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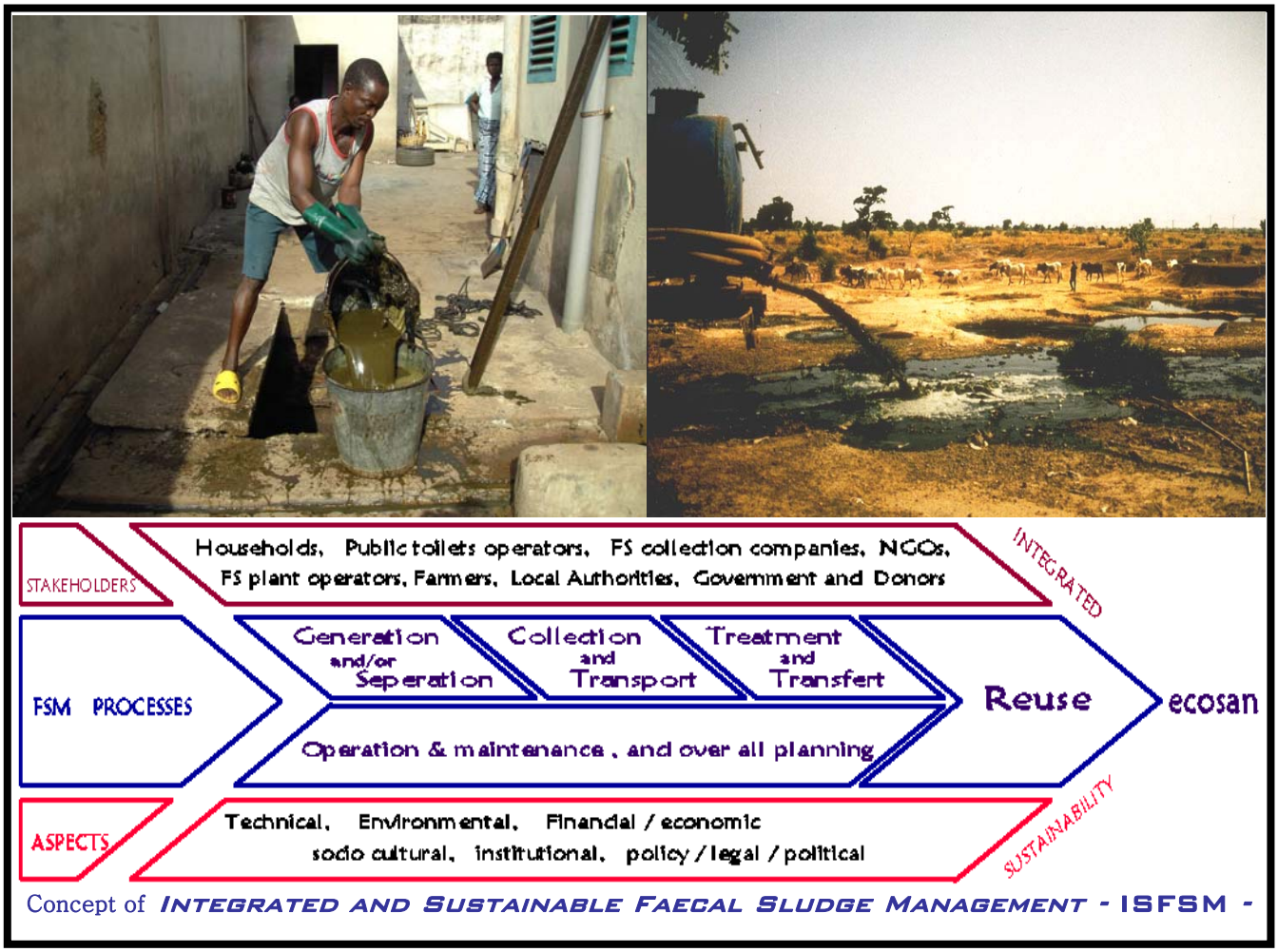

Financial and institutional challenges to make faecal sludge management integrated part of ecosan approach in West Africa. Case study of Kumasi, Ghana.

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Institute for Water Education

Financial and institutional challenges to make faecal sludge management integrated part of ecosan approach in West Africa. Case study of Kumasi, Ghana.

Master of Science Thesis
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This research is done for the partial fulfilment of requirements for the Master of Science degree at the UNESCO-IHE Institute for Water Education, Delft, the Netherlands

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March 2006

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

Dedication

Another cake that I’m offering to you Félicité and Mélika Sthella.
May the peace of the Almighty God always protect and help us to have more.
My mother, father, aunt, brothers and sisters, you can also share this cake with us.

Abstract

The debate on sanitation services provision in Africa should go beyond technologies and focus more on appropriate financial and institutional arrangements to reach systems' sustainability irrespective of donors' financial supports.

The aim of this study is to adapt the Faecal Sludge Management (FSM) in West African context to the ecological sanitation (ecosan) concept. Kumasi, a city in Ghana located 300 km Northwest of Accra the capital city, is used as a case study.

In the context of this thesis, I understand "ecosan" to be a sanitation system that is sustainable in all aspects (however this thesis focuses mostly on the financial sustainability) and which allows "closing the loop" (this means returning nutrients and soil conditioners from sanitation systems back to agriculture).

In Kumasi where FSM issues are institutionally better tackled than in many other towns in West-Africa, the system sustainability is still a problem because of the high government subsidy through donors' support. Improved financial and institutional arrangements need to be found for an economical and ecological sustainability of the system in accordance with ecosan approach.

The approach used for the research is based on literature review and direct contact with relevant stakeholders in Kumasi through open discussion, key informants interviews, interviews in which structured questionnaires were used, and field observation. Staffs for four collection companies and 20 households were interviewed.

A new concept developed in the research which is the ISFSM (Integrated Sustainable Faecal Sludge Management) concept, has been used as a framework to propose a new financial mechanism for sustainable faecal sludge management for the city. The ISFSM developed is based on IWRM (Integrated Water Resources Management) and ISWM (Integrated Sustainable Waste Management) concepts, and is a concept which places Faecal Sludge Management (FSM) under the umbrella of ecosan. The principles of this concept are equity, efficiency, ecological integrity, public participation and interaction with other urban service. From these principles I derived the CTP-approach (which implies that the service beneficiaries have to pay the service they receive at the right cost but at a fee that they are capable to pay) which also implies a cross-subsidy, and WTP-approach (which implies that the tariff of a product should be set at the amount that the clients are willing to pay), which are the main tools used, together with the cost recovery (CR) tool, to analyze the financial situation for the FSM system.

Based on the ISFSM concept, the research shows how the FSM system of the city, can be independent from donors financial support if the potential revenue in both households and farmers are brought out. This revenue was estimated: (i) for households based on an the CTP assumption of 05% of his or her income that a person can spend on the toilet emptying service, and (ii) for compost sale to farmers based on a tariff of US$ 1.4 per 50 kg bag of compost determined from the farmers' WTP results. It has been found that the FSM system financial cost recovery can reach 167% from this estimated revenue. This potential revenue includes US$ 109,200 per month from households which represents 34% (*current estimated FS collection coverage*) of the total revenue that can be expected from all the households in the city, and US$ 18,000 per month from farmers. A sensitivity analysis showed that only 55% to 70% of the households CTP is needed to achieve the reasonable cost recovery of 100%. This theoretical approach still has some practical limitations which are addressed in this thesis. This approach can then be applied to other West African cities to overcome sanitation problems in a sustainable manner.

It is also concluded that the FSM is currently not integrated and sustainable in Kumasi. The institutional and financial challenges that are required to make the FSM integrated and sustainable were found to be: (i) reach efficiency and equity for the system cost recovery by applying the CTP and WTP approaches; (ii) reach the ecological integrity (closing nutrients loop) by adding a composting step to the current FSTP for compost production for reuse in agriculture to ensure that nutrients are returned back to the environment; (iii) public participation by considering the stakeholders' view, allowing transparency and accountability mechanism to inform the public on the importance of FSM service and on why they should pay a CTP-based fee to benefit for the sanitation service; (iv) interaction with the solid waste allowing the association with solid waste management service for co-composting (composting of both faecal and solid waste) to enhance the compost quality.

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May peace, enjoyment and hard work always triumph!

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Acronyms and abbreviations

BOT	Build Operate and Transfer
CAPEX	Capital expenditures
CR	Cost Recovery
CREPA	Centre Régional pour l'Eau et l'Assainissement à faible coût (Regional Centre for Water Supply and Low-cost Sanitation)
CTP	Capacity To Pay
ecosan	Ecological sanitation
EPA	Environmental Protection Agency
FS	Faecal Sludge
FSM	Faecal Sludge Management
FSTP	Faecal Sludge Treatment Plant
GoG	Government of Ghana
HH	Household
HRM	Human Resources Management
ISFSM	Integrated and Sustainable Faecal Sludge Management
ISWM	Integrated Sustainable Water Management
IWMI	International Water Management Institute
IWRM	Integrated Water Resources Management
KMA	Kumasi Metropolitan Assembly
KNUST	Kwame N'Krumah University of Science and Technology
MDG	Millennium Development Goals
O&M	Operation and Maintenance
OPEX	Operational expenditures
OSS	On-Site Sanitation
SANDEC	Sanitation for Developing Countries
TS	Total Solids
UESP	Urban Environmental Sanitation Programme
WMD	Waste Management Department
WTP	Willingness To Pay

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1 INTRODUCTION

1-1 Background

1-1-1 General overview

There is nowadays a strong push for sanitation programmes in developing countries to solve the problems of the approximately 2.6 billion people without access to basic sanitation. The aim is to find more viable and sustainable solutions to sanitation in order to meet the Millennium Development Goal (MDG) Number 7, target number 10 ("Halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation" (UNDP, 2005)). A new approach to sanitation is ecological sanitation (ecosan), which has been proven in many pilot projects to provide benefits such as: protect the environment, save water and money, provide barriers to water pollution and water-related diseases, and recycle water and nutrients for reuse in agriculture. Ecosan is a new paradigm in sanitation provision, which is not limited to a specific technology but encompasses all sanitation systems that lead to sustainable systems.

