the excreta/FS is transported has something to do with emptying and transport methodologies as well as the disposal mechanisms. One idea, which was not part of the original concept but was found to be

helpful, was the fact that understanding the type of latrine technology is also necessary for effective FS management.

Lastly, it was conceived that the mode of transport and disposal could provide useful clues for managing emptying, transport and disposal services more effectively using the HCES approach. This concept too was right because the findings showed that the transport and disposals in the city were largely informal and indiscriminate. This requires a comprehensive management system that understands the causes, the processes and the linkages for such services. This implies that effective management of urban on-plot sanitation system should not be treated as a piecemeal service but as a coordinated system that includes all the unit processes comprising the emptying, transport, disposal reuse or treatment.

7.5 Implications for cross-cutting issues in urban sanitation management

This section discusses the implications of the findings under the sanitation issues raised in the literature that are important for urban sanitation management.

7.5.1 Latrine technology

The more improved forms of latrines, such as the WCs, double alternating pits and single VIPs, which had less emptying and transport problems could be promoted in the urban communities. This implies that households who choose bucket and simple pit latrines should be educated about the collection and emptying problems as well as the health and safety issues associated with them. Generally, sanitation authorities and households should look at the big picture of the urban on-plot latrine technologies in terms of their design, use, and location so that they can be conveniently used with less mess and risk as well as more accessible and cost effective emptying operations.

7.5.2 FS Emptying and transport

The empirical finding in this research proved that the high cost of emptying and transport of the FS are a concern for the poor. Among the means of emptying, manual emptying was unhygienic, messy and more expensive than the mechanical counterpart due to lack of subsidy. This means governments; NGOs and other sanitation financiers could assist the manual emptiers with effective and affordable emptying tools so that they can operate efficiently with minimal mess. Or, shift away from the manual emptying and move incrementally to fully mechanize emptying. This implies that engineers should review the spectrum of emptying technologies available for low-income countries, fill technological gaps (based on the various emptying problems), and come up with technologies that can effectively address each emptying scenario.

7.5.3 Financing emptying and transport

The cost of manual pit emptying and bucket collection was borne solely by users. Behavioural and attitudinal problems as well as lack of understanding about excreta and FS management issues compound the emptying cost to the users. Subsidised emptying could be offered to the low-income earners to defray their emptying costs. In the HCES management approach, consultations and engagements with the households, the emptying operators, and the municipal authorities could help to reach an affordable emptying price range for all. In order to avoid emptying complications and costs, the households and the authorities should understand the cost complexities and operational implications associated with their choices, practices and attitudes right from the beginning of establishment of any sanitation option.

7.5.4 Social issues

In this research, women household heads were found to be very few (3%) as against 97% for men (Section 6.2). At the household level, women's roles in excreta management were restricted to collection and disposing of stools of

infants and the vulnerable in the households. Handling of the fresh excreta in the household requires techniques that can prevent faecal contamination and spread of infection in the households. Therefore women should be included in the household sanitation matters and assisted with the capacity to address the management of faecal matter appropriately.

The users' knowledge, attitude and practice or behaviour were found to constrain both manual and mechanical emptying through the items dropped into the latrines as some of these could injure manual operators and hinder mechanical operations. Behaviours such as construction of kiosks by the users for selling items and putting up of electric poles in the streets by service providers could block access to vacuum tankers and other emptying equipment (Section 6.7) In a situation where mothers could eat their infants' faeces, superstition could be seen as very critical in hygiene promotion programmes (Section 6.6.2). As far as the manual emptiers were concerned, social stigma was a factor that could impede their work (see Section 6.6.2).

Research carried out in high density low-income urban areas has revealed that strong social factors motivate people to invest their own limited resources in improving sanitation facilities and practices (WELL, 2004; IP3, 2004). However the literature did not imply the same for pit or bucket emptying. So the motivation factors that drive households into getting their latrines emptied found in this study could be used as basis for education, training and sensitization programmes.

Household's perceptions about the quality of the services they receive as well as an effective complaints' handling system could play a central part in the development of their rights and consumerism for the services they receive (Skelcher and Walsh, 1992). This implies that service providers should have a good complaints handling system to deal with clients' complaints satisfactorily. Therefore, the following steps of complaints system adapted from Cavill (2005) could be effective to address the households' complaints satisfactorily:

- Straightforward talk,
- Guaranteed response mechanism,

- Setting clear times or standards for investigation and response,
- Making the link between grievances and disciplinary procedures,
- Providing feedback for management decisions to prevent a recurrence of the problem.

But understanding and putting the above-named measures into action by the emptiers, especially the informal small scale manual emptiers, will be a daunting task that would require full training and assistance.

7.5.5 Disposal mechanisms

Four main routes for disposal of the FS were noticed: Open defecation; burial disposal within the neighbourhood; disposal on farms; and disposal at the official disposal site (Section 6.7.2). Of particular hygienic concerns were the faecal mess surrounding some latrines; the open defecation; and the disposals within the community and the farms, including urban and peri-urban farms. These disposal mechanisms had links with the prevailing types of latrines. Latrines in bad hygienic and ventilation shape discouraged use and encouraged open defecation. This therefore calls for the capacity to design on-plot latrines appropriately. It also means that regulations and byelaws should be improved and enforced.

Emptied excreta from the bucket latrines and sludge from most of the manually emptied pits were either buried within the community or reused. This means that a fairly significant chunk of the communities' faecal matter resides close to them (Figure 6.2 in Section 6.7.2.6). In order to confront these problems effectively there is the need for regulatory measures that would allow closer monitoring of the emptying and transport services in each neighbourhood or community.

Other consequences of indiscriminate and uncontrolled dumping, poor burial and irresponsible farm reuse, are that they constitute attraction points for scavenging animals that could spread faecal and microbial contaminations around. Denudation can also wash poorly disposed excreta into low

depressions which could serve as a culture medium for pathogens. This therefore calls for good policy, regulations and enforcement measures from the authorities to streamline and manage excreta and sludge disposal within the low-income cities where on-plot latrine is the main sanitation choice. But doing so would require that the local authorities have the capacity to understand, plan and monitor the linkages of urban sanitation issues which, unfortunately, this study did not find in the study area.

7.5.6 Planning

Poor latrine design, accessibility problems, and unplanned disposal mechanisms could hinder the smooth operations of urban on-plot latrines. Therefore there is the need for effective urban sanitation planning that would allow access to emptying and transport as well as appropriate disposal of the excreta or FS. Ideally communities should be well planned before settlement by taking into consideration the latrine technologies, their accessibilities, emptying, transport and disposal requirements.

7.5.7 Policy and regulations

The research findings have revealed that emptying, transport and disposal mechanisms as well as FS reuse were, to a large extent, informally organized and unregulated. As fresh excreta and FS which are not fully treated are harmful to handle, there is the need for these to be properly regulated, controlled, guided and monitored through an effective policy, regulatory and management framework to ensure protection of public health. Therefore urban emptying, transport and disposal policy and regulations should take into consideration the following key issues:

- the latrine technologies available in a community,
- the contents of the FS to be emptied,
- how and when the excreta or the FS should be emptied
- how and where the FS should be transported, and
- how it should be disposed, treated or reused.

In the light of this study, the existing principles and model of the HCES approach need to be modified in order to address the urban FS emptying, transport and disposal issues effectively. Key issues worthy of consideration include: disposal problems at the interfaces of neighbourhoods; peculiar capacity development needs; regulation and monitoring of emptying services as well as financial arrangement for the emptying and transport. As a result, the next section proposes an HCES approach model that could be suitable for managing urban FS emptying, transport and disposal in the low-income countries more effectively and systemically.

7.6 Proposed HCES management solutions for urban FS emptying, transport and disposal.

The findings reveal that urban FS management problems stem from the households, the emptiers as well as the municipal and local authorities. The key management issues concern emptying difficulty and mess; improper and interfacial disposal problems; as well as lack of financial, skills and technical capacity to adequately address the problems. Also lacking is the understanding about the urban on-plot sanitation linkages; lack of proper regulatory mechanisms; and poor monitoring and communication network.

Emptying mess, improper and interfacial disposal problems are caused by the emptiers, while emptying difficulty is caused by households who block access to pits and put into the pits inappropriate objects. Financial problems concern both the municipal authorities and the households. The financial responsibility of the municipal authorities should include subsidizing the emptying and transport services as well as provision of treatment facilities and holding tanks (refer to the glossary) as transfer stations for the FS. In the case of the households, they are to pay either partially (in the presence of subsidy) or fully (in the absence of subsidy) for the emptying and transport services. Skills and technical capacity to manage emptying, transport and disposal services are needed by the emptiers as well as the municipal and local

authorities who have to regulate and monitor the services. Farmers reusing the FS also need capacity to understand FS application to the land in a hygienic and productive way. Such training and skill development should be provided by the municipal authorities themselves or by an external governmental institution, benevolent organisations and other development partners as the situation may demand. It is also the municipal and local authorities who should regulate and monitor all FS activities as well as provide the platform for effective communication network for all the stakeholders involved. Even though, understanding urban sanitation linkages is the responsibility of all the stakeholders, it is the municipal authorities who should take the lead in the series of efforts to plan, educate, implement, regulate and monitor all sanitation programmes concerning the on-plot sanitation services. The role of sanitation advocacy groups, the media, NGOs and government development partners is to discuss with or pressurize the government about the sanitation problems in the city. Where the government or the local authorities are insensitive to the sanitation concerns raised, the households and the communities can be sensitized about the sanitation problems through media, forums and campaigns which could be organized by sanitation advocacy groups so that they can put pressure on the authorities to help address the problems.

Critical look at the problems and the responsibilities of the stakeholders involved reveals that the municipal and the local authorities should be the primary target to get the FS management in the city started and run in a coherent manner. This is because they have the mandate for rules and regulations that control urban sanitation services. Thus, it is the municipal authorities who should put in place good sanitation policy, as well as regulatory, monitoring, evaluation and communication mechanisms that can ensure the smooth operations of the emptying, transport, disposal and reuse services. Since the research did not find the authorities playing these roles in the study area, it is proposed as part of the solution that the sanitation advocacy groups such as the NGOs and the media as well as the sanitation development partners should trigger or start the management action by raising the awareness and or putting pressure on the authorities to initiate and

lead the urban FS management process. In order that the urban FS management will be household centred, this study recommends that the views and concerns of the households should be collated by the authorities (through strategies such as survey, interviews, forums or focus group discussions) and then factor these views and concerns into the sanitation policy, regulations and plans. This should be done because households are fragmented and do not have an organised front or administrative structure that can organise, plan and implement FS management programmes in a coherent manner. In addition, the sanitation authorities, the media and concerned NGOs, should help educate the households through mass education about appropriate FS management issues, particularly with the regard to:

- the call for emptying of their latrines before the pits or buckets fill up to the brim.
- the avoidance of putting improper materials into the pits.
- preventing blockage of access to the emptying and transport services.

The authorities should also encourage communication between themselves, the households, the emptiers and the farmers, who reuse FS, by setting up offices or communication links in the communities that will allow for closer and frequent interaction among the stakeholders to allow for exchange of views, settlement of disputes and complaint of grievances concerning impropriety of service.

Putting all the above ideas together in a management framework, results in a diagram below that portrays the flow of management duties and communication links that are needed for an effective urban FS management. Under the diagram, there is a key table explaining the flow in the form of arrow signs.