In West African cities today, the sanitation reality is that thousands of tons of faecal sludge from conventional on-site sanitation systems (i.e. mostly septic tanks, pit latrines; private and public toilets; wet or dry sanitation but without urine diversion) are disposed off untreated and indiscriminately into lanes, drainage ditches, inland waters, estuaries and the sea. The existing financial and institutional arrangements in most cities are not allowing the success of faecal sludge management (FSM) programmes.

Many sanitation experts regard ecosan and FSM programmes as two separate entities. It is my view however that FSM should be considered as an integrated part of ecosan to solve developing cities' sanitation problems.

In this thesis, I describe how to overcome financial and institutional challenges so that FSM can be part of an ecosan approach to deal with West African cities' sanitation problems in a sustainable manner.

1-1-2 Problem description

More than 75 % of houses in large cities and up to 100 % of houses in towns in sub-Saharan Africa are served by conventional[1] on-site sanitation facilities (OSS) which results in the production of faecal sludge (Strauss *et al*., 2004). The produced faecal sludge from the OSS facilities are not collected and treated properly due to the lack of adequate faecal sludge management system.

To overcome these problems, new sanitation technologies such as dry urine diversion toilets in many varieties according to the local conditions, have been developed and tested with success in pilot projects under ecosan programmes. They are proving their capacities to meet one or many of sustainability conditions such as: protect the environment, save water and money, put barriers to water pollution and water-borne-diseases, and recycle the waste for reuse in agriculture. But they are not able to solve the problems of the huge amount of faecal sludge from OSS facilities that are currently in use.

[1] no urine diversion; water borne or dry sanitation

Do we have to provide dry urine diversion (UD) toilets to all the population in West Africa before we begin to solve the problem of human waste in our cities, where a dramatic amount of faecal sludge from the OSS-dependend population is indiscriminately dumped into the environment?

In fact the view and strategies of many planners today while talking about ecosan, is the implementation of UD toilets, where the dry faecal sludge can be safely removed from the toilets some time later, and be reused in agriculture with no high-tech treatment (this refers to as "closing the loop"). But the scaling up of UD toilets to a whole city (mostly the urban areas) is not easy because of the socio-cultural constraints, the waste handling at household level (urine storage and transport), and mostly the replacement of the existing OSS facilities.

On the other hand, the evaluation of the success of sanitation programmes or the rate of meeting MDGs in sanitation is just based on counting the number of sanitation facilities in the communities with no care about where the thousand of tons of sludge from OSS facilities is ending up.

Practical and sustainable approaches are therefore required for the sustainable management of the huge amount of the existing faecal sludge in the developing cities. These approaches include not only good technologies but also appropriate financial and institutional mechanisms.

In Kumasi (a city located 300 km Northwest of Accra, the capital of Ghana), for example, a faecal sludge treatment plant (Buobai pond system) has been in operation for three years (2001-2003) but was abandoned after the ponds had filled up, for financial reasons. Another treatment plant (Dompoase pond system) is now operating.

For Kumasi, which I chose as a case study for my research, some previous studies have been completed to address the financial problems of the faecal sludge system. But their results are still not realistic and needed further work, as I will show in this thesis.

This research is searching for better institutional and financial mechanisms that can be applied for sustainable faecal sludge management in developing cities. It is based on the ISFSM (Integrated and Sustainable Faecal Sludge Management) approach that I developed in Section 6-1, using IWRM (Integrated Water Resources Management) and ISWM (Integrated and Sustainable Waste Management) concepts as a basis.

1-2 Research description

1-2-1 Scope of the research

The scope of this research is to investigate the institutional and financial aspects of the enabling environment for integrated sustainable faecal sludge management (with emphasis on opening up reuse opportunities).

The city of Kumasi in Ghana was chosen as a case study for the research because some studies in faecal sludge management have already been undertaken there, by IWMI[2] and SANDEC[3], and some useful data was available.

[2] International Water Management Institute
[3] **San**itation for **De**veloping **c**ountries

1-2-2 Research objective

The objective of the research was to investigate how faecal sludge management can be made an integrated part of an ecological sanitation approach in Kumasi with regard to financial and institutional aspects.

Specifically for the case study of Kumasi, the research objectives were:

1. To describe the current situation in Faecal Sludge Management (FSM) in the city;
2. To analyze the institutional situation and interactions of the keys stakeholders in FSM;
3. To analyze the financial situation based on ISFSM approach (see Section 6-1 for the approach);
4. To develop financial mechanism for integrated and sustainable FSM for the city, and collect stakeholders views about this mechanism.

1-2-3 Research questions

Based on the specific objectives, the research questions can be formulated as:

RQ 1. How is faecal sludge managed in Kumasi?

RQ 2. What are the institutional situation and the interactions of the keys stakeholders in FSM?

RQ 3. What is the current financial situation in FSM?

RQ 4. Can the faecal sludge management for the city be made integrated and sustainable?

1-2-4 Research hypothesis

My research hypothesis is:

"The existing financial mechanism and interactions of the stakeholders in faecal sludge management in Kumasi do not allow an Integrated and Sustainable Faecal Sludge Management (ISFSM) for the city."

2 LITERATURE REVIEW

2-1 Overview of sanitation problems and potential solutions

There is a major challenge to reach over 400 million people without access to improved sanitation in Africa. In urban areas in Africa, the excreta disposal situation has become dramatic: thousands of tons of sludge from on-site sanitation installations – so-called faecal sludge (FS) – are disposed off daily untreated and indiscriminately into lanes, drainage ditches, onto open urban spaces, into inland waters, estuaries, and the sea. Due to a lack or poor excreta management systems in many cities of developing countries, low-income areas are faced in particular with serious health and environmental problems (Steiner *et al.*, 2002). This problem has been called "the faecal sludge crisis".

The faecal sludge crisis problems can be minimised if appropriate faecal sludge management (FSM) is introduced, not only with regard to FS treatment, but also pertaining to adequate and safe emptying of sanitation facilities, FS transport and its safe disposal or reuse (Steiner *et al.*, 2002).

In urban areas of developing countries, dry or water-borne on-site sanitation (OSS) systems predominate over water-borne, sewered sanitation. OSS comprises non-sewered household and public toilets, aqua privies and septic tanks. In sub-Saharan Africa, more than 75 % of houses in large cities and up to 100 % in towns are served by on-site sanitation facilities (Strauss *et al.*, 2004).

The traditional way of solving the worldwide sanitation problems is the use of conventional sanitary systems such as sewage system based on flush toilets, and pit latrines used in poor areas in developing countries.

The water-borne systems rely upon a dependable water supply in order to function correctly. According to Winblad and Simpson-Hébert (2004), "they are inadequate and are based on hiding human excreta in deep pits ('drop and store') or on flushing them away and diluting them in rivers, lakes and the sea ('flush and discharge')". The consequence is the destruction of the environment. Over 95% of sewage in developing countries is today discharged untreated, polluting rivers, lakes and coastal areas (UNDP, 2005).

The other disadvantage of these sewage systems is the misuse (waste) of the water resources. Over a year for each person some 400-500 litres of urine and 50 litres of faeces are flushed away with 15,000 litres of pure water. Water from bath, kitchen and laundry may add up to another 15,000 – 30,000 litres for each person (Winblad and Simpson-Hébert, 2004).

According to UNDP (2005), water pollution, scarcity of freshwater, destruction and loss of soil fertility, and food security are serious problems faced by society today.

It is therefore time to consider what Lavoisier[4] said about constituent elements of our universe, *"Nothing is lost, nothing is created, everything is transformed"*, to remember that our resources are finite and we need to protect them. It is obviously the same thought while Esrey (2001) said *"Food for people, and people for food"*.

Ecological sanitation (**ecosan**) could be the beginning of a new public health revolution (Winblad and Simpson-Hébert, 2004).

2-2 What is ecological sanitation, ecosan?

2-2-1 The approach

[4] Antoine Laurent Lavoisier is a contemporary Chemist.

Ecological Sanitation (ecosan in short) is based on the idea that urine, faeces and water are resources in an ecological loop. It is an approach that seeks to protect public health, prevent pollution and at the same time return valuable nutrients and humus to the soil. This recycling of nutrients helps to ensure food security. Ecological sanitation is a safe approach to recovering nutrients from human excreta (Esrey *et al.*, 2001).

Many consider ecosan as limited to dry sanitation or urine diversion toilets[5]. This is only a specific toilet type responding to ecosan principles because the waste from them is easy to handle and safe for the reuse without high-tech treatment. Esrey (2001) states that "Toilets, particularly ecological toilets, are a major part of the ecosan concept, but are only a part. Ecosan encompasses more, it's about a way of life, and how we should live on this planet, not just about how toilets should be different."