Figure 7.1: Diagram depicting an effective management of urban FS for Tamale and other low-income cities

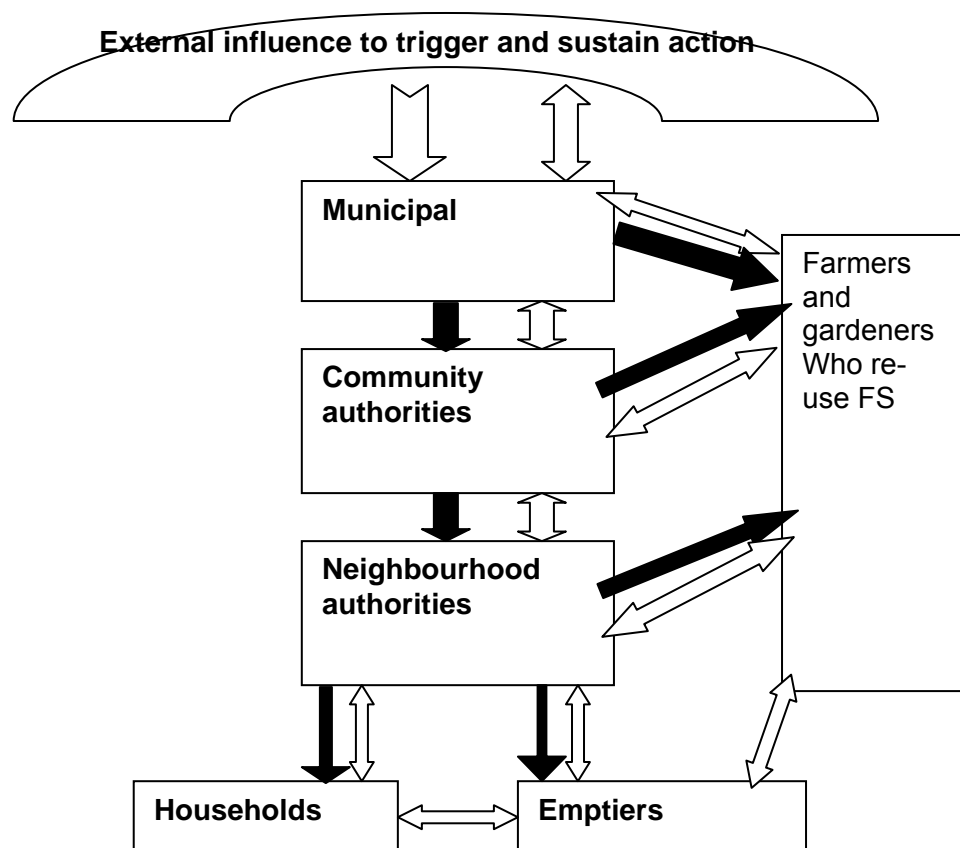
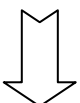

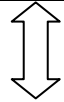


Table 7.1: Explanations to Figure 7.1

KEY	EXPLANATION
	Influence on the municipal leaders from external sources such as the donor community, development partners, advocacy groups, NGOs and the media
	Implementation and control line for policies, plans, strategies, regulations, and monitoring
	Two way communication and interaction links between the stakeholders

As explained in the Section 7.2, households' role in the urban FS emptying, transport and disposal is limited only to their individual latrines. The households are fragmented and do not constitute a formal administrative structure that can legitimately organise, plan and implement FS management programmes without the permission or mandate from the local authorities. Thus, in the management hierarchy, it is the municipal authorities who should formulate and review the FS management policies and regulations as well as monitor and evaluate the programmes periodically. It is the community and neighbourhood leaders who should monitor the FS services in their areas of jurisdiction and ensure that there is full compliance to the regulations. Apart from advocacy and putting pressure on the sanitation authorities, NGOs and benevolent organisations which want to engage in the FS management activity should collaborate with or seek the consent of the municipal and local authorities to ensure that they work within the policy framework and in conformity with regulations so that there is harmony in the overall management strategy. The media and other pressure groups should always remind the authorities to deliver the necessary sanitation programmes that will benefit all, especially the poor and the vulnerable.

7.7 Chapter summary

The chapter is concerned with the discussions of the research findings in the light of the research questions and the hypothesis with the wider implications for management of urban sanitation. The significance of the chapter is the recognition of the fact that the HCES has limited capacity to address the urban FS problems effectively unless it puts greater emphasis on the need for active participation of the municipal and local authorities. This has led to the proposal of a management approach with specified roles of the municipal and local authorities as well as the households and the other sanitation stakeholders. The following key points are deduced from the chapter:

Hypothesis Testing

The hypothesis that the HCES approach could manage urban FS emptying and transport effectively in the low-income communities was proven to be limited in its current state. The explanation is that although the households are responsible for urban on-plot sanitation waste in terms of generation and payment for the emptying services, they are incapable of controlling what goes on beyond their areas of jurisdiction.

Testing of the HCES principles and the conceptual framework

The findings showed that the approach though good, needs modifications to adapt to the dynamics, the linkages and the challenges in the urban areas. Some of the challenges facing the adoption of the HCES approach are:

- i) Households, neighbourhoods and communities are not as clearly demarcated in the low-income urban communities as the concept pictorially depicts. There is no management arrangement made within the model for the interfaces within neighbourhoods and communities. Besides, households' mandate for FS management covers only their areas of residence while the neighbourhoods and communities may also lack clear mandates and roles for urban excreta disposal issues in the interfaces.
- ii) Even though the HCES approach promises grounds for effective consultation and consensus building among the stakeholders as a prelude to the launching of any sanitation programme, it is practically difficult to start the management process as well as provide a platform that could effectively engage different interest groups.

The Need for Capacity development

The research findings show lack of understanding and skill about the appropriate way of managing the on-plot latrines and their excreta in terms of emptying, handling, and disposal and reuse issues. Therefore, the adoption of

the HCES management approach will need both the technological and managerial skills in order to effectively manage the various urban on-plot systems and their emptying and disposal linkages at all management levels in the city. Besides, there is the need to support the activities of the manual operators so that they can do their work well to avoid emptying and disposal mess.

Women's role

Women who keep the latrines and homes neat; clean up any mess after emptying as well as collect and dispose of stools of infants and the vulnerable, do not have much voice and influence in urban sanitation management. Therefore, urban sanitation management should pay particular attention to the roles of women and the vulnerable in the societies.

Guidance points for decision makers

Urban FS/excreta management across cities should consider key issues such as the socio-economic diversities and emptying price mechanisms; latrine use practices; the appropriateness of the latrine in terms of technology, use, location and access; as well as the emptying technologies and methods. To this end, it would be advisable to streamline technologies and systems concerned with excreta emptying, transport and disposal in the urban areas.

Decision narrowing

Instead of concluding on, or narrowing decisions down to, any universal set of principles to practise HCES or any urban management approach, practitioners should have open-mindedness and be versatile in their approach to planning and organizing urban sanitation programmes. This may be achieved by always leaving room for improvement, innovation and modifications peculiar to any urban setting. This means the need for capacity development at all levels of management. Therefore, the sanitation authorities, practitioners and service providers need skills, techniques and capabilities to learn and adapt pretty fast as time goes on. Household should also be educated to understand the

implications of their sanitation choices and actions.

The dynamism in the HCES approach

As urbanization, technology, socio-economy and culture are dynamic so shall the principles of the HCES approach be in order to confront the urbanization, technological, socio-economical, cultural and urban spatial dynamics.

8. Conclusions and recommendations

8.1 Chapter outline

This chapter discusses the conclusions of the research; the significance of the findings and contribution to the body of knowledge; the limitations of the research; and the recommendations for both the urban sanitation authorities and practitioners.

8.2 Conclusions

An extensive literature review on cross-cutting issues around excreta and FS emptying, transport and disposal helped in the process of identifying gaps and weaknesses in knowledge and practice. These gaps and weaknesses helped in formulating the research questions, the hypothesis, and the conceptual and the study frameworks.

The gaps and weaknesses in knowledge established in the literature concerned the following:

- Effective management system for urban FS emptying, transport and disposal in the low-income countries.
- In particular, no substantive information was found relating to :
 - how far the excreta or sludge removed from the latrines is transported to the disposal points;
 - household financial needs and perceptions about the emptying and transport services;
 - the empirical study of effects of disposal distance and accessibility on cost of emptying and transport;
 - households' perceptions about quality of emptying and transport services in their communities, and
 - FS reuse and its implications for emptying, transport and disposal mechanisms.

The following points are key issues concluded from the field work regarding the findings and analysis about the urban FS emptying transport and disposal:

- The contents of latrines from 50% of households were disposed of within 500m of the household.
- FS from manual emptying is more likely to be dumped within the neighbourhood than that from mechanical emptying. Also the less the improvement in the latrine technology, the greater the tendency for its content to be emptied and disposed of closer to settlements.
- About 53% of latrine emptying was done by the informal manual emptiers. However their means of emptying was messy and risky
- Many users (about 42%) could not express what safe disposal is.
- Users' perceptions about safe disposal varied: burial, farm reuse, official disposal site, far in the bush.
- Mere presence of household latrine does not stop indiscriminate disposal unless the latrine is in good condition and users are willing to use them.
- Using 8 users per household latrine, the average volume of FS emptied from pits and tanks per year per household was 1.3m³; while that collected from bucket latrine per year per household was 1.8m³.
- Price for the emptying and transport services varied widely due to subsidy, negotiation skills, inputs into the pits, emptier-user relationship, pit size and means of emptying and transport.
- Bit payments for bucket collection seemed to be less of a problem to the users than bulk payment for the pit latrines.
- Access for emptying the latrines was problematic and increased cost to households. Lack of access and bulky materials dropped into the latrines by the users increased cost of emptying. About 59% of households dropped their anal cleansing materials into the latrines after use.
- Households were generally not satisfied with the quality of emptying services and they complained about the emptiers reaction times to service; cost for emptying; poor service delivery; and improper disposal and hygiene problems.

- Key motivational factors to get the households' latrines emptied in descending order of importance were hygiene, convenience, affordability, flies and odour.
- Reuse was popular and acceptable among the user population and there is a potential for FS market due to the high demand for it by the farmers. It is inferred that good reuse management could improve agriculture; local socio-economy; emptying and transport; and the overall environment.

Considering the effective management system for the FS emptying, transport and disposal, the study concludes that:

- i) The emphasis of the HCES approach on households' involvement in the decision making, planning, and management of urban sanitation is inadequate for an effective city-wide excreta and FS management. Therefore the study recommends the need to trigger management action by putting pressure on the municipal authorities to initiate and lead the management process with clear mandates and roles regarding all the processes, the linkages and capacity development issues for the urban FS management. Since all these issues are dynamic, the HCES approach needs periodic review and modifications to take care of the peculiarities of each urban area.
- ii) The emptying, transport and disposal mechanisms of the excreta and FS, as well as the costs of these, depend on the type of latrines, latrine use and the technology available for emptying and transport;
- iii) Owing to the types of latrines and the emptying methods, more disposal was done closer to settlements.

The literature review and the research findings have therefore the following implications for sector professionals, practitioners, NGOs, institutions and policy makers:

- In the broader context, there is the need for good regulatory and byelaws for supervising; monitoring; and coordinating sanitation programmes more effectively, whilst interacting intimately with households in order to understand their needs and concerns.
- Households' tenure, financial and socio-cultural interests affect latrine choice, use and emptying requirements. Besides, neighbourhoods and communities may not be as clearly defined and demarcated as is demonstrated in the HCES approach diagrams. Interfaces may exist which might be hot spots for disposal problems and pollution since they may not fall under the jurisdiction of any one settlement (i.e. household, neighbourhood or community). Therefore, there is the need to develop capacities at all management levels within the HCES approach to adequately take care of any uncertainties, peculiarities and complexities associated with sanitation systems in any urban area.
- There is the need for sanitation authorities and planners to fully comprehend and monitor human excreta disposal in the city in order to prevent disposal malfeasance.
- There is the need to pay more attention to the way women collect and dispose of the faecal matter of the infants and the vulnerable in the households.
- There is the need to streamline on-plot sanitation system as well as its accompanying emptying, transport and disposal requirements in a city in order to facilitate service provision.
- Municipal authorities, Community leaders, Community-based organizations (CBOs) and households should collaborate more actively to address urban sanitation problems.
- Literature and these research findings have noticed that NGOs' interest in urban FS emptying and transport is very weak even though they play an active role in the other aspects of sanitation. Therefore NGOs

should be actively involved in or support excreta collection and pit emptying in the urban areas.

8.3 Contributions to the body of knowledge

The study has established that the nature of fragmentation of the on-plot latrines and the heterogeneity of the urban excreta/FS emptying, transport and disposal problems found in the study area means that the current principles and model of the HCES approach is limited in content and capacity to effectively address the urban excreta management problems. Therefore modifications are needed in the HCES approach to clearly specify the roles of the municipal and local authorities in terms of regulation, supervision and monitoring of the emptying, transport, disposal and reuse services in all areas of the city. There is also the need to be emphatic about the processes and the linkages of the FS management with the specific capacity development needs. Apart from this, the study has also contributed to the body of knowledge through the following findings:

- The study has contributed to painting a picture about the distance of transportation and disposal of excreta in the city by showing that, the types of latrine and their emptying, transport and disposal mechanisms could lead to a situation where excreta concentration in the city could be more within the city centre and decrease as one moves towards the fringes of the city.
- In discussing the hypothesis, the study suggested some useful points to be adopted in the HCES approach for urban FS management
- The study has proposed an appropriate management framework and developed a general guiding figure for urban excreta or FS emptying, transport and disposal management in Tamale and other cities of low-income countries.
- The study has shown that the choice of latrines and the technological means by which the latrines are emptied can significantly affect disposal mechanisms and cost to the users.

- The study has established that users' knowledge, attitudes and practices as well as latrine use affect emptying and transport costs and operational difficulties.

8.4 Limitations of the research

This research has made an important contribution to the understanding of effectively managing FS emptying, transport and disposal problems that concern urban households. However, the study acknowledges a number of limitations to its findings. Firstly, the study was carried out in a city with a limited variety of on-plot latrines used. Therefore the findings about such latrines may not have wider application to other latrines that were not covered by this research. Secondly, these latrines were emptied with either very basic emptying tools or conventional vacuum tankers. There was no opportunity to ascertain the effectiveness as well as the acceptability of the small-size emptying technologies mentioned in the literature. Thirdly, the data for the research were collected from Tamale, Ghana, with different political, administrative, socio-cultural and economic contexts. Therefore the findings may not apply universally to every urban situation. Fourthly, the study focused only on the household latrines and their FS emptying and transport problems, and therefore fails to address the emptying and transport problems regarding public and communal latrines. Besides the quantitative data obtained were mainly from landlords or caretakers who were mainly men and so their views may not necessarily reflect those of their female counterparts. Fifthly, the study only collected data from on-plot latrines and so discounted other low-cost sanitation systems such as the condominium sewerage which does not need emptying. Therefore, it might be inappropriate to apply the same management approach recommended in this study in a low-income urban community where such sewerage exists.

Despite these limitations of the research, the findings provided credible and reliable information regarding key problems and appropriate management solutions to the urban on-plot latrines and FS or excreta emptying, transport and disposal.