Schmitt (2003) also states "The term Ecological Sanitation stands for ecologically and economically sustainable sanitation systems. It does not refer to a specific technology. We use it rather to describe a whole range of technologies and institutional arrangements, which address both the issue of water scarcity and better sanitation. Ecosan covers closed-loop systems of wastewater management, which concentrate on the principles of recycling water and nutrients as well as reducing the need for freshwater and is a holistic alternative to conventional sanitary systems. "

Ecosan is therefore multidisciplinary and must not be considered as a specific technology for human waste management but include many other aspects for which the financial and institutional aspects can predominate. Klutsé and Ahlgren (2005) state "It is always easy to overcome socio-cultural constraints when the benefit is demonstrated. In most of the pilot sites the approach has created an open interest in the reuse of toilet products and the repellent aspects of the excreta has in general been forgotten in favour for their obvious advantages as fertilizer ".

According to Winblad and Simpson-Hébert (2004), the local variables that influences the choice of an ecosan system are (i) *climate*: temperature, precipitation and solar radiation; (ii) *population density and settlement pattern*: the availability of space for on-site/off processing, storage and local recycling; (iii) *social/cultural*: the custom, beliefs, values and practices that influence the design of the social components of sanitation system, its acceptability by the community; (iv) *economic*: the financial resources of both individuals and the community as a whole to support sanitation system; (v) *technical capacity*: the level of technology that can be supported and maintained by local skills and tools; (vi) *agriculture*: the characteristic of local agriculture and homestead gardening; (vii) *institutional support*: legal framework, extend of support for the ecosan concept in government, industry, financial institutions, universities and NGOs.

Better financial and institutional arrangements for sanitation service provision in a sustainable manner can also be therefore considered as ecosan approaches.

2-2-2 Toilets facilities in West Africa

In general terms, toilets can be distinguished as follows:

- Dry toilets with urine diversion (UD): They are toilets without flush water and where the faeces are separated from the urine.
- Dry toilets without urine diversion: They are toilets without flush water and where the faeces and urine are mixed.

[5] Urine diversion toilets work by separating urine from faeces to produce dry waste which is easy to handle.

- Wet toilets with urine diversion: They are toilets where the faeces is flushed separately from urine.
- Wet toilets without urine diversion: They are toilets where the faeces and urine are mixed and flushed (conventional water-flush toilet).

The choice of each system depends on the local conditions in term of technology, affordability and acceptability.

In West Africa the first two systems are considered as dry toilets because of their characteristics of generating dry waste that can be safely handled after staying some time in the pits. A particular form which is the double vault UD toilet (UD toilet where two vaults are used alternatively to generate FS that can be used in agriculture without any high-tech for the FS treatment) is promoted under many ecosan programmes. For example in CREPA many pilot projects have been described in CREPA (2004) to optimise the toilets construction cost and the agronomic impacts of the generated FS used. But the dissemination of this type of technology can only be easy in rural area where the farms are not far from houses.

The common form of conventional OSS systems found in urban areas in West Africa are either wet (water borne sewerage system or septic tank) or dry (pit latrine or VIP[6] latrine) with no urine diversion. They produce faecal sludge that is hard to treat and poses serious sanitation problems to West African cities. They need to be managed in a sustainable way as part of an ecological sanitation concept.

2-3 What is Faecal Sludge and Faecal Sludge Management ?

It must be noted that the body of literature on FSM is still quite limited, which is why this literature review is also relatively small. The bulk of the literature published on this topic comes from SANDEC and IWMI.

2-3-1 Faecal sludge and FS characteristics

Faecal sludges (FS) are sludges of variable consistency accumulating in septic tanks, aqua privies, family pit or bucket latrines and unsewered public toilets. These contents comprise varying concentrations of settleable or settled faecal solids as well as of other, non-faecal matter. Further to this, the sludges exhibit varying degrees of biochemical stability attained through anaerobic digestion mainly, depending on the ambient temperature, retention period, and inhibition or enhancement due the presence of other, non-faecal substances (Heinss *et al.*, 1998).

The elements that characterize the faecal sludge are presented in Table 2-1.

[6] Ventilated Improved System (see more in Section 4-2-1-1)

Table 2-1: Daily per capita volumes; BOD, TS, and TKN loads of different types of Faecal Sludges (Source: Heinss et al. (1998))

Variable for the FS	Septage [1]	Public toilet and bucket latrine sludge [1]	Pit latrine sludge [2]	Fresh excreta
• **BOD** g/cap·day	1	16	8	45
• **TS** g/cap·day	14	100	90	110
• **TKN** g/cap·day	0.8	8	5	10
• **l/cap·day**	1	2 (includes water for toilet cleansing)	0.15 – 0.20	1.5 (faeces and urine)

Values are low for septage because most of the pollutant load is in liquid phase (effluent)

Notes from Heinss et al. (1998) for Table 2-1 :

1 Estimates are based on a faecal sludge collection survey conducted in Accra, Ghana.

2 Figures have been estimated on an assumed decomposition process occurring in pit latrines. According to the frequently observed practice, only the top portions of pit latrines (~ 0.7 ... 1 m) are presumed to be removed by the suction tankers since the lower portions have often solidified to an extent which does not allow vacuum emptying. Hence, both per capita volumes and characteristics will range higher than in the material which has undergone more extensive decomposition.

2-3-2 Faecal sludge crisis

According to Klingel *et al.* (2002), if the FS is not properly managed, negative impacts on the urban environment (Figure 2-1) and on public health (faecal sludge crisis) may result such as:

- environmental pollution caused by effluents of septic tanks or community toilets which are not desludged regularly;
- indiscriminate dumping of large amounts of faecal sludge removed from these sanitation facilities, into the environment due to lack of treatment facilities;
- faecal sludge use in unhygienic way in agriculture due to the lack of sludge treatment.

Figure 2-1: Dumping of faecal sludge in the outskirts of Ouagadougou, Burkina Faso (source: Klingel et al.(2002))

2-3-3 The FSM processes

The faecal sludge management is the adequate management of the produced sludge to avoid the FS crisis by providing proper FM management systems which include adequate de-sludging of sanitation facilities, safe handling and transport of sludge, treatment of sludge, and safe disposal or reuse.

The FSM processes are all the necessary steps of FSM that need to be considered when planning any FSM system, mainly in order to close the faecal sludge loop.

These processes, as shown in Figure 2-2, can be defined as (based on (Klundert and Anschütz, 2001)):

- *Generation and separation process:* consists of all the activities related to the toilets facilities promotion or provision to the community for the excreta generation and its possible separation from the urine.
- *Collection and transport process*: consist of all the activities related to the faecal sludge collection from houses or utilities and its haulage to the faecal sludge treatment plant.
- *Treatment and transfer process:* consist of activities related the faecal sludge treatment and the eventual transfer to the reuse and landfill site.
- *Disposal and reuse process:* consist of all activities related to the faecal sludge reuse or safe disposal.
- *Operation and management process*: consist of activities necessary for the overall planning and management of faecal sludge until the production of a safe end product.

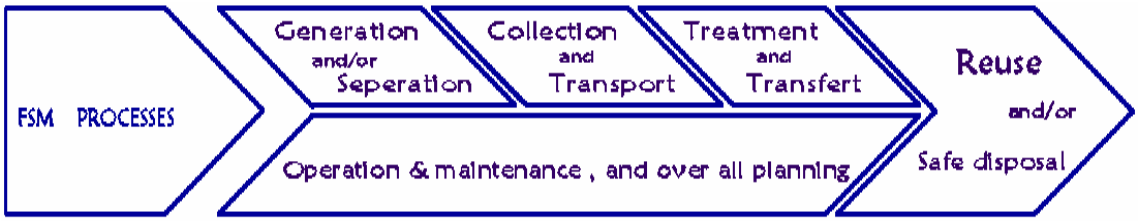


Figure 2-2: Processes of faecal sludge management based on (Klundert and Anschütz, 2001)).

2-4 FS treatment

2-4-1 Principles of faecal sludge treatment

Faecal sludge has several characteristics that make it difficult to handle. Faecal sludge cannot be discharged into surface waters or be treated like wastewater because its pollutant concentrations are too high. It cannot be landfilled or treated like solid waste because its moisture content is too high. It cannot be directly used for crop fertilizing because its pathogen content is too high. The first stage of faecal sludge treatment thus mostly involves the stabilization of the sludge and the separation of the solid phase and the liquid phase. In this way the liquid part can be treated specifically, usually with wastewater treatment technologies. The solid part can further be treated to enhance its characteristics for either landfilling or agricultural reuse. Hence, sludge treatment involves different treatment steps

where available techniques can be combined in various ways depending on the existing constraints and the treatment objectives (Klingel *et al.*, 2002).

2-4-2 Overview of Treatment Options

When classifying faecal sludge treatment options, a distinction is usually made between options with and options without solids-liquid separation. Another way of classifying FS treatment options is to distinguish between separate treatment of faecal sludges and co-treatment. Co-treatment comprises options treating septage or latrine sludges together with municipal wastewater, wastewater treatment plant sludge, household/municipal solid waste, and with organic residues (e.g. sawdust or woodchips) (Heinss *et al*., 1998). Figure 2-3 shows the theoretical faecal sludge treatment options.

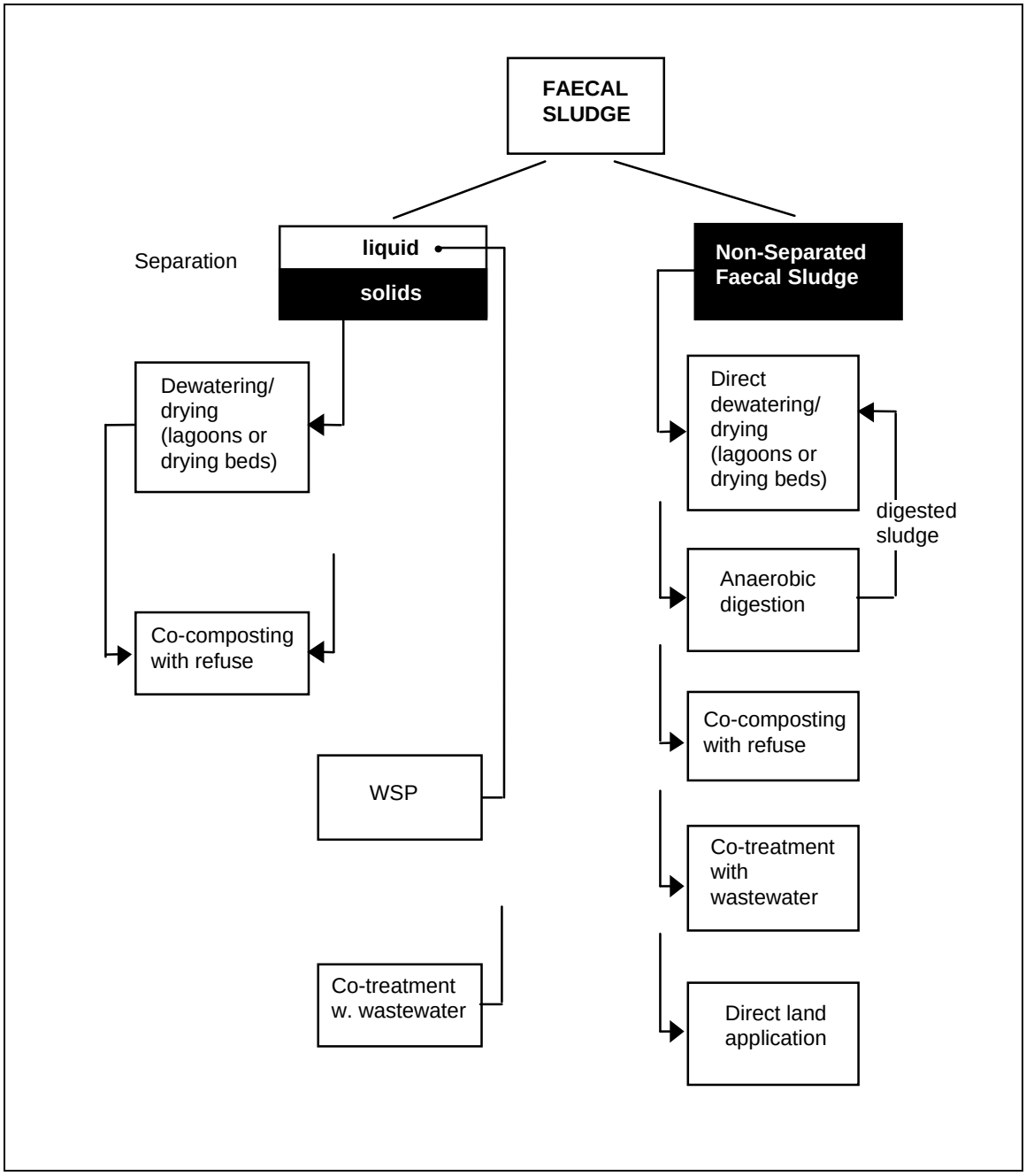


Figure 2-3: Theoretical Options for Treating Faecal Sludge (Source: Heinss et al. (1998))

Figure 2-4 also gives an overview on the treatment processes, but with some possible combinations and the destination of the end product.

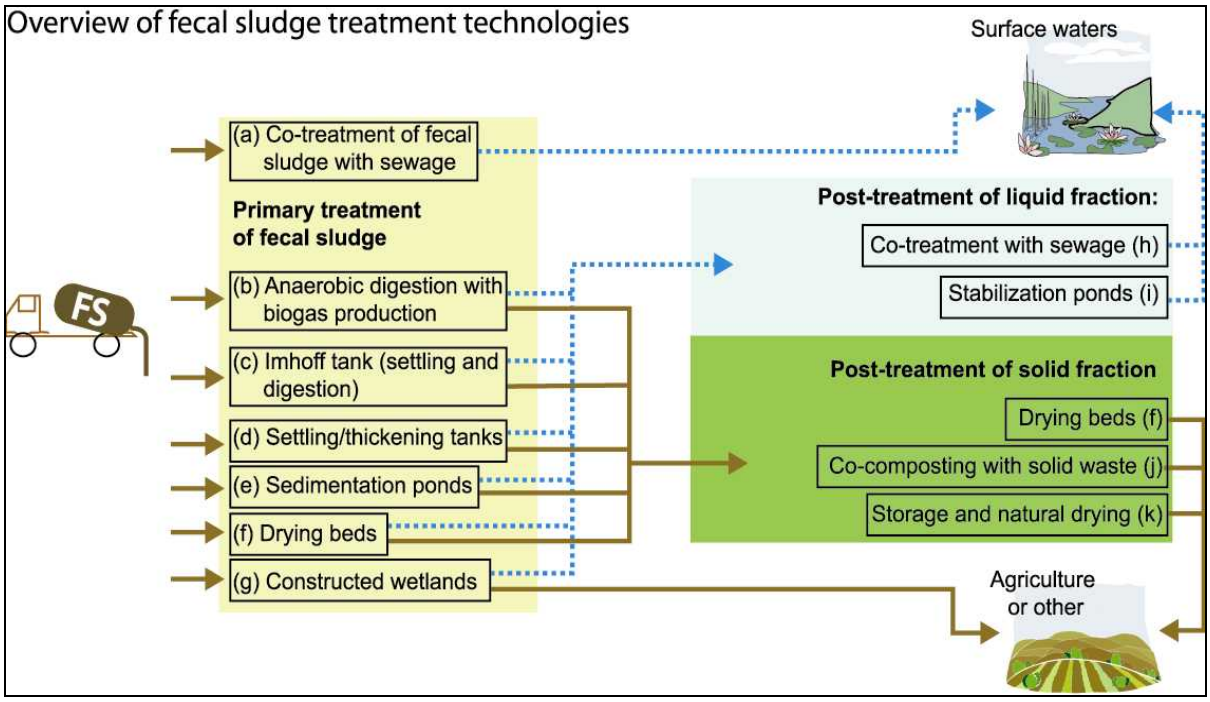


Figure 2-4: Overview of "simple" faecal sludge treatment technologies and their possible combinations (source: Klingel et al. (2002)).

2-4-3 Selecting appropriate treatment options

Methods for treating human waste in developing and in newly industrialised countries should, in most cases, be of relatively low-cost; i.e., low in capital and operating costs. Chosen systems must also be compatible with the expertise available in the particular country at various professional levels, and with the institutional/entrepreneurial set-up responsible for scheme implementation and servicing. The preferred options will, in most cases, comprise low or modest levels of mechanisation and concomitant minimum external energy input (Heinss *et al*., 1998).

The disadvantage of treatment options of low capital and operating costs is their large land requirements. This, in turn, creates a great challenge to the fast growing urban agglomerations where land becomes increasingly scarce and, hence, relatively costly. Therefore, when selecting appropriate options for the treatment of faecal sludges (and wastewater), a judicious choice must be made with respect to these factors - economic and technical feasibility vs. land requirement. A feasible strategy may consist in establishing an optimum number of decentralised, small to medium-sized treatment plants serving a selected number of urban districts or zones. Haulage distances for vacuum tankers will thereby also be reduced (Heinss *et al*., 1998).

2-4-4 Low cost treatment options and treatment efficiency

Table 2-2 shows the possible removal efficiencies of various low cost FS treatment options.

According to Strauss and Koné (2005), options such as (i) co-treatment of septage and wastewater in waste stabilisation ponds (including pretreating FS in settling/anaerobic ponds), (ii) septage treatment in constructed wetlands, (iii) FS dewatering on unplanted

sludge drying beds, and (iv) combined composting (co-composting) of dewatered FS and organic solid waste, are under collaborative research with partners such as IWMI, KNUST, KMA in Ghana and other partners in Bangkok.