8.5 Recommendations

From the conclusions and the discussion of findings in relation to the key research questions, two sets of recommendations emerge: one for sector professionals and authorities; and the other for further research.

8.5.1 For Sector professionals and authorities

- Emptying technology and methods are critical to the effectiveness of urban FS emptying and transport.
- Attention must be paid to latrine location and technology in terms of use, type, volume, sub- and super-structure developments as these could impact on emptying, transport and disposal mechanisms. Besides, emptying, transport and disposal of FS should be tied to household's affordability and socio-cultural interests or preferences.
- Where on-plot latrines abound in the city, the sanitation authorities should take measures to supervise, monitor and regulate the latrine facilities as well as their emptying, transport, disposal and, where appropriate, reuse mechanisms.
- Community leaders and municipal authorities should take particular interest in monitoring the interfaces and demarcate suitable disposal areas in situations where disposal of FS occurs within the neighbourhood so as to avoid mess and environmental health risks.
- Where development has not started in an urban area, authorities, planners and households should ensure that the appropriate latrines are built at appropriate sites to allow access for emptying and disposal issues.
- Households must be educated more about on-plot latrines in terms of technology, type, siting and function so that they can make the right decisions and choices.
- The services from the informal small-scale service providers (the scavengers or conservancy labourers) are very valuable and therefore their capacity development needs should be catered for in order to improve urban FS emptying services in the low-income communities.

- Project planners and leaders of community-based projects should understand the constituents and dynamics of the communities in which they work, as community is heterogeneous in terms of socio-culture; economy; latrine tenure, technologies and uses.
- Proper contracts should be signed and duly followed to improve sanitation services in the urban communities.
- There should be complaint and conflict management mechanisms to address sanitation concerns.

8.5.2 For further research

- There is the need for harmonization of emptying technology that could achieve sustainable pit emptying in the urban areas without mess and environmental pollution.
- The operations and health status of the manual informal emptiers need more investigations.
- There is the need to investigate how the informal small-scale emptiers could form partnerships with the municipal authorities and other organizations to improve FS emptying and transport.
- The FS reused for agriculture is informal and poorly organized. It may therefore contain both pathogens and chemicals unsuitable for agricultural purposes. Therefore the health risks to fauna and flora associated with FS farm reuse should be investigated.
- There is the need for quantification of urban FS in terms of how much is generated at the household level per given time; how much is transferred from the households and how much is disposed of at various disposal sites within the metropolis at a given time or period. This will help in properly tracing origins and destinations of the human excreta in the city and how to effectively manage them.
- More studies are needed about how women collect and dispose of excreta of infants and the vulnerable in the households; and the impact this has on household health.

- Urban FS management can be more effective if the interfaces are properly understood and taken care of and so this should be further investigated.
- Factors that enhance or constrain effective communication and interactions between households, the emptiers, the communities and other urban sanitation stakeholders at both neighbourhood and community levels should also be investigated.
- There is the need to study into detail the marketing of FS in areas where reuse is popular.
- There is the need to research into the health risks associated with animals scavenging the neighbourhood disposal sites.
- The role and effectiveness of holding tanks as temporary storage for improving urban FS transport as well as the possibility of satellite community based treatment options should be investigated in the urban communities of low-income countries as these can help for effective management of urban FS in the low-income countries

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List of Appendices

Appendix 1: Household Survey Questionnaires

Household information concerning management of urban FS

A. Household information

House number					
Settlement Name					
Respondent's Sex	Male		Female		
Tenure status	Landlord/Caretaker		Tenant		
No. of residents in household					
Residents using the toilet(Users)					
Source(s) of income	unemployed	Civil service	Trader/business	farmer	miscellaneous
No. of income earners in household					
No. of Consumer items in HH	TV	Refrigerator	Radio		
Religion of respondent	Islam	Christian	Traditional belief	Atheist	Other
Date					
Surveyor's name					

1. Is there latrine in household?

Yes. Proceed to question 4 &5	No. Go to questions 2 & 3

2. Why is there is no Latrine in the household?

No space	Unaffordable to construct	Can't maintain it	Other
If other explain			

3. In absence of household latrine, where do residents go to toilet?

Use Public Latrine	Use open defecation	Wrap and throw	Other
If other explain:			

4. Estimate how far the latrine is from motor route (by research assistants).

5. What type(s) of latrine is/are in the household? *Inspect the latrine type(s).*

Bucket latrine	Simple pit latrine	Double Pit latrine	VIP latrine	Aqua Privy	WC to septic tank	WC to sewer	Pour flush single soakpit	Pour flush double soakpit	Other
If other, give details									

6. Why do you think this type of latrine was chosen?

Prestige	convenience	security	affordability	policy
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7 i. Estimate the volume of the pit/pan in household (by research assistants)

7ii. Why did you build the latrine to this size?

Based on no. of users	Based on space available	Based on affordability	Based on Convenience	Based on policy & regulation	Other
If other explain					

8 Apart from your latrine type, mention other types of latrine you are aware of::.....

9. a. Who paid for the construction of your latrine?

Self	Municipality/ government	NGO	Other
If Other explain			

b When something is wrong with the latrine who fixes the problem?

The landlord/caretaker	Tenants	The municipality	Private service provider	Other
If other, give details				

10) Why did you put your latrine where it is now?

Security	Convenience	space restrictions	No reason	Policy guideline	Other
If other, explain					

11. Are you satisfied with the location of your latrine?

Yes	No
-----	----

12. In your opinion what problems do the location of your latrine create in terms of emptying and transport?

B. Emptying services and practices

13.1 If a Pan or Bucket is used, how often is it emptied?

Daily	Weekly	Other
If other, provide details		
How much is paid per emptying of pan?		

13.2 What anal cleansing material is usually used?

Tissue paper	Ordinary paper	Water	Stick	Rag	Other
If Other, explain					

13.3 Is anal cleansing material put into the pit after use?

yes	No
-----	----

13.4 What criterion indicates your pit/tank/pan is full and need emptying?

0.3-0.5m to brim	Excreta/sludge almost to the brim	Difficulty in flushing through	Stench strength from pit/tank	N/A	Other
If other, explain					

13.5 In your opinion, what contributes to the filling rate of the latrine, after the excreta?

Cleansing material	flushing water	infiltration	miscellaneous waste	Other
If other explain				

13.6 When the latrine is full and emptied, how much of the volume do you think is removed?

All	Three-quarters	half	Quarter	Not full yet	Unknown
How much is paid for this removal?					

13.7 Who empties the latrine when it is full?

Landlord/Caretaker	Tenants	Municipal authority	Private service provider	Other
If other explain				

13.8 Who pays for emptying your latrine?

users	Unit committees	Municipality	NGO	Other
If other, explain				

13.9 How long does it take for your pit/tank to require re-emptying?

1-2yrs	3-4yrs	5-6yrs	7-8yrs	9-10yrs	Other
If other explain:					

13.10 How is the emptying done?

Manually	Mechanically
If manually, mention tools/equipment	If mechanically, mention tools/equipment

used.	used.
-------	-------

13.11 To what extent are you happy with the mess free of the equipment used for emptying and transport of Faecal Sludge?

Very happy	happy	Indifferent	Unhappy	Very unhappy
If other explain				

13.12 Do you have problems with your latrine regarding emptying and transport?

No, go to question 14	Yes, proceed to the next question.
-----------------------	------------------------------------

13.13 Which of the following problems do you associate with emptying and transport of latrine contents?

Access to the bucket/pit/tank	Cost	Frequency	hygiene	None	Other
If other, explain					

14. What motivates you to get your latrine emptied?

Sludge Transfer, Disposal and Reuse

15.What do you think happens to the sludge after emptying from the Latrine?

Buried onsite/neighbourhood	Dumped offsite	reused	unknown	Other
If other, explain				

16 Who transfers or transports the sludge to disposal site?

Users	Municipality	Private service provider	Conservancy labourers/scavengers	Other
If other, specify				

17.Who pays for the transfer of the emptied sludge to the disposal sites?

Users	Municipality	NGO
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18 How is the emptied content transported?

Cart	Tanker	Hand or head	Other
If other, explain			

19. Roughly how far is the disposal site from your household? Estimate in m or km

20. Do you believe the Faecal Sludge is safely disposed off in the city?

No	Yes
What do you mean by safe disposal?	

21.How satisfied are you with the cost of emptying and transport?

Satisfied	dissatisfied	Indifferent	Other
If other, explain			

Reuse possibilities

22. Have you heard about the use of Faecal Sludge for farming activities?

No.	Yes.
-----	------

23. How interested are you in FS reuse on the farms?

Interested	Indifferent	Not interested
------------	-------------	----------------

Users perception about management of emptying and transport services?

24. What is the most frequent dispute you encounter with the emptying and transport service?

25 When you observe something wrong with your latrine infrastructure or services to which of the following do you complain?

Nobody	Community leaders	Municipality officials	Private service provider	Other
If other, specify				

26. Are you satisfied with the authority or service provider's response to complaints in your community?

No	Yes
----	-----

27. How satisfied are you with the overall management of sanitation in your community?

Very satisfied	Satisfied	Indifferent	dissatisfied	Very dissatisfied
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Miscellaneous Information

The householder may add any additional information of interest, indicating which question(s) the comments relate to. Thank the householder for their time and responses

Appendix 2: List of semi-structured interview with respondents (informants)

INFORMANTS INTERVIEWED DURING THE RESEARCH		
No.	Name	Details
1	Mr. Samuel Akwetey	The Municipal chief engineer for Water and sanitation in Tamale.
2	Mr David Ananias Abongo	Solid and Liquid waste Technical Manager for the Tamale Municipal Assembly.
3	Mr Iddi Asumah	The Environmental Health officer of the Tamale Municipal assembly
4	Mrs Joana Bukari	Environmental Health Officer, University of Development studies, Tamale.
5	Mr Babba Issa	Tamale Prison Service driver of FS truck
6	Mr Nabilzo Ozuro	Conservancy labourer for FS in Tamale
7	Mr Zeba Kpeleg	Conservancy labourer for FS in Tamale
8	Mr Songariba-Yee	Conservancy labourer for FS in Tamale
9	Mr Adingo Ananias	Conservancy labourer for FS in Tamale
10	Mr Atenga Naba	Conservancy labourer for FS in Tamale
11	Mr A. Bawa	Conservancy labourer for FS in Tamale
12	Mr. Philip Amoah	Environmental Scientist and Leader of the team dealing with "Quantification of Health Risks associated with reuse of faecal sludge in Tamale" for International Water Management Institute(IWMI), Accra
13	Dr Cofie Olufunke	Soil scientist and leader of research into human excreta reuse. IWMI, Accra
14	Mr N.A. Frimpong	Technologist for Kumasi Metropolitan Assembly(KMA) responsible for human excreta management
15	Mr J.C. Mensah	PRO for KMA, Kumasi
16	Mr R. Kuffour Amankwaa	PhD Research into Dewatering of FS for cocomposting, UST, Kumasi, Ghana
17	Mr Kweku Quansah	Director for Water and sanitation services, Ministry of Local Government and Rural Development(MLGRD), Accra
18	Mr Thomas Sayibu Imoro	Programme Manager, New Energy, Tamale
19	New Energy staff , Tamale	The New Energy, Box 811,Tamale.
20	Mr Agyemang Nelson	The Director , YDF, Kumasi
21	Dr Richard Opoku	Medical Doctor, Tamale Regional Hospital, Tamale
22	Mr K. Baah	Vice-principal(Academic). Presbyterian Training College, Akropong
23	Mr Yakub Alhassan	Administrative Officer, TREND, Kumasi
24	Mr Yakubu Saani	Administrative Officer, ACTION AID, Tamale
25	Mr Blay	The Chief Engineer of AMA, responsible for solid and liquid wastes, Accra
Other semi-structured interviewees. Four farmers reusing faecal sludge for farming activities(Full transcript of three of them will be reproduced and attached as appendix)		

Appendix 3: Notes used during orientation of survey enumerators

General points used for the orientation

- Orientation is given to all field assistants in the same day. The orientation includes an overview of the purpose of the research and notes on specific parts of the questionnaire.
- Wherever possible, field assistants with experience of survey work and or knowledge of the municipality should be engaged.
- If permission is needed from the head of the district (elder, chief, local authority representative) then these arrangements will need to be made prior to the survey commencing;
- The assistants should introduce themselves to be household representative and explain the purpose of their visit; agency, which is supervising the work; the length of the visit; why the household has been selected; and what the questionnaire entails (brief);
- Ideally, the survey should begin shortly after the orientation to ensure that fieldworkers remember the issues raised in the orientation(few days required);
- Field assistants need to be aware that in order to conduct the survey correctly, they will need to give adequate time to each household. The average amount of time for each household will depend on the individual case, but a guide will be gained from the experiences of the pilot survey. It must be stressed to the field assistants that quality rather than quantity is the crucial factor. For example if one household is taking an hour , then no more than 5 households should be set for each assistant on a given day.;
- The survey does request assistants to take measurements (of distance of latrines from motor routes and disposal sites as well as latrine sizes). Where possible, this should be done with appropriate equipment. Where this equipment is not available, best estimates should be given.
- A verification survey will be required once the main survey has been completed. This is a device designed to enable WEDC to assess the reliability of the survey. The verification survey should cover 5% of the main survey and will need to be conducted by different assistants to those who interviewed householders originally.