Table 2-2: Selected options for (pre)treating faecal sludge: design criteria and possible removal efficiencies (source: Strauss and Koné (2005))

Treatment process or option	Design and operational criteria	Treatment goals and achievable performance		
		Solids-liquid separation	Removal of organic pollutants in liquid fraction	Removal of parasites (helminth eggs)
Settling/ anaerobic ponds	300-600g $BOD_5/m^3/d$ HRT[1]: ≥ 15 days SAR[2]: 0.02 m^3/m^3 (Rosario) and 0.13 m^3/m^3 (Accra)	BOD_5 > 60-70%	Filtered BOD_5 > 50%	Eggs concentrated in the settled and floating solids
Constructed wetlands (planted drying beds)	≤ 250 kg TS/m^2/year SAR: 20 cm/year (Bangkok; *Typha augustifolia* - cattail); bed permeability unimpaired for 7 years; vent piping required	SS > 80 %	To be treated in ponds or constructed wetlands for enhanced BOD, nutrients or pathogen removal	100% retained on top of the filter media
Co-composting	Dewatered FS (TS = 20-25 %): organic solid waste = 3:1 – 2:1 (vol. ratio) Windrow turning @ 10 days' interval for 8 weeks	- Compost maturity reached after 10-12 weeks - Heavy metal concentrations in compost meet the standards of industrialised countries		No. of viable eggs < reuse guideline

[1] *HRT: Hydraulic retention time* [2] *SAR: Solids Accumulation Rate*

2-5 Benefits for humanure reuse in agriculture

2-5-1 Reuse versus disposal

According to Klingel *et al.* (2002), reuse of sludge should be preferred over disposal on landfill for several reasons: (i) commercialisation of treated sludge can generate revenues; (ii) no use of landfill space; (iii) faecal sludge, in contrast to sewage sludge has little chemical contamination and can therefore be considered as valuable resource, which should be valorized. In a long-term point of view, the recycling of waste is always the preferable option in accordance with the ecosan principle of "closing the loop". One should only consider disposing the treated sludge if there is no need and market for a soil conditioner, or if the additional expenses for providing a product suitable for agricultural use can not be justified. Generally, the disposal of treated sludge is not problematic, as long as the sludge is sufficiently dehydrated and a sanitary landfill is available (Cofie, 2003).

2-5-2 Nutrients in faecal sludge

Excreta are a rich source of organic matter and of inorganic plant nutrients such as nitrogen, phosphorus and potassium. Each day, humans excrete in the order of 30 g of carbon (90 g of organic matter), 10-12 g of nitrogen, 2 g of phosphorus and 3 g of potassium. Most of the organic matter is contained in the faeces, while most of the nitrogen (70-80%) and potassium are contained in urine. Phosphorus is equally distributed between urine and faeces (Cofie, 2003).

The annual excretion of 500 litres of urine and 50 litres of faeces can provide an equivalent of 7.5 kg of NPK fertiliser which is enough fertilizer to grow 230 kg of cereal crop (Winblad and Simpson-Hébert, 2004).

2-5-3 Nutrient as soil conditioner

Excreta is not only a fertiliser, but its organic matter content, which serves as a soil conditioner and humus replenisher is of equal or even greater importance. This is an asset not shared by chemical fertilisers (Cofie, 2003).

Therefore dumping human waste is also depleting and destroying the limited natural resource of the environment.

2-5-4 Composting and co-composting

Composting refers to the process by which biodegradable waste is biologically decomposed under controlled conditions by microorganisms (mainly bacteria and fungi) under aerobic and thermophilic conditions. The resulting compost is a stabilised organic product produced in such a manner that the product may be handled, stored and applied to land according to a set of directions for use. Important to note is that the process of "composting" differs from the process of "natural decomposition" by the human activity of "control". "Control" has the goal to enhance the efficiency of the microbiological activity, to restrict undesired environmental and health impacts (smell, rodent control, water and soil pollution) and assure the targeted product quality (Cofie, 2003).

“Co-composting” means composting of two or more raw materials together – in this case, FS and solid waste. Other organic materials, which can be used or subjected to co-composting, comprise animal manure, sawdust, wood chips, bark, slaughterhouse waste, sludges or solid residues from food and beverage industries. Co-composting FS and municipal solid waste (MSW) is advantageous because the two materials complement each other. The human waste is relatively high in nitrogen content and moisture and the MSW is relatively high in organic carbon content and has good bulking quality. Furthermore, both these waste materials can be converted into a useful product. High temperatures attained in the composting process are effective in inactivating excreted pathogens contained in the FS and will convert both wastes into a hygienically safe soil conditioner-cum-fertilizer (Cofie, 2003).

Benefits derived from compost are numerous and have been well documented in the literature. Compost amendment in the soil affects the physical, chemical and biological characteristics of soils. It also enhances suppression of soil borne pathogens (Cofie, 2003).

2-6 Financial and institutional aspects of FSM

2-6-1 Planning principle of financial arrangements

The following statements are noted from Klingel *et al. (*2002) for the FSM financial arrangement planning:

- The management of faecal sludge can only be successful in a sustainable way when its financing is ensured. You have to pay very much attention to find stable arrangements for covering running costs like salaries, operation and maintenance of equipment and facilities. As far as possible, the running costs have to be recovered from the service fees or revenues. Dependence on external subsidizing should be minimized.

- Possible sources of financing for FS management can be the fees collected from households, the municipal budget, and revenues from sludge commercialization or from selling of licenses to private enterprises. Funding from central government or external donors is generally limited to investments.
- You have to think about a sound fee system, where fees sufficiently contribute to cost recovery, are acceptable for the service users, and can be actually collected.
- Be careful not to overestimate revenues from sludge commercialization. You need to base your calculation on careful assumptions. This is especially true if the sold product is new on the market and no experience with the willingness to pay of farmers exists. Depending on the situation, it may be possible that you can generate revenues through licensing private companies for sludge collection, or through fees for disposal at the treatment site. In other contexts, however, fees for disposal a treatment site may be repelling and entrepreneurs may rather dump the sludge elsewhere.
- Always make the implementation of new components of faecal sludge management dependent on available resources, both for investment and for operation costs. Better is to implement small-scale components, which actually work in a sustainable way, than to start too ambitious projects, which may fail soon due to lack of money for the day to day running.

2-6-2 Overview of cost and benefit in FSM estimated for Kumasi

The costs of FSM components presented in Table 2-3 has been estimated in US$ per tTS (ton of Total Solid) for Kumasi.

Table 2-3: Faecal sludge management costs in Kumasi (source: Steiner et al. (2002)).

Item	Costs per t TS [US$][1)]	Remark
FS collection:		
• Truck capital cost	17	Assumption: Treatment plant in the middle of circular collection area (ideal case) of 300,000 PE[7]
• FS truck haulage costs	11	
FS treatment:		Primary treatment by settling ponds, secondary treatment by facultative and maturation ponds, including biosolids post-storage, 200 m^3 FS daily capacity
• Investment costs	27	
• O+M costs	21	
Biosolids sale:		
• Transport to buyer	5	Assumed sales price of US$ 5 per m^3 biosolids; dewatered FS is mixed with 50% binder (e.g. sawdust)
• Revenue from sale	-15	
Sum	**66**	Total net costs per t TS, excluding land purchase and monitoring programme

[1)] Capital costs were annualised at 5% interest rate with 10 years depreciation period for the truck and 15 years for the treatment plant.

[7] Population Equivalent: 1 PE = 14 g TS per day and capita.

2-6-3 Financial and institutional scenarios proposed by previous study

The two major challenges for improving FSM consist of ensuring that FS is transported to the appropriate (treatment) site, and that the biosolids produced from treated FS are marketable to local, urban and peri-urban farmers or other potential buyers. Identifying, analysing roles, seeking advice of and concerting with key stakeholders (i.e. households, FS collection entrepreneurs, municipal and national sanitation authorities, farmers) are essential factors to meeting these challenges. Establishing sound financial structures and flows is a further important prerequisite (Strauss and Koné, 2005).

According to Strauss and Koné (2005), the "money flux" model illustrated in Figure 2-5 can be used as a FS management planning tool.

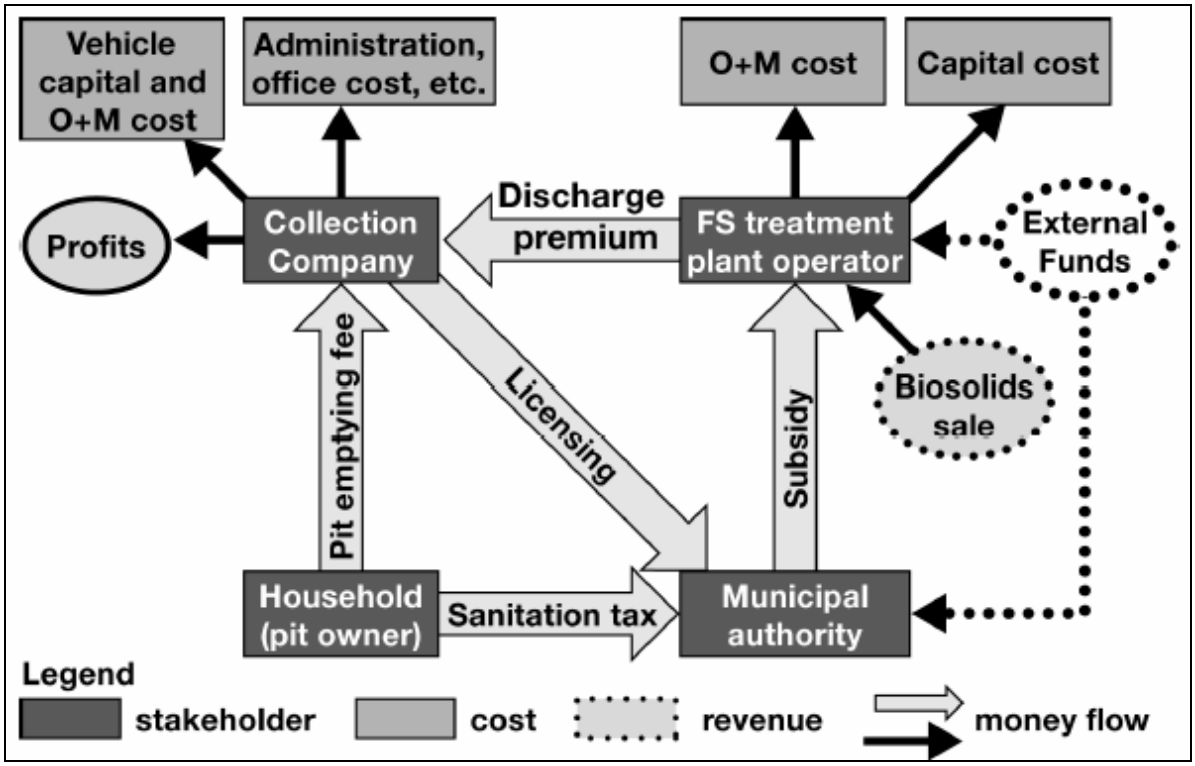


Figure 2-5: Proposed money flux and stakeholder relationship tool for integrated FSM (Discharge premium arrow: paying the FS haulers rather than charging them – an incentive-based regulatory tool). Source: (Strauss and Koné, 2005)

In this money flow, Strauss and Koné (2005) state "For all FS to be delivered to the treatment sites, we propose the special strategic element of reimbursing rather than charging FS haulers." This regulatory market tool is likely to curb indiscriminate FS dumping and, thus, reduce public health risks and water pollution. The costs of the treatment plant operations must be covered by licensing fees, sanitation taxes, proceeds from the sale of treated biosolids, and/or from subsidies (Strauss and Koné, 2005).

The entire scheme is sustainable only if: (i) households can afford pit emptying; (ii) enterprises can make a profit while adhering to the rules and regulations; (iii) treatment operations meet the established treatment objectives and are profitable or operated at least at cost; and (iv) the responsible authority can achieve sustainable integrated FSM at minimal costs (Strauss and Koné, 2005).

SANDEC has conducted financial assessment studies on FS collection enterprises in Bamako (Mali), Ouahigouya (Burkina Faso) and Kumasi (Ghana). The studies reveal that FS collection is a profitable business if haulage distances remain short and if licensing fees and sanitation taxes levied by public entities are channelled back to subsidise the system (Strauss and Koné, 2005).

Alternative innovative money flow options for more sustainable FSM in Kumasi have been proposed by Steiner *et al.* (2003). They are presented in Annex-5.

In Chapter 6, I critically compare my own proposed financial mechanism with these previously proposed options. The limitations of the previous work was that it was based on a number of assumptions (see Box 2-1) and on theoretical figures from others studies as presented in Table 2-3. My research aims to improve the details and practicalities of these new types of arrangements.

Box 2-1: Assumptions made by Steiner et al. (2003) to build the money flow in Annex-5.

To develop the money flow models, the following assumptions were made:

- Pits and septic tanks are emptied mechanically by vacuum trucks.
- A faecal sludge treatment plant is available to allow production of biosolids safe for reuse and, hence, no FS landfilling is required. Irrigation with liquid effluent is not possible due to its salt content, normally ranging beyond the plant's salt tolerance limit. Hence, treated FS is sold and not disposed of.
- The costs are derived from (except for the dumping fee) and expressed in US$ per t TS of raw FS. These are estimates based on the Ghanaian context and only valid for the assumed conditions (e.g. transport distance). Treatment costs are based on the settling ponds treatment scheme (associated with WSP for liquid polishing), situated in Kumasi (see Steiner 2002a). Land purchase costs are not included.
- The treatment plant treats an assumed sludge mixture of about 1:4 (public toilet sludge:septage). The assumed mean TS load of delivered FS amounts to 25 g TS/l.
- All the costs are expressed in US$/t TS and based on annual O+M costs and annualised capital costs.
- If there is a fee for FS delivery to a designated treatment site, about US$ 2 per truck load of 8 m3 is assumed, or about US$ 10 per t TS (25 g TS/l). However, the fee is proportional to the volume discharged.
- An average sales price of US$ 5 per m^3 of biosolids is assumed. According to Steiner (2002a), a benefit of US$ 10 per t TS can be derived from the sale of biosolids (US$ 15/t TS sales revenue – US$ 5/t TS transport costs to farmer). Although this may currently appear to be a far too optimistic revenue, it is integrated in the money flow model, which will hopefully become reality in the near future.
- To convert the pit emptying costs expressed in US$ per t TS into an emptying fee per pit, the pit emptying costs per t TS have to be multiplied by the pit volume and its TS content (e.g. US$ 120 per t TS would correspond to US$ 15 for emptying of a 5 m^3 pit with a TS content of 0.025 kg/m3 (120·5·0.025)).
- Administration charges for a sanitation tax or a remuneration system are not considered.
- The money flow models include only pit owners as FS producers, however, they also comprise public toilets.

3 ANALYTICAL FRAMEWORK AND METHODOLOGY

3-1 Analytical framework

This is the development of tools used in the research to tackle both institutional and financial issues for better faecal sludge management as would like the ISFSM approach.

3-1-1 Units of analysis

The units of analysis are:

- the whole faecal sludge management system in Kumasi that will be described through FSM processes shown in Figure 2-2;
- the key stakeholders in the FSM system in Kumasi for which the financial situation, institutional situation and interaction have been analyzed.

These stakeholders include:

- the FSM **services beneficiaries** , which are the main focus in the financial analysis;
- the **private operators** operating in FSM (faecal sludge collection companies and FSTP operator);
- the Waste Management Department of Kumasi Metropolitan Assembly (WMD/KMA) which is the FSM **system manager**; and
- the Environment Protection Agency (EPA) which is the **regulator** in FSM;

3-1-2 Stakeholders institutional analysis tools

3-1-2-1 Private operators institutional analysis tools

To check whether the private collection companies are performing well and to see how sustainable their activities can be, the following tools have been used:

- *Operational performance and internal organization:* The operation management, financial management, human resources management and customer management tasks have been analyzed.

- *External environment:* The comfort of the companies in their operating environment has been analyzed.

3-1-2-2 System manager institutional analysis tools

The tools used here are organizational tools needed for good performance that I build based on the ISFSM principles (see Section 6-1 for the principles). They include:

- *Market orientation:* The utility must develop some internal strategies for good performance to reach its operation's cost recovery. It uses *efficiency* principle to promote outcontracting and private sectors involvement depending on the nature of the service, and *interaction* with other sectors to multiply sources of revenues.

- *Private providers orientation:* Motivation of the collection companies to provide the service to households, and allowing them to have profit while setting the discharge fee. High discharge fee might encourage the illegal dumping and jeopardize the *ecological integrity* principle.

- *Service beneficiaries orientation*: The tariff setting for the service provision to the beneficiaries should be done with care of the social characteristic of the service implying the use of *equity* principle. The system must also be accountable to the beneficiaries and involve them in decision making based on *public participation* principle.

3-1-2-3 Regulator institutional analysis tools

To check how successful the regulatory actions in the faecal sludge management are, the following tools proposed by Asian Developing Bank, ADB (2005), have been used:

- *Effectiveness of the regulation:* The clarity of roles and objectives, autonomy, credibility, participation, transparency, accountability, predictability and capability of the regulatory body, have been analyzed.
- *Powers of the regulation:* The standards setting power, information gathering, enforcement and sanctions, and arbitration power, been analyzed.

3-1-3 Financial analysis

A financial analysis of the FSM system examines the financial status of the system. A "financially healthy" system is a system in which all the operational stakeholders are making reasonable profits from adequate services provision to the various beneficiaries, who are the only sources of revenue. Such a system has full cost recovery irrespective of any external financial support or any revenue from non-beneficiaries of the services.

When a system is not financially healthy, good strategies need to be developed to: (i) stimulate and collect the potential revenues from its various beneficiaries, and (ii) well allocate these revenue amongst operational stakeholders to avoid excess profit by ones to the detriment of others, and eventual disappearance of money from the system through embezzlement.

The financial analysis will therefore be based on the key stakeholders financial assessment. It will include the sources of revenue analysis, the system operators financial analysis and the system manager financial analysis (see Section 5-2-1 for details on these clusters).

The financial analysis helps to construct the main financial flow of the system and to determine the system cost recovery level.

3-1-3-1 Financial tools for sources of revenue analysis

The sources of revenue analysis seeks to evaluate the potential revenue that can be derived from the various sources of revenues previously identified, based on efficiency and equity (mainly if the service is a human right or social service) principles.

The possible sources of revenue in faecal sludge management are households which are the beneficiaries, and farmers as clients if the FSTP produce compost for reuse in agriculture.

- From households side, the analysis seeks to evaluate their expenditures on the service they receive, and compare them to the right amount they can pay for it. Here I use the approach of Capacity To Pay (CTP), which is the cost that the user is able to pay in relation with his or her income. In fact households have to pay the service at its right cost (efficiency principle), and can only pay what they are able to pay. A cross-subsidy amongst households is then required to achieve the efficiency since they do not have the same revenue. These two elements will be used to evaluate the potential revenue from households.

- From farmers side, I use the Willingness To Pay, which is: “the maximum sum that an individual, over a given time period, is prepared to pay rather than forgo his or her purchase”. The potential revenue from sale of compost to farmers will then based on their willingness to pay for the compost.

3-1-3-2 Financial tool for the private operators’ financial analysis:

Because of the large scope of the research, the net profit margin is the only tool I used for the financial analysis to characterize the FS collection companies. The net profit margin is one of the indicators which measure the profitability of a firm. I chose this ratio because it links directly the net profit of the firm to its revenue and can indicate how much the company earns per a certain amount of revenue (for example we can know how much it earns per one dollar invested).