- One of the key points during the orientation is to stress the importance of reliability in the research-therefore, a standardised and consistent approach to the questionnaire is a central aim for the field assistants.

General points outlining the purpose of the research

- To provide decision-makers, health and development professionals and engineers employed by government and NGOs with information about appropriate management system that can effectively address the FS/excreta emptying, transport and disposal in the urban areas of low-income countries.
- To develop an acceptable HCES management framework for the urban communities of the low-income countries regarding emptying, transporting and disposal of FS.
- The output from this study will be used at the policy, planning and management of FS from on-plot sanitation systems.
- There are major research themes which, in brief, include factors bordering on the use of HCES to manage urban FS emptying, transport and disposal.

Specific points relating to the questionnaire

- Assistants must ask the questions in the way they phrased. Do not paraphrase. Households should be allowed to give their own answers and must not be prompted. If householder appears unsure read out the list of possible options.
- Some questions are to be asked by the assistant to the householder, some rely on the assistant's observation. All questions are to be asked by the assistant to the householder except for the following:
 - i) inspection of facilities and surroundings
 - ii) Measurements and record takings
 - iii) Plan and map sketches

Miscellaneous information

- The questionnaire provides guidance notes to answering questions in a certain order if a given answer is recorded. These are clearly explained.
- All sections of the questionnaire need to be completed. Every question has been designed and included for a reason, and assistants should therefore try

to complete the questionnaire as fully as possible. If this is not possible, assistants should mark a question with 'not known' or 'no answer given'.

Appendix 4: Methodological notes: Chi, square, Cramer's V and Phi tests

Chi-Square Test

Chi-Square tests are used to verify whether two variables are independent of each other or not. The results of interest are the levels of significance associated with the Pearson chi-square. This value, which is the probability that our results were produced by random chance, can range from 0.00000 to 1.0000. The lower the significance value, the less likely that the results were produced by random chance.

Chi-square tests are generally recommended for categorical data such as: i) nominal-nominal; ii) dichotomous-dichotomous; iii) nominal-ordinal; and iv) interval-nominal. In any case, the chi-square test checks whether the observed frequencies that occur in each category differ significantly from the frequencies you would expect under the null hypothesis.

The value is calculated by summing over all the cells the squared residuals divided by the expected frequencies- i.e.:

$$\chi^2 = \sum_{ij} \sum_{ij} (O_{ij} - E_{ij})^2 / E_{ij}$$
, where O and E are observed and expected frequencies respectively.

The calculated chi-square is compared to the critical points of the theoretical chi-square distribution to produce an estimate of how likely or unlikely the calculated value is if the variables are independent so to speak. If the two variables are independent, the probability that a random sample would result in a chi-square value of at least that magnitude is low. Such probability is known as observed level of significance. If the probability is small enough (i.e. less than 0.05 or 0.01), then the hypothesis that the two variables are independent (null hypothesis) is rejected. In the SPSS 15, if the expected frequencies (expected counts in SPSS) is less than 5, then Fisher's test for 2*2 chi-square must be used. But if the chi-square is more than 2*2, then the

'Exact' option on the crosstabs dialogue tab could be used instead of the asymptotic only option which is the default setting in the SPSS. Generally the 'Exact' statistics can be useful in situations where the asymptotic assumptions are not met. Standard asymptotic methods involve the assumption that the test statistic follows a particular distribution when the sample size is sufficiently large. When the sample size is not large, asymptotic results may not be valid. Asymptotic results may also be unreliable when the distribution of the data is sparse, skewed, or heavily tied. Exact statistics also provides the option of estimating exact p-values by Monte Carlo simulation. This can be useful for problems that are so large that exact computations require a great amount of time and memory, but for which asymptotic approximations may not be sufficient.

The degree of freedom in chi-square is calculated as $(r-1) \times (c-1)$, where r is the number of rows and c , the number of columns in the crosstabulation.

Cramer's V and Phi

Cramer's V is used to measure the strength of association or relationship between Chi-square variables. Cramer's V values ranges between 0 and 1. The closer to 1, the stronger the relationship and vice-versa. Phi is used to tell both the strength of association and the direction of association and so it has value ranging from 0 to 1 or 0 to -1. It is mainly used in dichotomous-dichotomous chi-square variables.

Appendix 5: Chi-square statistical outputs

Chi-Square Tests for Reason for Latrine tech choice * Latrine Technology Crosstabulation

	Value	df	Asymp. Sig. (2-sided)	Monte Carlo Sig. (2-sided)			Monte Carlo Sig. (1-sided)		
				Sig.	99% Confidence Interval		4	99% Confidence Interval	
					Lower Bound	Upper Bound	Sig.	Lower Bound	Upper Bound
Pearson Chi-Square	3.583E2	20	.000	.000 ^b	.000	.000			
Likelihood Ratio	376.745	20	.000	.000 ^b	.000	.000			
Fisher's Exact Test	367.230			.000 ^b	.000	.000			
Linear-by-Linear Association	1.011E2	1	.000	.000 ^b	.000	.000	.000 ^b	.000	.000
N of Valid Cases	428								

a. 12 cells (40.0%) have expected count less than 5. The minimum expected count is 1.55.

b. Based on 10000 sampled tables with starting seed 2000000.

c. The standardized statistic is -10.054.

Symmetric Measures for Reason for Latrine tech choice * Latrine Technology Crosstabulation

		Value	Approx. Sig.	Monte Carlo Sig.		
				Sig.	99% Confidence Interval	
					Lower Bound	Upper Bound
Nominal by Nominal	Phi	.915	.000	.000 ^a	.000	.000
	Cramer's V	.457	.000	.000 ^a	.000	.000

		Value	Approx. Sig.	Monte Carlo Sig.		
				Sig.	99% Confidence Interval	
					Lower Bound	Upper Bound
Nominal by Nominal	Phi	.915	.000	.000 ^a	.000	.000
	Cramer's V	.457	.000	.000 ^a	.000	.000
	N of Valid Cases	428				

a. Based on 10000 sampled tables with starting seed 2000000.

Chi-Square Tests for Emptying method * Satisfaction with Emptying Method

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.850E2	4	.000
Likelihood Ratio	308.587	4	.000
Linear-by-Linear Association	34.742	1	.000
N of Valid Cases	428		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 11.07.

Symmetric Measures for Emptying method * Satisfaction with Emptying Method

	Value	Approx. Sig.
Nominal by Nominal Phi	.816	.000
Cramer's V	.816	.000
N of Valid Cases	428	

Chi-Square Tests for Means of Disposal * Emptying Means/Method

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.479E2	3	.000
Likelihood Ratio	258.659	3	.000
Linear-by-Linear Association	31.993	1	.000
N of Valid Cases	428		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 12.75.

Symmetric Measures for Means of Disposal * Emptying Means/Method

	Value	Approx. Sig.
Nominal by Nominal Phi	.761	.000
Cramer's V	.761	.000
N of Valid Cases	428	

Appendix 6: Formula for calculating volume and price of bucket latrine collection and pit emptying

Formula for Calculating the Household Bucket Latrine Collection Volumes and Price Collected per year

Average volume collection of bucket latrine per year in a household = (Number of collections done in a household per week) x (52 weeks/year x volume of the household bucket).

Average price of bucket Latrine collected per year in a household = price of bucket latrine emptied per week in a household x 52 weeks per year

Formula for Calculating volumes of Pit/Tank Emptied per year in a Household and the price per volume emptied per year

Volume of Pit or Tank emptied per year in a household = Volume of pit or tank emptied per re-emptying period in a household /the number of years in the re-emptying period

Price per volume of Pit or Tank emptying per year = Price per re-emptying period/ the number of years within the re-emptying period

Appendix 7: Full text transcripts of informant interviews

Interview with the key informants from Tamale municipality

1)Mr Sampson Akwetey(SA): The Municipal chief engineer for Water and Sanitation in Tamale.

1)Researcher(R): How many members of staff do you have?

SA: There are about 15 staff working under me. Out of this number 7 are women.

2)R: Are these adequate for the job at hand?

SA: No. We still need more people to help our department run more effectively. For example one person is handling both liquid and solid waste which is too big a work for one person since the two sectors are all busy.

3)R: So you think this affects efficiency in management?

SA: Obviously yes!, These sectors are very sensitive and disturbing and therefore more hands are needed to oversee their effective management.

4)R: What constrains you to employ more hands?

SA: Lack of funds is the biggest constraint. Also it is the government who does employ staff. When we submit request for additional staff it may take years to happen and sometimes it does not happen at all.

5)R: How effective is your sanitation byelaws?

SA: We are doing our best to make sure the byelaws are not flouted but as I have said before our staff number is inadequate to do effective monitoring. Indiscriminate open defaecation is a major problem.

6)R: Could you tell me more about your sanitation programmes here in Tamale?

SA: Our programmes have been divided into schools, public and households programmes.

7)R: What types of latrines do you have in Tamale?

SA: We have WC to septic tanks, KVIP, aqua privy, Enviro loo, Bucket latrine and simple pit latrines. The simple pits are found mainly in the peri-urban rural settlements. Even some government bungalows have bucket latrine system. But we are now phasing out the bucket latrine system because it is nasty, unhygienic and attract a lot of flies. We hope to phase them(the bucket latrines) out by 2009. Some holding tanks were provided to some communities but they have not been properly utilised. They have all being soiled with excreta as conservancy labourers carelessly dispose their content into them. Some also prefer to dump their load into nearby forest or burry behind the households. I must also say that 'free range' defaecation is very popular here in Tamale.

8)R: Is there any subsidy you provide for sanitation?

SA: Oh, yes.

9)Who provides the subsidy ?

SA: The government of Ghana and other development partners such as IDA, NDF, and AFD. Now there is ongoing 'Urban Environmental Sanitation Project (UESP II)' which started in November 2004 and will end in December 2009. This project is meant for issues like Sanitation, Solid Waste Management, Community Infrastructure and Institutional Strengthening. The sanitation aspect looks at construction of public toilets, schools toilets and household toilets. The Public Toilets consist of 24 Seater WC at Tamale Central Markets; 20 Seater WC at Aboabo Market lorry park etc. and other important public areas. A number of schools are to benefit from aqua -privy and KVIP toilets. About 1,500 household toilets are to be provided throughout Tamale. A subsidy of the equivalent of \$150 per facility is to be provided while beneficiaries will provide the remaining amount either in kind or cash.

10)R: Which communities do benefit from these subsidies?

SA: The subsidy is meant to establish latrines for the poor rural communities such as Dungu, Fou, Kataraga, Kpanvo Tishegu, Bulpela, Lamashegu, etc. We practise stick and carrot approach, which means we help you to build the latrine and if you fail we sanction you.

11)R: How about subsidy for latrine emptying and FS transport?

SA: Officially we do not subsidise emptying and FS transport. Our trucks are not in good condition. So the prison services and the university of Development studies use their trucks to help empty and transport FS in the city. We charge lower fee than these institutions.

12)R: Is indiscriminate dumping common practice in Tamale?

SA: It used to be but not now. We have official disposal site where both solid and liquid wastes are dumped so our bylaws are stringent on defaulters. Our worry is the dumping which goes on in the farms. We will have wished that the dumpings are well coordinated, so that we can monitor developments. This is because the FS dumped are not well decomposed and we fear that farmers and public might be infected.

13)R: Why are you unable to coordinate the farm dumpings?

SA: The farmers sort of organise the dumpings with the drivers underground. There is mutual benefit because the farmers get their FS 'fertiliser' by offering cash incentive to the drivers.

14)How widespread is the FS reuse in Tamale?

SA: FS reuse is quite widespread. During the dry season, farmers demand for the FS outstrips supply because this is the time when the FS is much needed. In the rainy season the rate of emptying and transport increases because of infiltration into the latrines and unfortunately there is no demand for FS at this time.

2)David Ananias(DA): Solid and Liquid waste Technical Manager for the Tamale Municipal Assembly.

1)R: Could you describe what you do as technical manager?

DA: I am in charge of overseeing the technical and management aspect of solid and liquid wastes.

2)R: Is FS liquid or solid waste?

DA: We classify FS under liquid waste

3)R: What form of sanitation systems do you have, I mean on-site and sewerage systems?

DA: Tamale sanitation system is mainly on-site. There one centralised sewerage system in the Tamale military barracks, but the treatment facility for the centralised sewerage system. The public latrine systems consist of 105 aqua privies; 8wc to septic tanks; 8KVIP; 2enviro loos and 1 bucket latrine system.

4)R: Who manages the public latrine system?

DA: The unit committees and some private persons manage the public latrines. They charge persons using the latrines. They are responsible for cleaning and general maintenance including emptying. We offer the caretakers and the cleaners, including some emptiers some education and training so that they will do their work better.

5)R: Whom do latrine owners report for emptying when their latrines are full?

DA: The unit committees managing the public latrines report to us to assist them get them emptiers. We sort of act as middlemen linking them to both conservancy labourers and truck emptiers. Some of the households also contact us for similar assistance.

6)R: You mean, the latrine owners cannot contact the emptiers directly?

DA: Latrine owners can make their own arrangements to get their latrines emptied.