The net profit margin derives from the income statement which is a summary of operating performance over a period of time (e.g. a fiscal quarter or fiscal year). The statement begins with sales or revenues, and expenses are deducted from sales or revenues to arrive at incomes (Schouten, 2005). The calculation steps of the net profit margin is show in Annex A2-2-1.

3-1-3-3 Financial tools for the system manager financial analysis:

The tool used here is limited to the cost recovery level estimation. But only the O&M cost recovery and financial cost recovery are used (see their definition in Section 0).

3-2 Operationalization

This section describes the operationalization of the analytical framework, using the tools developed to answer the research questions RQ1 to RQ4.

RQ 1. **How is faecal sludge managed in Kumasi?**

I operationalize the description of the faecal sludge management system as follows:

- FS production: different toilet facilities used in the city; distribution (number/ percentage) of toilets facilities in the city; population coverage of each facility; amount of FS produced monthly in the city and per toilet facility; overall problems of FS production.
- FS collection and transport: organisation of the collection by the authority: who provides the service? Number of collection companies and average monthly waste collected; other ways (like manual emptying) of FS collection and amount collected; population coverage of each collection services (per company) and type of facility served; Collection and transport problems.
- FS treatment and transfer: organisation of the treatment and transfer; existing treatment plants: age, capacity, treatment process, current state, problems; list of the collection companies delivering to the plant; transfer and management of the end-product.
- FS reuse or disposal: amount of treated waste generated per plant; existence of users and amount demanded; position of the users on a map; the supply system (transport, distribution);

RQ 2. **What are the institutional situation and interactions of the keys stakeholders in FSM?**

I operationalized the tools used in Section 3-1-2 as follows:

- **For the private operators institutional analysis (waste collection companies)**

- Operation management: daily number of trips; daily number of households served; duration to answer the service demand; households satisfaction of the service provided; number of staff per monthly household served; assets management and type of maintenance.
- Financial management: billing and collection; tariff setting; investment decision; staff payment.
- Human resources management: coverage of HRM functions; staff motivation; job satisfaction; training programmes within the company.
- Customer management: coverage of customer management functions; coverage of customers' complains; revenue depended on customers.
- External environment: incentives from the authorities; capacity building from the authorities; external support from any institution; community perception on their activities; communities' reaction on tariff change.

- **For the system manager institutional analysis:**

- Autonomy and performance targets: existence of financial (investment), managerial or decision making autonomy; existence of performance target for the completion of the Department's functions; accountability mechanism: to whom and for what?
- Market orientation: internal performance targets set for the Staff; internal accountability mechanism; capacity building; efficiency strategy like outcontracting or private sector involvement.
- Private providers orientation: strategy developed to avoid illegal dumping; training opportunities to the private companies;
- Service beneficiaries orientation: strategy for equity (special arrangement for the poor in the tariffs); degree of public participation, public awareness; accountability to the services beneficiaries.

- **For the regulator institutional analysis:**

⋆ *Effectiveness of the regulation*

- Clarity of roles and objectives: Roles and objectives of EPA; existence of clear mandate to accomplish them; stakeholders and government agencies involved in the roles; regulatory processes (procedures followed to carry out rules and responsibilities); problems encountered with the stakeholders.
- Autonomy/credibility: Existence of political or local authorities influence.
- Participation: Involvement or consultation of keys stakeholders.
- Transparency: Existence of clear rules and guidelines to be followed for decision making/ explanation of how and why decisions are made to all stakeholders.
- Accountability: Accessibility of decisions.
- Predictability: Degree of confidence rules made, assuring that there will not be a sudden change putting the serviceability at risk.

- Capability: Availability of competent and well trained professionals in the regulation body.

⋆ *Powers of the regulation:*

- Standards setting: Existence of power for standards setting for environmental conditions and proper sanitation services provision for households by the multiple providers.
- Information gathering: Power and means to gather information for the system.
- Enforcement and sanctions: Existence of power to enforce and sanction by imposing fines and penalties for non-compliance.
- Arbitration: Resolution of dispute among stakeholders; power to settle dispute between households and operators and between operators and government or local authorities.

RQ 3. **What is the current financial situation in FSM?**

I operationalized the tools used in Section 3-1-3 as follows:

▪ **For the sources of revenue analysis**

- Household income: monthly income of the head of the household; monthly income of other members of the household;
- Expenditures on water and sanitation: monthly expenditure on water; monthly expenditure on solid waste; monthly expenditure on faecal sludge: monthly expenditure on public toilet; contribution in the emptying fee paid by the whole house; emptying frequency.

▪ **For the private operator financial analysis**

- Annual revenue and annual total cost;
- Discharge fee paid;
- License fee and taxes.

The use of the tool is more simplified for Manhole Managers[8] who are informal private operators in the FSM system.

▪ **For the system manager financial analysis**

- Operating expenditures (OPEX) and capital expenditures (CAPEX) of the faecal sludge treatment plant;
- CAPEX interest rate and depreciation period.

RQ 4. **Can the faecal sludge management for the city be integrated and sustainable?**

The answer for this question will be derived from the findings analysis that will be based on the ISFSM principles. We need to check if there is a possible financial mechanism for ISFSM for the city and obtain stakeholders' views on it.

- Potential revenue from households: households' income per residential area of the city; number of households per residential area;
- Potential revenue from farmers: farmers' willingness to pay for compost and the compost demand;
- Additional cost to implement ISFSM.

[8] See Section 5-2-3-2 for more details.

3-3 Research methodology

Various approaches have been used, after identification of key stakeholders, to collect the data related to the operationalized analytical framework. Depending on the accessibility of the information needed, these approaches include: *literature reviews*, *key informants interviews, direct observation and discussions*, *household interviews*, and *open discussions*.

3-3-1 Key stakeholders identified

At the preparation phase of the data collection stage and during the research, the key stakeholders (presented in Table 3-1), have been identified with IWMI's officers and the WMD's officers (see Annex A1-1).

Table 3-1: Stakeholders in Faecal Sludge Management in Kumasi

Stakeholder category	**Stakeholder**
National Government	Government of Ghana (GoG)
Local government	Kumasi Metropolitan Assembly (KMA) Waste Management Departement (WMD)
Regulator	Environmental Protection Agency (EPA)
Donors	Worldbank
Research institutions	International Water Management Institute (IWMI) (*Representation of West Africa*) Sanitation for Developement Countries (SANDEC) (*Research Institution based in Switzerland*).
Private Sector	Faecal sludge collection companies (17 in total are currently providing the service to households) Dompoase faecal sludge treatment plant operator Manholes Managers, informal operators providing the collection service to bucket latrines owners.
Beneficiaries	Households in various residential areas (low income, middle income and high income areas)
Farmers	Recognised as potential stakeholders (they are not yet direct stakeholders)

3-3-2 From the operationalization to the methodology

- **About the operationalized research question RQ 1, the following methodologies have been used to collect the operationalized data:**

- Literature review: use of literature including the WMD's working reports, worksheets to collect data about the FS production and collection. Worksheets (photocopies) from the FS treatment plant also help to estimate the amount of FS discharge by each collection company at the plant.

- Key informants interview: continuous discussions with WMD's officers (see Annex A1-1) help to collect on the whole system.
- Field observations: I made direct observations during some field works with WMD's (manual) toilets emptyers; it also includes guiding visit and discussions at faecal sludge treatment plants organized by IWMI and the WMD.

▪ **About the research question RQ 2, the methodologies used are:**

- Open discussions: discussion with the WMD's Director and the EPA's Director based on the points listed in Annex A1-2.
- Literature review: to find out some missing data that could not be found during the discussions because of the unavailability of the respondents (mostly (Mensah, 2005)).
- Questionnaires used for faecal sludge collection companies to collect their operationalized institutional data (see Annex A1-3, questionnaire *section 1*).

▪ **About the research question RQ 3, the methodologies used are:**

- The same structured questionnaires used with the collection companies, give also some of the required financial information (see Annex A1-3, questionnaire *section 2*).
- A short open discussion with the manhole manager was conducted to find the relevant financial information.
- Questionnaires used for households interviews to collect the operationalized data on households' income and expenditures on water and sanitation (see Annex A1-4, questionnaire *section 2*).
- The open discussion with the WMD's Director, also provides some of the financial information about the faecal sludge treatment plant.

▪ About the research question RQ 4, the methodologies used are:

- Through the open discussion with the WMD staff, and questionnaires with collection companies and households, the stakeholders' views about the anticipated financial problems have been collected.
- The information on households as operationalized in this question could not be found through the households' survey because of the limited sample size. Therefore special literature review on the number of households and their income in the different residential areas of the city was necessary. Due to the age of the data found and my ignorance of the statistical events that have occurred over the time, it was necessary to work with the city's Statistical Service to process and update these old statistical data collected. The Annex-3 shows how the statistical data has been updated.
- The information on compost has been found in a previous study (Drechsel *et al.*, 2004) on farmers willingness to pay for compost.

3-3-3 Households interviews

3-3-3-1 Sample size

I chose the sample size of households as 20. The number chosen was small because of the limited time and the large scope of stakeholders to be covered. I chose households from the various income areas (high, medium and low income areas).

The partitioning of households into income classes is shown in Table 3-2. I took the higher percentage in low income area because of higher variability of toilet facilities in this class.