7)R: So you mean there are no standardised arrangement, such as contract or official deal, between latrine owners and those who empty the latrines?

DA: No, latrine owners can just walk into our office or phone for help, or contact the emptiers themselves and negotiate a deal for emptying. There is no official contract signed between the stakeholders. Arrangements are casual and personal.

8)R:How does attitude and behaviour of users and latrine owners affect efficient emptying and transport of FS?

DA: You see, latrine owners wait till their latrines are full to the brim before they seek help for emptying. Sometimes it takes long time before we or the other institutions with trucks can help, and between the time of request for help and the time help can arrive the latrine is being used. In such cases some of the pits or vaults overflow and mess up the place. Most people prefer the emptying service of the municipality because we charge far cheaper. Some of the users also put into the latrine so many unwanted objects like plastics, and other solid waste materials and all this affects the emptying service.

9)How much does the municipality and other private services charge per emptying and transport service?

DA: We charge 10 Ghana cedis per service. The institutions charge between 20 and 30 Ghana cedis. The manual operators charge far higher. For a public latrine they can charge about 70 to 100 Ghana cedis.

10)R: This seems too expensive?

DA: Yes but the work is a difficult one. Moreover the money is shared between 4 or 5 people who do the job.

11)R: Why then do people go for such expensive manual operation rather than the truck service which is far cheaper and more efficient?

DA: Our vehicles suffer constant breakdown because they are too old. And sometimes those of the institutions also breakdown. In such case, latrine owners have no choice but to resort to the service of the manual operators. Sometimes too the contents in the pits or vaults are either too hard to be siphoned and or too large for the truck to siphon.

12)R: How about the bucket latrine systems?

DA: The conservancy labourers do all the emptying of the bucket latrine system. Most dump and bury their collections near the households and sometimes cover them with rice husks.

13)R: How do you rate the capacity of the conservancy labourers in doing their work?

DA: eeeh, It's not bad actually. In fact the pit emptiers are very skilful and we feel they are the best to do the work. Our concern is that sometimes they do not follow strictly the advice concerning safety and protection. Sometimes the gloves they use are worn out and boots are torn.

3)Mr Iddi Asumah(IA): The Environmental Health officer of the Tamale Municipal Authority

1)R: What do you do as environmental officer?

IA: My department is concerned with the software issues about sanitation. We educate the public as well as private people about the need for improved sanitary conditions.

2)R: So far what has been your experience concerning latrines?

IA: We do social marketing to encourage people to construct latrines and also educate about the proper use of latrines including cleanliness and hand washing after visiting the latrine.

3) R: Do people take your advice?

IA: Some do and some do not. Those in the rural areas seem not to grasp the need for latrine construction. Most still use open defaecation. Various reasons are given why open defaecation is preferred. Reasons such as poverty and need for free air are cited. In some communities with latrines, users hate to shit on top of others faeces and so would shit around the squatting holes resulting in ring of faecal matter around the squatting hole.

4) So you mean users behaviour and attitude affect the proper use of the latrine?

IA: Very much so. I know of some communities far north where members of a household refused to use latrine constructed for them because of where the latrine was sited. You see, the nature of settlements here is such that family members build their houses, usually huts, on one compound in circular fashion. This latrine was unfortunately built at a location where anybody entering or leaving the latrine is seen. This made it uncomfortable for the users and so they somehow rejected the latrine. I know of some communities where users refuse to defaecate on top of each other's excreta and so they defaecate around the squatting hole in circular, I mean ring manner[he demonstrates].

5)R: Do you educate users about the use of anal cleansing materials?

IA: Not really. What we emphasize on is the washing of hands after defaecation. Here people use all manner of materials for anal cleansing such as stones, water, piece of cloths, sticks leaves, newspapers etc. depending on number of reasons including religion, affordability and culture.

6)R: How do you educate the community?

IA: We organise the community and talk to them. Sometimes we visit house to house to educate with learning aids like posters.

7)R: You do not use media like radios, TVs and newspapers?

IA: No, no. It is too expensive to use these media. TV education will have been fine but the poor are not able to afford TV. Also many people do not even read newspapers. Those who read do not read everything and so newspaper education will be far less effective. Radio will be OK if not its high broadcasting cost.

8)R: What are the roles of women in sanitation in Tamale as well as FS management is concerned?

IA: Women clean the latrines, collect the stool of children the sick and the very aged and throw away.

8) R: If you say 'throw away' what do you mean? I mean where is the stool kept after cleaning or collection?

IA: They are thrown into bush, household latrine(if any) or thrown into the public latrine.

4)Babba Issa(BI): Tamale Prison Service driver of FS truck

1)R: What work do you do?

BI: I am the FS truck driver for the prisons services here in Tamale. I am responsible for dislodging and transporting Fs from prisons service latrines

2)R: Do you do this job everyday?

BI: No. I also empty private latrines for households and public latrines.

3)How much do you charge per emptying?

BI: I usually charge between 20 and 30 Ghana cedis

4)R: Why the variation in price?

BI: Sometimes some latrines are difficult to reach by the normal siphon hose or tube due to difficulty in accessing the latrine. We therefore have to connect additional siphon hose to reach the latrine vault or tank. When that happens more energy is required to do the siphoning, and therefore more fee is charged.

5)R: Who collects the money from the clients?

BI: With the prisons service it is the Finance Department that collects the money from the clients.

6)R: What are some of the problems you encounter with the emptying and transport?

BI: Sometimes I get the instruction from the Finance Department to go for emptying only to find out that there is no vehicular access to the client's latrine. Sometimes too the vaults are filled with plastics and other materials that make siphoning difficult.

7)R: What do you do when there is no access?

BI: When there is no access for my truck, what can I do?

8)R: You ask me?

BI: I mean I cannot do the job. I will have to return and report the situation to my bosses.

9)R: What do you think there is no vehicular access to people's homes?

BI: I think people simply do not follow building regulations. People encroach on other people's property and build on unauthorised areas. Sometimes kiosk operators put their kiosks to block access routes. I mean this is a mess!

10)What do you do when there are plastics and other materials the truck cannot siphon?

BI: We try to avoid the visibly bigger obstructive objects. But unfortunately some of these objects, I mean the plastics etc, sometimes block the siphon hose. When that happens emptying operation has to cease for the system to be repaired.

11)R: Who repairs the truck when it is broken down?

BI: I do almost all the repair works?

12)R: Are you engineer by profession?

BI: No, but I have been trained by the Prisons Service to maintain the truck when there is breakdown

13)R: Where do you dispose of the FS?

Bl: I dispose of the FS at the municipal disposal site

14)R: How much do you pay for disposing at the municipal disposal site?

Bl: Nothing.

15)R: Have you been approached by any farmer for the FS you transport?

Bl: Yes, several times.

16)R: How much do you charge them for sending the FS to their farms?

Bl: I do not charge them per se. They only have to pay me some token fee for the fuel and that depends on the distance I have to travel to the farm.

5)Joana Bukari(JB): Environmental Health Officer, University of Development studies, Tamale.

1)R: What do you do as environmental health officer in this university?

JB: I make sure that the sanitary condition on campus is in good condition.

2)R: What forms of latrines do you have on campus?

JB: Students use KVIP. There are both WC to septic tanks and KVIP at some lecturers' residences.

3)R: I have visited some of the students latrines and they look quite clean with little odour and few flies. What do you do to reduce the smell and flies number?

JB: We pour septic into the latrine to reduce the bad odour and fumigate every three months to keep away the flies and insects.

4)R: What do you do when the latrines and septic tanks fill up?

JB: We have our own truck that collects the FS for disposal.

5)R: Do you have disposal or treatment facility on campus?

JB: No, we utilise the disposal and treatment site of the municipal assembly.

6)R: How often do you empty the latrines?

JB: Not often due to holiday breaks.

7)R: Then the truck emptying driver must be less busy?

JB: Not really, since we also empty both public and private latrines.

8) Do you do that for free?

JB: Of course not. Some fee is charged.

9)Is there official contract between the university and the municipality for emptying public and private latrines?

JB: No, not to the best of my knowledge. It is just verbal arrangement between us and those responsible for the latrines.

Interview with the conservancy labourers in Tamale

1)Conservancy labourer(CL)1(Nabilzo Ozuro) For Emptying

1)Researcher(R): What equipment or tools are needed for emptying of latrine contents?

CL1: We usually require ladder, two buckets, two shovels, 1 pick axe, Wellington boots, hand gloves, nose masks and anti-septic soap. The ladder helps us to get to the bottom of the pits. The buckets for collecting the sludge from the pit and deposit it outside the pit. The boots are for protecting our feet. Hand gloves to protect our hands. Nose masks are to protect our nostrils and to prevent bad odour. The anti-septic soap for washing the whole body after digging.

2)R: You said 'we', how many of you do the work?

CL1: We are usually 4 people working in batches of two. When one batch is tired then another comes to assist.

3) R: Are women involved in the emptying?

CL1: No, not at all. This work is too tough for women

4)R: How long does it take to empty a pit?

CL1: It depends. For about 20 seater public latrine, we use about 7days to empty.

5)R: What is the cost for manually emptying the 20 seater pit?

CL1: About 50 to 100 Ghana cedis

6)R: How about cost for manually emptying of household latrine?

CL1: It is about half the cost of the public one.

7)R: This seems expensive.

CL: Not really, because the work is too difficult

8)R: What makes the work difficult?

CL1: It is nasty and the smell is too bad to bear, so we often drink hard liquor to help us overcome the smell and nastiness. You can also fall sick.

9)R: But when you are drunk you will not have enough energy to work

CL1: We also eat heavily before starting the emptying process so that reduces the alcohol effect, I think.

10)R: So you eat heavily in order that you do not get drunk?

CL1: Partly. We also eat heavily before the work so that we do not have to eat during the work which takes several hours.

11)R: What diseases usually worry you?

CL1: Diarrhoea, headache, nausea, vomiting

12)R: Do you like this job?

CL1: Initially I did not like it but now I am Ok with it.

13) R: How do you get latrines to empty?

CL1: When some one's latrine is full he looks for us. Sometimes the municipal authorities also inform us to do the work.

14)R: How do you come together to work as emptying group?

CL1: We are friends usually from the same tribe or region who work with human excreta, so we talk among ourselves to do the work.

15)R: Do you sign any agreement papers with clients?

CL1: No, we have verbal negotiation about how much to collect per latrine emptying.

16)R: Where do you deposit the contents after emptying?

CL1: We place the fresh sludge on surface around the latrine for it to dry.

17)R: Then after that?

CL1: After that the contents are collected by municipal authorities for onward disposal. Sometimes some farmers also collect them for their farms

18)R: What difficulties do you go through when you are doing the emptying work?

CL1: Sometimes there are sharp objects mixed with the FS that injure us?

19) Can you give me examples of some of these objects?

CL: metal pieces, sticks, broken bottles and stones.

20)R: Do you go for any lessons or trainings towards your job?

CL1: What happens is that sometimes the municipal authorities offer some education about health and the need to protect ourselves during emptying.

2)Conservancy labourer(CL)2(Zeba Kpeleg)

1)R: Which tribe do you belong to?

CL2; Frafra

2)R: What hand tools do you use for collection and emptying of bucket latrine?

CL2: bucket and broom

3)R: What do you use the broom for?

CL2: For cleaning the back of the latrine when there is spillage of excreta.

4)R: Do you use hand gloves for your work?

CL2: No

5)R: How many buckets can you remove a day?

CL2: I can empty about 40 buckets a day.

6)R: What is the charge per bucket collection and emptying?

CL2: Between 0.50 and 1Ghana cedis per bucket.

7)R: How do you dispose of the contents?

CL2: I dig a hole in a nearby bush or empty space behind the house and bury it.

8)R: Do you obtain permission from the neighbourhood where the waste is disposed of?

CL2: No. I use my own sense of judgement to select a waste piece of land.

9)R: What do you mean by 'waste land'?

CL2: A land which is not used for building or public activity. Here we call it, 'No man's land'.

10)R: Which time do you do your job, day or night?

CL2: I normally start working very early in the morning.

11)R: Can you be specific?

CL2: About 3am when it is a bit dark

12) Why so early?

CL2: I do the job early so that I avoid many flies. Very early in the morning the flies are not active as in the day.

13)R: Do you usually fall sick?

CL2: Yes.

14)R: How often?

CL2: I cannot be specific, but I often find myself weak and sick.

15)R: Which part of the body often troubles you?

CL2: I have stomach ache and head ache sometimes. I have skin itching rashes.

R: Are you paid promptly by collecting the bucket latrines?

CL2: Yes. At first some people did not use to pay. But I made them pay double by pouring the excreta in front of the entrance into their house. Once I do that they pay me double to collect the excreta and clean up the place as well. So these days people have learnt their lessons as they me promptly.

R: Do the other emptiers and bucket collectors do this as well?

CL2: Yes, we are friends, you know. So when we meet we discuss some of these punitive measures together.

3) Conservancy Labourer(CL)3 (Songariba-Yee)

1)R; Which tribe do you belong to?

CL3. Frafra

2)R: What work do you do for a living?

CL3: I work on latrines and other labourer work

3)R: What work do you do on the latrines?

CL3: I sometimes collect bucket from latrines and empty the contents for a fee. I also engage in emptying of pit latrines

4)R: How much do you charge per bucket?

CL3: I charge about 0.80 Ghana cedis.

5)R: Are you happy with the amount of money you collect?

CL3: Mmmm....., somehow happy. But I would prefer more money.

6)R: Why then don't you charge for more money?

CL2: It is because the latrine owners do not want to pay more

7)R: Do you belong to any latrine workers club, say emptying and transport club?

CL3; No, I have not heard of any latrine club here in Tamale.

8)R: Do you think it is a good idea to have one?

CL3: I believe so

9)R: Are you happy with your work on collection and emptying of FS?

CL3; Somehow. What we need is more money and it will be alright to do the work.

1)Conservancy labourer(CL)4(Adingo Ananias) For Emptying

1)Researcher (R):What do you do for a living?

CL4: I empty latrines

2)R: Which latrines do you empty?

CL4: I do empty bucket latrines, pit latrines and KVIPs

3)R: What tools are needed for emptying bucket latrines?

CL4: I use bucket and broom

4)R: How about gloves, you do not use them?

CL4: Yes, but they are torn.

5)R: Why don't you buy new gloves?

CL4: I sometimes use ordinary plastic bags around my hand instead of gloves.

6)R: How about the pit and KVIP latrines, what tools do you need to empty them

CL4: Buckets, ropes, ladder, pick axe, shovels or spades, and wheel barrows are needed.

7)R: What do you use the ropes for?

CL4: Sometimes some of the sludge is watery so we attach the rope to the bucket to reach the deeper depths and pull the stuff out the pit.

8)R: And where do you dispose of the sludge?

CL4: Wet sludge is sometimes put around the latrine to dry out...and the dry stuff is disposed of not far from the latrines. Or sometimes it is dumped into public garbage bins or into nearby bush.

9)R: How do you get to know that there is job of emptying somewhere?

CL4: The latrine owners inform us directly. Sometimes we also get job information from the municipal assembly.

10)R: When you say 'we' what do you mean? Do you mean you are in association or group?

CL4: I mean friends. We are just friends who know each other. We are not in organised association.

11)R: Why don't you form an organisation, say, "Latrine emptiers association"?

CL4: I don't know.

12)R: Are you interested in having one established?

CL4: If it helps, why not?

13)R: What complaints do you usually receive from clients (the households, etc)?

CL4: Sometimes they complain that the latrine environment is dirty with pieces of faecal matter after emptying.

14) R: And what do you tell them?

CL4: Nothing, really because the nature of our work is such that there will always be some sort of mess around.

2) Conservancy (CL) 5 (Atenga Naba)

1)R: Which Latrines do you empty?

CL5: Bucket and pit latrines

2)R: Are you happy with the job?

CL5: ehhh, not really.

3)R: What is it about emptying you do not like?

CL5: The work is nasty and difficult.

4)R: Can you explain further, 'nasty and difficult'?

CL5: The bucket latrine system is always spilling with fresh human excreta. Sometimes I have to divide some of the bucket's content into two, put some of the excreta into another empty bucket before I can carry it for disposal. The pit latrines are also quite hot as one gets deeper. Sometimes all kinds of objectives such as sticks, plastics metal pieces are encountered during emptying and some of them are very sharp and dangerous. The smell is also obnoxious, but I am now used to that.

5) R: How about the equipment and tools used for emptying and transport of the sludge, are you happy about them?

CL5: Not much, because the nature of the tools is such that we have to almost get into contact with the excreta. Sometimes the bucket that contains the excreta leak and therefore make transporting difficult.

6)R: How do you dispose of the faecal sludge?

CL5: That depends on the location. If there is a free bush nearby, I dig a hole in the bush and bury it; or I put it into nearby holding tank or public latrine, if there is no free bush nearby.

7)R: Do you obtain permission from the authorities before disposing into the public latrine?

CL5: No..

8)R: Is the amount of money you get from latrine emptying enough for your expenses?

CL5: Not really.

10)R: How often do you get emptying job?

CL5: Pit latrine jobs are seldom. But bucket latrine emptying is almost daily.

11)R: Which one do you prefer, pit latrine emptying or bucket latrine emptying?

CL5: Pit latrine job is tougher but there is more money per operation than bucket latrines. Also because we operate as a group, we derive inspiration and encouragement from each other.

12)R: Are your clients happy with your work?

CL5: Yes, I think so

13)R: Why do you think so?

CL5: Because they do not tell me anything bad

3) Conservancy Labourer (CL) 6(A. Bawa)

2)R: What work do you do for a living?

CL6: I work on latrines and other labourer work

3)R: What work do you do on the latrines?

CL6: I sometimes collect bucket from latrines and empty the contents for a fee. I also engage in emptying of pit latrines

4)R: Where do you dump the bucket latrine contents?

CL6: I dump them into the ground for burial.....it depends on the place. Sometimes I also put them into holding tanks or public latrine nearby.

5)R: How much do you charge per bucket?

CL6: I charge about 0. 80 Ghana cedis.

6)R: Are you happy with the amount of money you collect?

CL6: Mmmm....., somehow happy. But I would prefer more money.

7)R: Why then don't you charge for more money?

CL6: It is because the latrine owners do not want to give us more money

8: R: Do you belong to any latrine workers club, say emptying and transport club?

CL6; No, there is no such club here in Tamale.

9)R: Do you think it is a good idea to have one?

CL6: I believe so

10)R: Are you happy with your work on collection and emptying of FS?

CL6; Somehow. What we need is more money and it will be alright to do the work.

Interview with farmers in Tamale reusing FS

Farmer (F) 1

1)R: Good morning sir, the weather looks good.

F1: Good morning. You are welcome

2)R: I understand you reuse FS for farming activities. Do you like it?

F1: Very much so

3)R: What is it about FS you do not like?

F1: Sometimes there are some unwanted objects in the FS. Also the smell is quite unpleasant.

4)R: What do you mean by unwanted objects in the FS?

F1: Sometimes there are plastics ,and sharp objects which might cause injury.

5)R: When do you need the FS most?

F1: In Tamale, farming starts in the rainy season, and so during the dry season FS is needed to be stored on my farm so that by the time the rainy season comes, it is decomposed enough to be utilised

6)R: Is it easy to get the FS to your farm?

F1: Sometimes, it is very difficult as more farmers also need the FS in their farms. But I make sure I get at least something for my farm every year.

7)R: How does the FS reach your farm?

F1: I arrange with the drivers of FS to bring to my farm.

8)R: How do you arrange with the drivers, do you sign any paper with them or... you simply inform them to come and render service to you?

F1: O.. I just inform them of my interest and meet with them at pre-arranged place; Or wait on the way to the municipal disposal site where I stop the incoming FS trucks and divert them to my farm.

9)R: Do they bring it for free?

F1: No, not at all. I pay some money

10)R: How much do you pay?

F1: eeh.. haha..It's OK, I cannot tell you.

11)R: Why do you need FS at all on your farm?

F1: Farm lands here do not have enough food for the plants and the soil is also in poor condition so the FS helps to provide food for the plants and help improve the soil

12)R: Why FS but not any other fertiliser.

F1: This is because FS is cheaper than chemical fertiliser. I also use cow dung but it is not enough at all.

13)R: How do you apply the FS onto your farm?

F1: I dig it into the soil with hoes to prepare the land for farming.

14)R: What are the common diseases that trouble you?

F1: sometimes stomach and headache. I also feel dizzy sometimes and I cough often.

Farmer 2

1)R: What sort of crops do you cultivate?

F2: maize, sorghum

2)R: Do you use FS on your farm?

F2: Yes

3)R: Why do you use FS on your farm?

F2: To help my crops grow and produce .

4)R: You mean without the FS, your crops cannot grow and produce?

F2: You see, I use the same land every year and so without fertiliser the plants cannot grow, that is why I need to add fertilizer to my land every year. But I cannot afford to buy enough chemical fertiliser for my land. That is why I go for FS.

5)R: Where do you get FS for your farm activities?

F2: Almost all my FS supplies come from the drivers of FS. I pay some amount of money to the drivers. The drivers say, they need money to pay for fuel for transport.

6)R: How much is the 'fuel charge'?

F2: I pay about 10 Ghana cedis (1GHC=1\$USD).

7)R: Are you able to get enough for your farm?

F2: Sometimes yes, sometimes not. It all depends on how much I can pay for the supplies. Sometimes too I cannot get the quantity I want because the FS supply is not enough.

8)R: Why is the FS quantity not sometimes enough?

F2: It is because other farmers are also interested but the FS is not enough for all of us. This happens in the dry season.

9)R: So in the rainy season, FS supply is not a problem?

F2: In the wet season, the FS cannot dry well. We also plant our seeds during this period and so it will be too late for the FS to be used.

10)R: How do you spread the FS on your farm?

F2: Sometimes I ask the drivers to put the loads at several points in the farm. They are then left to dry and when they are dry, I evenly spread them on the field to be ploughed in by tractor or hoe.

11)What diseases trouble you most?

F2: Diarrhoea, stomach ache, skin rashes, foot pains.

Farmer 3

1)R: How many crop farms do you have in a year?

F3: I have two farms. Every year, I grow maize and sorghum

2) R: What fertiliser do you use to help your crops to grow well?

F3: The fertiliser they sell at the shops are too expensive for me so I use cow-dung and faecal sludge.

3)R: Do you use FS for all your farms?

F3: Yes

4)R: How do you get the FS to your farms?

F3: I get them from the FS truck drivers. Sometimes the labourers who empty latrines also give me their FS at a small fee. I use their FS for my small backyard farm

5)R: How much fee do you pay to such labourers?

F3: Sometimes 2 Ghana cedis. It depends on the amount of FS I get.

6)R: How do you arrange with the truck drivers to send the FS to your farm?

F3: I call them on their cell phones and talk to them about it. They know me and I know them so there is no problem.

7)R: Do you pay money to them before you get the FS?

F3: Yes. They charge me only petrol fee.

8)R: And how much is the petrol fee?

F3: They don't want us to tell people about it, you know.

9)R: So are you happy about the fee you pay to them?

F3: Yes, I do not have any problem about that, because they help me a lot by carrying the FS to my farm to the places I want.

10)R: Do you experience any problem in using the FS on your farm?

F3: Not really. When it is dry it does not smell so it is OK.

11)R: What about the quality of the FS, is it good enough for you?

F3: Hmmm..., yes. Sometimes there are some objects such as broken sandals, broken bottles, etc which are not good for the soil.

12)R: Is your family, especially wife, happy with the application of FS to the farm?

F3: I have three wives and 12 children who help me on the farm. All of them are happy to work with the FS

12)R: Thank you for your time.

Interview with key informants from Kumasi

Mr Richard Kuffour Amankwaa(RKA). PhD Research into Dewatering of FS for cocomposting, UST, Kumasi, Ghana

1)R: Where do you take your FS samples for analyses?

RKA: I do take samples from both public and household latrines for analyses.

2)R: Why samples from both the public and private latrines?

RKA: The samples from both latrine systems are tested for their sludge characteristics: consistency, TDS, microbial contents, etc. The public KVIP is meant to receive and digest the latrine content long enough to harmless state before emptying for disposal or reuse. But due to high usage rate, the contents are emptied earlier than expected with high content of fresh faecal matter and other materials.

3)R: Which other materials?

RKA: Some of the users defaecate into plastic bags in their homes, especially during nights and then dump them into the latrine vaults when they visit the latrine.

4)How widespread is the practice?

RKA: This is quite a common practice found in most of the public latrines.

5)How does this affect emptying?

RKA: eemm, some of the truck emptying drivers have complained about the difficulty posed by these plastics and other objects towards suction of the sludge

6)What other objects are you referring to here?

RKA: I mean sticks, rags and other hard material used as anal cleansing materials

7)R: Indiscriminate dumping has been worrying, what do you think are the reasons for indiscriminate dumping?

RKA: Usually the distance to the disposal site is too far for some of the FS transporters especially those carrying the bucket latrine for disposal. The byelaws are also not strictly enforced against the practice, I think.

8)R: What is usually co-composted with FS?

RKA: Some researches done here in Ghana have used degradable organic wastes from market, kitchen, vegetables, garden etc., mixed with the FS for co-composting.

9)R: Why the co-composting with FS?

RKA: Research shows that FS reuse is popular in Ghana, especially in the northern part of Ghana. But unfortunately the FS collected from most of the latrines are not fully digested and so contain pathogens. The composting ensure the pathogens in the FS are killed and that reuse can be safe.

10)R: Is there any complaint about health hazard associated with reuse by farmers?

RKA: I have not encountered anything of the sort personally, but reports I have read suggest that some farmers who use FS for farming often complain of diseases like diarrhoea, stomach pains and foot rots which might be associated with use of improperly digested FS.

2)Mr N.A. Frimpong(NAF): Technologist for Kumasi Metropolitan Assembly(KMA) responsible for human excreta management.

1)R: What latrine types do you have in Kumasi city?

NAF: There are WC to septic tanks, KVIP, Bucket latrine, aqua privies, simple pit and Borehole latrines. The bucket latrines are being phased out by KMA. Right now the proportion of bucket latrines is less than 2% of the total latrines in the municipality

2)R: How about sewerage system?

NAF: The city of Kumasi has very few community based centralised sewage systems located at Ahensan estate, Chirapatra and UST campus.

3)R: What do you think are the reasons for the choice of particular technology?

NAF: There are several reasons. Some people consider cost of construction and operation as basis for choice. Others consider the space available and soil type. Some communities dictate what types of latrine they want.

4)R: How about policy, does it play a role in determining choice of latrine?

NAF: mmmm, right now we have policy that no more bucket latrine systems should be built. In some communities we also discourage the construction of simple pit latrines due to inconveniences and space problems. Apart from that the we allow communities and individuals to build latrines of their choice, especially, the WCs, KVIPs and aqua privies

5)R: Is there a stipulated standard by which users tell when their latrines are full? If so what is it?

NAF: Not really. But users use their own discretion by way of sight, smell, leakage or experience. They use the latrines and by experience can tell when the latrine is full or about to get full.

6)R: Apart from the faecal matter, what else contributes to the filling of latrine vaults?

NAF: users dump into their latrines a variety of materials. For example some women drop into WC pads. Some people also drop into the latrines sticks, rags, plastic bags filled up with shit, and so on.

7)R: Do you think users attitude plays a role in latrine management?

NAF: Oh, yes, as I have mentioned before, some users put materials they are not supposed to put into the latrines. Some spit saliva and phlegm all over the latrine chamber. Some do not

squat properly and so defaecate on the squatting slabs and urinate onto the latrine floor. All this makes cleaning as well emptying of latrine difficult.

8)R: Who pays for putting up household latrine infrastructure?

NAF: The landlords usually pay for their own latrine infrastructure and maintenance. Sometimes some of the poor communities are assisted with some funds to build latrines, but this is not the norm. The public latrines are mainly built by the municipalities and the unit assemblies. Some private people also build and hire out latrines to the public.

9)R: Who empties the various latrine technologies?

NAF: The bucket latrine and simple pits are emptied by the conservancy labourers. The septic tanks, KVIPs and aqua privies are emptied with suction trucks. The conservancy labourers sometimes do empty KVIPs and aqua privies where their contents cannot be siphoned by the trucks or the latrines cannot be accessed by the trucks. This is unfortunate because this form of manual operation is too expensive.

10)R: What causes the lack of accessibility by the trucks?

NAF: There are various factors. Sometimes the streets are either too narrow to allow the trucks to pass through or are blocked by mounted kiosks. In some instances there is no access at all.

11)R: How do you rate the skills of those responsible for emptying and transport of faecal sludge in the municipality?

NAF: The guys seem to know their job. We help by educating them about hygiene and the risks involved in their jobs.

12) Do you have enough official disposal sites to handle FS treatment in the municipality?

NAF: Yes,

13)R: Which types?

NAF: Chain of treatment ponds consisting of sedimentation, anaerobic, facultative and aerobic ponds.

14) R: Who are responsible for indiscriminate dumping in Kumasi?

NAF: These days the major cause of indiscriminate dumping is in the form of indiscriminate open defaecation. Besides, some conservancy labourers also dump indiscriminately their bucket latrine contents.

15)R: Are there byelaws regarding emptying and transport of FS? If so to what extent are these enforced?

NAF: There are byelaws regarding transport of FS. Those who break the byelaws are punishable by law.

16)R: What are some of the reuses FS is put?

NAF: Some of the FS are composted with other biodegradable organic waste on small scale.

Interview with key informants from Accra

A)Philip Amoah(PA), of *International Water Management Institute(IWMI)*: *Leader of the team dealing with "Quantification of Health Risks associated with reuse of faecal sludge in Tamale"*

1)R :It seems reuse in Tamale is very popular, what do you say about that?

PA: Oh yes reuse is popular among farmers in Tamale. Sometimes, especially during the dry season, the demand exceeds the supply.

2)R: How is the FS transported to the farms?

PA: Through the FS tanker operators. They discharge the contents onto their farms

3)R: What do you mean by 'They discharge their contents onto their farms''? To be specific, how is the disposal done?

PA: You mean, the method of disposal?

4)R: yes

PA: I see. Some dispose the contents into manually dug holes or depressions in the farm, and then allowed to dry. After that the contents are manually collected and spread onto the farm lands to be ploughed in. Sometimes some farmers just ask the drivers to discharge the FS in spreading manner onto the farms, where they are allowed to dry before ploughing in for reuse.

5)R: What tools do the farmers use to plough in the FS?

PA: Usually simple farm tools like hoes. They often do these with no hand gloves, protected boots, and nose gauze.

6)R: Why do you think the farmers need to protect themselves?

PA: This is necessary because not all the microbes are believed dead during ploughing. Some of the microbial eggs like ascaris and trachoma eggs can survive for 2 years or more in the farm soil

7)R: Are the farmers at any health risk?

PA: Yes. I very much think so.

8)R: Is there any empirical evidence to that effect?

PA: eeh.. not quite but farmers have been complaining of diseases like diarrhoea, foot rots, skin itches and headaches. Even though these may be associated with sanitary problems one cannot wholly ascribe these exclusively to FS reuse. There is current research going on to quantify the health risks associated with FS reuse and the outcome may help to establish empirically whether farmers who utilise the FS are at any health risk at all

9)R: How much do farmers pay to the FS drivers?

PA: I do not know the right figure but some money is obviously paid.

2)Mr Kweku Quansah(KQ): Head of Sanitation Department at the Ministry of Local Government and Rural Development(MLGRD), Accra

1)R: Is on-site latrines what you recommend for the cities in Ghana?

KQ: eeeh, Ghana's sanitation policy is open when it comes to latrines. Apart from bucket latrine system, which is disallowed, each community has been allowed to choose its own form of sanitation depending on the choice of the community concerned.

2)R: So you mean the bucket latrine system is no longer popular in Ghana?

KQ: I do not mean that, still the bucket latrine system is operating in several communities including those in Accra here. But it is the policy of the government that bucket latrine system should no longer be practised. We are also encouraging the conversion of the bucket latrine system into other approved systems such as KVIP, and WCs etc.

3)R: What is the funding situation for water and sanitation?

KQ: The funding for water and sanitation is still inadequate even though good progress has been made by government and the developing partners.

4)R: Specifically how do you see progress in sanitation?

KQ: Sanitation is still lacking behind water. Sanitation problems in the country are huge. Waste management is poor. Latrine systems are inadequate and in bad conditions so we are currently trying to give more emphasis on sanitation. Even here in Accra, some communities still refuse to put latrines in their homes. Even some latrines chambers in some homes have been converted and modified into rooms for hiring purposes. They use either public latrines or defaecate in the open.

5)R: Why do you think some landlords fail to put latrines in their homes or even convert the latrines into rooms for hiring?

KQ: It is bad attitude. They choose profit over hygiene.

6)R: What do the tenants say about that?

KQ: Tenants seem not to have any say. After all accommodation here in Accra is difficult to come by. Also it is the same tenants who do hire these converted rooms.

7)R: Do you have materials on sanitation I can purchase or have for free?

KQ: We do not have any materials at the moment for the taking. What I have is National Sanitation Policy on the pdf file. I can post it to you via email, if that is OK.

8)R: OK, thanks(researcher provides the email).

9)R: Do you have any programme for staff skill training or upgrade?

KQ: Yes, there are various programmes for training and upgrading the skills of staff here and those in the various regions. Right now we are considering sending some staff to your Department, that is WEDC, UK. So you can help us to get other useful information about the programmes there.

10)R: Surely I will be glad to do that. But have you checked WEDC website? There are a lot of useful information there.

KQ: Oh yes, It is from the website that I saw their programmes. The programmes seem very interesting. I hope they will help very much some of our staff.

Interview with NGOs

1)New Energy Staff,(NES): Tamale based NGO

1)R: Is New Energy international NGO?

NES: No, it is an NGO based here in Tamale, but we operate not only in Tamale but also in the upper west and east regions.

2)How do you get funding for your activities?

NES: WaterAid, an International NGO is our main funding and programme partners. Besides, we also do work with other NGOs, CBOs, municipal and other government departments.

3)What sort of work do you do?

NES: New Energy is development oriented. We work on water and sanitation projects. We also work on solar energy projects.

4)I have seen some interesting solar panels, boreholes and latrine facilities around. Did you do all these by yourselves?

NES: Yes, we can take you around to have a look at them if you want.

5)R: Sure! (We went around to have a look).

6)R: I am really impressed, so how do you assist in the construction of latrines for communities or individuals?

NES: We basically work in partnership with individuals who need latrines. We contribute 50% of the cost whilst the individuals also contribute 50% in cash or in kind.

7)R: Do people patronise in this project?

NES: So far patronage has been encouraging. The poorest of the poor need almost 100% subsidy. In some cases our sponsors are able to assist 100% subsidy for such individuals.

8)R: I have seen some private boarding school for girls along the road to the University of Development Studies where there is no latrine, can you help them?

NES: Usually the selection of individuals and communities for assistance is done with the help of sponsors and the municipal authorities.

9)R: Are you engaged in FS emptying and transport?

NES: No, we are basically involved in three exercises, that is sensitization for health promotion; supply of materials and construction of latrines for households; user education for appropriate use of facility(after the construction).

10)R: Do you believe latrine location in the household is important?

NES: Yes, because access to services like emptying can be a problem if the latrine is not properly located. This is a common problem in the city. Sometimes, users will be reluctant to use the latrine due to its orientation, therefore we pay special attention to latrine orientation.

2)Yakubu Saani(YS): The Director for Action Aid, Tamale

1)R: Is your NGO involved in sanitation?

YS: We used to be involved in sanitation. But since 2002 we have ceased dealing with sanitation issues

2)What aspect of sanitation were you involved in?

YS: We were doing advocacy, education and sensitization issues. We used to work together with the community leaders, municipal authorities and other NGOs in giving hygiene education and social marketing for sanitation.

3)Were you ever involved in latrine emptying and transport?

YS: No, not at all

4)R: So what do you do now?

YS We are now involved in poverty reduction programmes which include education for the poor and economic empowerment for the disadvantaged, especially the women.

5)R: Do you think you will come back to sanitation?

YS: May be. Time will tell.

Appendix 8: Summary of focus group responses

Summary of responses from Sakasaka focus group
<ul style="list-style-type: none">• The predominant latrine is bucket latrine.• Sometimes when the buckets are full, the emptiers do not come on time to empty and so it spills over. Therefore some household members use neighbours latrine or defaecate in the bush• Some users are careless about the use of water for anal cleansing as they wet the whole place with water. This combined with spitum and phlegm is nasty.• Women clean the latrines and empty the faeces of children who cannot use the latrine into the bucket.• Some emptiers do not bury their stuff well in the neighbourhood.• No written contract between households and emptiers. Informal verbal arrangement is used to get buckets emptied.• The municipality is not involved in the bucket emptying business• Some scavengers like rodents and chicken disturb the stuff which is improperly disposed off in the neighbourhood• Some members favour the use of human excreta for farming only if it is properly decomposed and devoid of bad smell.

Summary of responses from Changni focus group
<ul style="list-style-type: none">• Variety of latrine types available. But the most preferred are the VIPs and WC to sewer.• Some squatting holes on the pits are too large for children to use safely without assistance.• Some users shit on and around the pedestals, making it difficult for other users to use• Anal cleansing materials differ from user to user.• Some users carelessly drop in anal cleansing materials even if anal cleansing bins are provided.• Women and girls clean the latrines and empty anal cleansing bins.• The emptying service from the municipality is affordable but not reliable so households resort to emptying alternatives from the private sector which are more expensive.• Means of communicating to emptiers are personal contact and mobile phones.• Emptying prices are negotiable.

- Manual emptiers always leave some bits of FS around after emptying and transporting.
- Indiscriminate open defaecation is still practised

Summary of responses from Kakpagyili focus group

- Several households do not have latrines. Therefore many users go to the public latrines or do it openly.
- Public latrine users complain of the cost for using the public latrines
- The nature and location of some latrines make them susceptible to being filled up by flood water
- Prices for FS emptying can be bargained.
- Both manual and mechanical emptying is practiced, but mechanical emptying is preferred.
- Manual emptiers leave their emptied stuff close to latrines to dry out in the sun.
- Households need more help financially to construct more latrines
- Some latrines are in poor state and smell badly.
- Some members in household are reluctant to pay for emptying
- Some neighbours do not dispose off their anal cleansing materials properly. Therefore the light cleansing materials like papers are blown around carelessly by wind.
- Reuse of FS is practiced in the neighbourhood.

Box 12: Multiple responses from conservancy labourers focus group

- Manual tools used for bucket latrines are broom, bucket, and gloves.
- Manual tools used for pit latrines are ladder, bucket with rope attached, spade, pick-axe, boots, gloves.
- Manual emptying of pits are done in group made up of at least two people
- Expressed worry about the non-faecal objects thrown into pits because they create injuries
- Manual emptiers do other menial jobs to supplement income
- Conservancy labourers feel they are not respected in the society
- Some households, especially those with bucket latrines, wait till their latrine almost spill over before they inform emptiers.

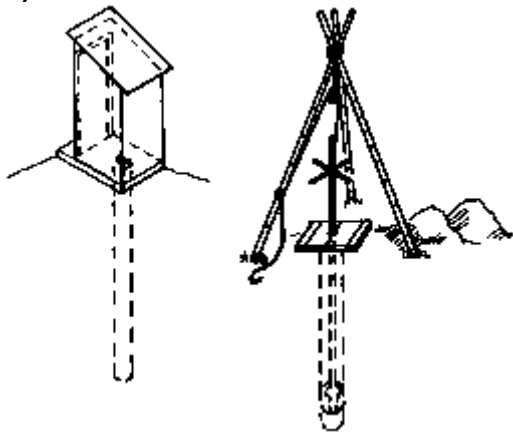
- Need mobile phones to improve communications with clients.
- Manual emptiers do drink hard liquor to overcome stench and stigma.
- Emptiers complain about skin diseases, diarrhoea and vomiting.
- Some farmers ask emptiers for FS for their farms by paying some fee for the sludge

Appendix 9: Examples of latrines and sanitation systems

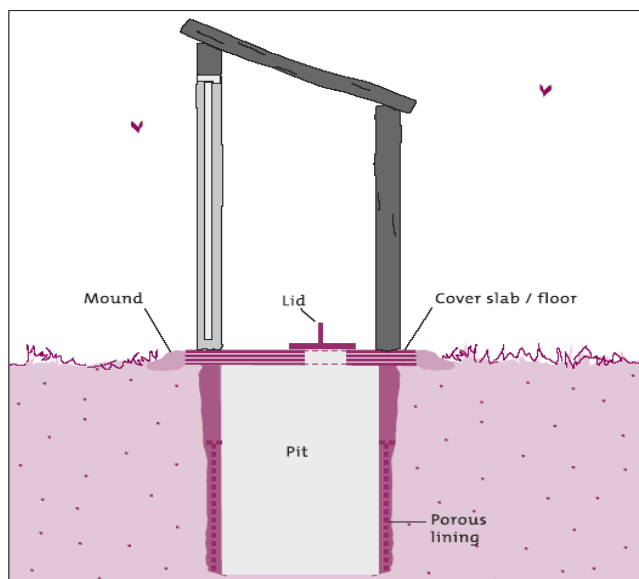
1) Open defecation



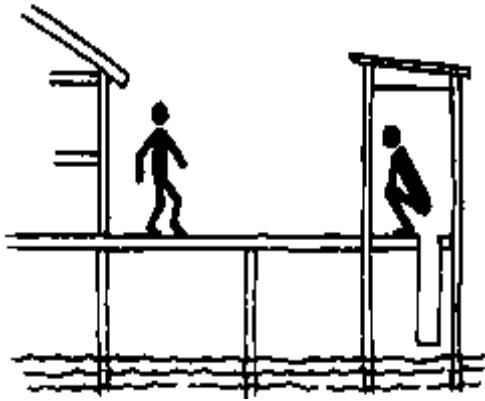
2) Borehole latrine



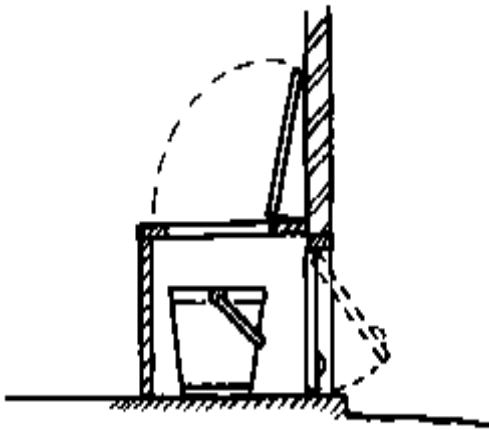
3) Simple pit Latrine



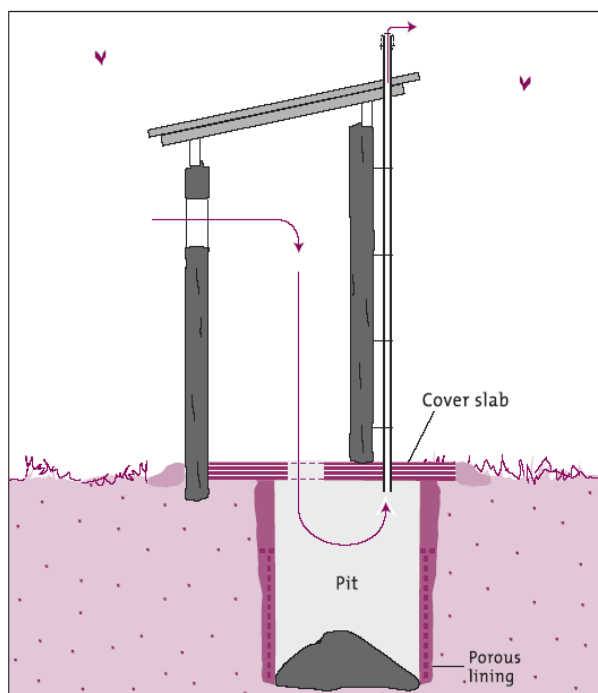
4) Overhung latrine



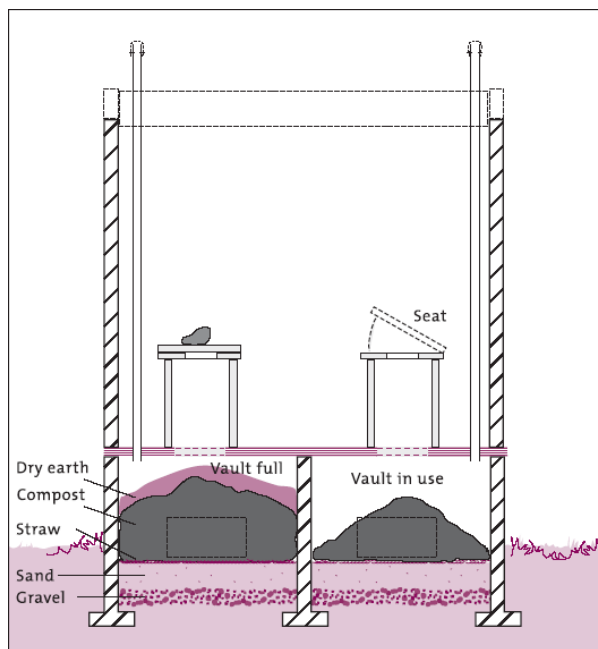
5) Bucket latrine



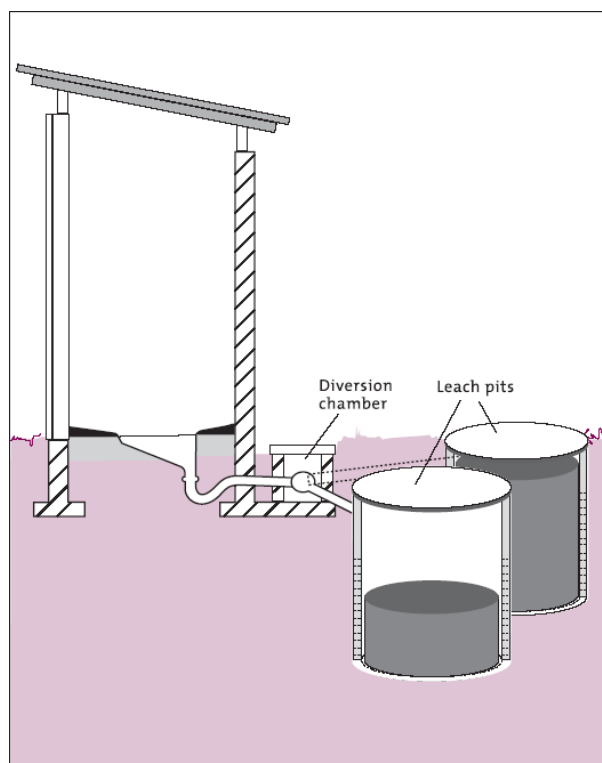
6) Ventilated Improved (VIP) Latrine (single)



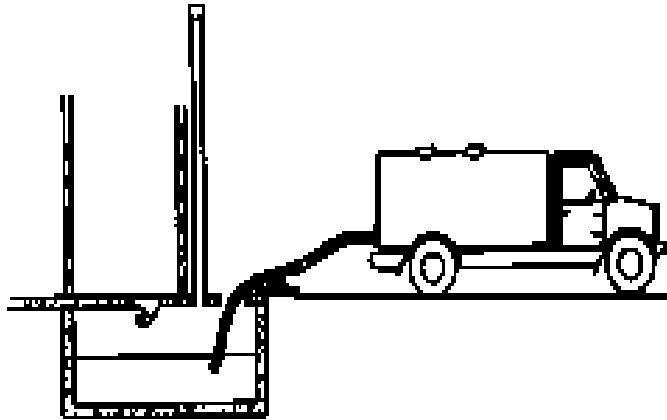
7) Double (Alternating) Ventilated Improved Latrine



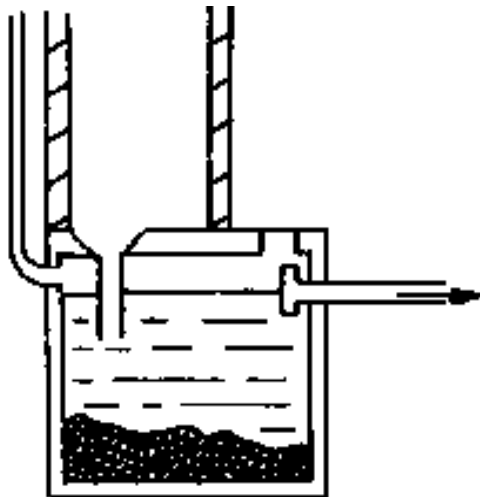
8) Pour Flush Latrine



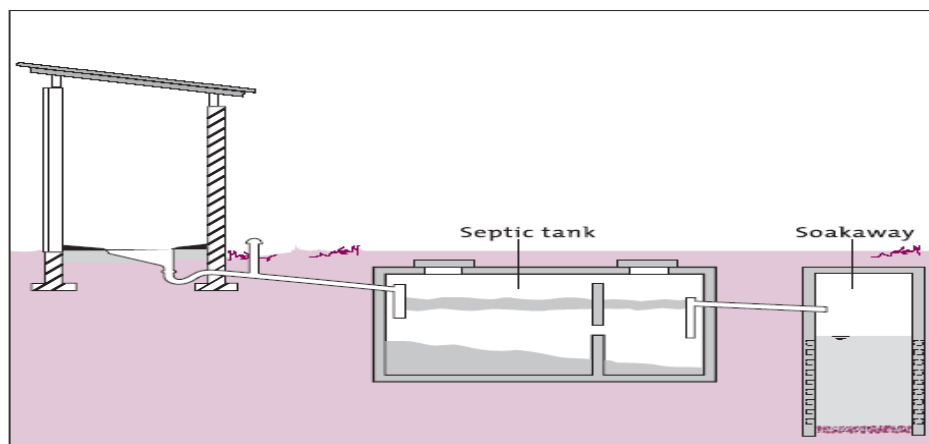
9) Vaults and Cesspits



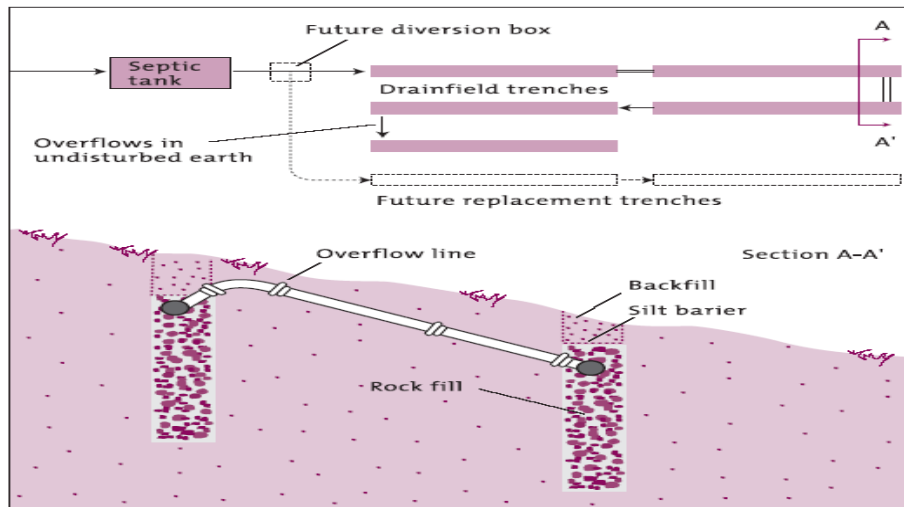
10) Aqua Privy



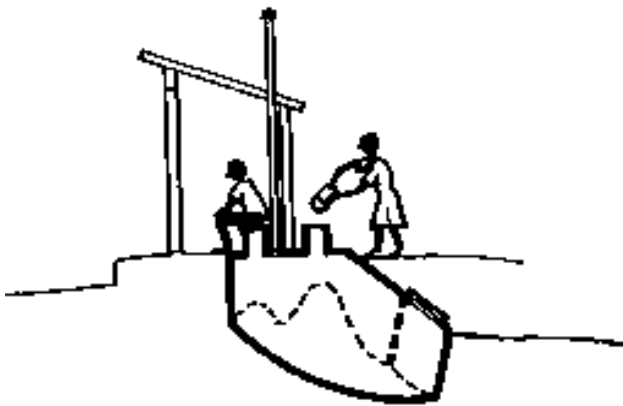
11) Septic Tank



12) Drain fields



13) Compost latrine



14) Sewerage