Table 3-2: Household interview's sample size in various income areas.

Income areas	Sample size	Percentage
Low income areas	10	50%
Middle income areas	5	25%
High income areas	5	25%
Total	**20**	**100%**

3-3-3-2 Choice of households and interview process

Households have been chosen at random since we have a small sample size in each income class.

First of all, I classified all the residential areas in the city into the three predefined income classes. This was done with the help of a WMD Officer who knows very well the city. This pre-classification shown in Table 9-5 in Annex A3-1, is based on the living standard (type of house), which do not necessarily reflect the income level in each case.

Then I based the choice of area household on a preliminary choice of residential area because I wanted to cover most of the areas in the city. In high and medium income areas, the selection of area was done with no criteria. On the other hand, in low income area where there is the larger variety of toilet facilities (all listed in Section 4-2-1-1), I included the criteria of existence of a particular type of toilet in the area. Hence, the process of selection was not fully random.

Once the area is selected, I went with an interpreter to the area to select a household. And in low income area, we selected a household which has a particular toilet I wanted to see. Moreover the choice can only be definitive when there is a head of family or somebody who knows well about the water and sanitation services they receive, at home. Otherwise we went to the next gate (the starting point was always where the taxi dropped us in the selected residential area). And finally, we can start our face-to-face interview, using the questionnaire in Annex A1-4.

3-3-4 FS collection companies interview

3-3-4-1 Sample size

Four private companies have been selected for the interviews. In addition, the WMD section which provides the collection services was also interviewed. The choice was based on the importance of the companies (how big it is as regards to the amount of trips discharged at the FSTP) and the availability of the respondents. The number of four private companies to be interviewed (out of 17 that operate in Kumasi in total) was fixed to keep the workload manageable. The manhole managers were discovered by chance during the study, and I interviewed only one of them.

3-3-4-2 Adaptation of the methodology to collect financial information

During the interviews, it was difficult (they don't want to give) to find the operationalized financial information to build the formal income statement. But I found a way to collect the necessary information as explained below.

From the discussion with one of the companies studied, I found that some partial financial statement per trip could be found and I use this way to collect the financial data.

The following applies to each trip of a collection truck:

- Only one household can be served per trip, and a household which needs more than two trips to empty its pit, has to pay the emptying fee per trip.
- For each trip, workers and truck drivers take money for the fuel ("fuel cost") and money to eat before providing the service ("shop money"). The money for the discharge fee at the FSTP ("discharge fee") is paid to KMA at the end of the month and the oil is bought for the truck every week ("oil cost"). These items could be provided per trip.

It was therefore possible to build the overall income statement from the income statement per trip, by multiplying by the monthly number of trips to the FSTP with the cost per trip (figures from the FSTP were more reliable than data from collection companies).

The remaining elements of the statement were: the staff salary, the maintenance cost and tax paid. We could estimate the salary from the number of workers and their salary, and the income tax given is 7.5% of the profit before tax (same for all the companies). But the maintenance cost could only be found in the previous study (Kaelin, 2005).

The income statements were therefore adapted for the collection companies as described in Annex A2-2-1.

4 THE KUMASI CASE: CURRENT SITUATION

4-1 Local context overview

4-1-1 Geography and population

Kumasi is the second largest city in Ghana, an African country located in the West Africa's Gulf of Guinea with an area of 238,540 km^2. Ghana enjoys a tropical climate with 1100 to 2100 mm of annual rainfall. It is subdivided in ten administrative regions and its capital city is Accra, located in the Greater Accra region in the southern part of the country.

Kumasi is the capital city of Ashanti region. Located 300 km Northwest of Accra, it covers 150 km^2 and counts about 1,201,280 inhabitants in 2000 (GLSS4, 2000).

Kumasi is in the humid forest zone and falls within the wet sub-equatorial climate with two distinct rainy seasons per year. It rains from late February to early July and from mid-September to early November with an annual average of 1,340 mm.

Ten suburbs divided into 24 major settlements compose the city according to the new division of KMA Planning Department (see Table 9-3 in Annex A3-1). This Department has estimated the 2004 population of the city at 1,482,480 inhabitants.

Figure 4-1: Location of Kumasi in Ghana. Source : http://www.ghanaweb.com/GhanaHomePage/geography/maps.php

4-1-2 Socio-economic aspects

Surrounding by forest and cultivated areas, the city of Kumasi is a commercial and industrial centre with formal industries in timber, food processing (including beer brewing) and soap manufacturing, together with informal activities in woodworking, light engineering, vehicle repair, footwear, furniture manufacture and metal fabrication. The centre of the city has one of the largest market centres in West Africa with over 1000 sellers (IWMI and SANDEC, 2002).

The socio-economic status of many households in Kumasi is very low. In 1989 almost half of the households in Kumasi had either none or only one identifiable asset such as a radio, fan, sewing machine, cassette player, refrigerator, or motorcycle. Education levels, on the other hand, are relatively high. The majority of adults have at least a primary education (the average number of years of education is eight). Almost all households in Kumasi now have electricity, for which they pay, on the average, $1.63 per month[9]. The estimated per capita annual income in 1989, is about $180 (Wiftintn *et al*., 1992).

Housing was, and still is, seen as an important issue affecting whether people invest in sanitation improvements (Saywell and Hunt, 1999).

[9] All $ quoted in this thesis are US$

Living conditions in many parts of Kumasi are very crowded. About 95 percent of all households live in apartment buildings, and 90 percent of all households live in a single room. The average size of a household in Kumasi is 4.6 persons, and the average number of people in an apartment building is about 50. Over 55 percent of households in Kumasi live in buildings with more than ten households, and more than one quarter of the households in Kumasi live in buildings with more than 60 people. There is no room for people to cook, wash, or bathe in their single rooms, so many of these activities take place in the courtyard of the apartment building or along the street (Wiftintn *et al*., 1992).

Urban and peri-urban agriculture in Kumasi has an important socio-economic impact. It contributes to food security and increases the income of the urban poor. In a recent material flow study conducted for Kumasi. It was found that urban and peri-urban agricultural soils are greatly depleted of organic matter and nutrients (IWMI and SANDEC, 2002). On approximately 120 hectares of land (about 0.8% of the urban areas) in urban and peri-urban Kumasi vegetables are cultivated intensively (Moser, 2004).

4-1-3 Sanitation infrastructure and services

In Ghana, less than 40% of urban residents are served by solid waste collection services and less than 30% by an acceptable household toilet facility. Insufficient financial, technical and institutional capacity of the municipal authorities to collect, transport, treat and/or dispose solid and liquid wastes is one of the major urban problems (Danso *et al*., 2003). Despite 25 - 30 per cent of the Kumasi's development budget being spent on solid waste and excreta management, services were fragmented and inadequate (Saywell and Hunt, 1999).

The current domestic daily solid waste generation in Kumasi is 610 tonnes of which 250 tonnes is generated from the two main markets. Currently, the bulk of the solid waste generated in the metropolis is collected by the private sector based on a mixture of contract and franchise arrangements. The main collection methods employed are House-to-house and Communal Container Collection systems. The Communal Collection System entails the location of metal containers (skips) at designated sites known as transfer stations, which are shared by a number of houses within that community. When the skips are full, they are transported and emptied at the final disposal site by skip loading trucks. Where there are no containers, households deposit their refuse temporarily on the ground. The communal containers used for the service have been found to be too high making them user-unfriendly. This results in waste being thrown next to the containers mostly by children (IWMI and SANDEC, 2002).

The current location of a temporary landfill site at about 3.5 km from the Kumasi Airport is highly undesirable but operations continue because of lack of alternative sites. Dumping of refuse result in smouldering and the sporadic outbreak of fire which created a smog cover over the surroundings of the landfill (IWMI and SANDEC, 2002).

In drinking water supply, most households in Kumasi (about 58 percent) have access to a private connection to the municipal water supply system in their apartment building or house. The vast majority of these households share the connection with other households living in their apartment building or compound; only about 3 percent of the households in Kumasi live in a single-family dwelling with a private water connection solely for their use. Another large group of the population in Kumasi (about 32 percent) purchases water from neighbours because they do not have piped water in their apartment building or compound. The remaining group use other sources such as wells or public tap (Wiftintn *et al.*, 1992).

The disposal of faecal sludge (FS) from public latrines, household bucket latrines, and septic tanks, is one of the most critical waste problems of the city of Kumasi. The next sections will explain more about the current situation in FSM.

4-1-4 Sanitation programmes in Kumasi

From the history line of Kumasi sanitation programmes provided by Saywell and Hunt (1999) and from Mensah (2005), the following statement can be drawn up:

- *In 1957*: After independence from British rule, Kumasi had relied on public toilets (mainly aqua privies) and home bucket latrine system. Between 1951 and 1974, several different sanitation plans had been developed for Kumasi but none implemented (because of lack of finance).
- *In 1975*: Kumasi Ventilated Improved Pit (KVIP) latrine was developed by Kumasi University of Science and Technology under a research programme on low-cost sanitation systems.
- *In 1985*: The construction of one hundred public KVIP latrines was initiated by the Kumasi City Council.
- *In 1989*: UNDP - World Bank Regional Water and Sanitation Group for West Africa and the Government of Ghana initiated the Kumasi Strategic Sanitation Programme (KSSP) in January. Household interviews to collect information about existing sanitation practices and willingness to pay for improved sanitation was carried out with 1,224 respondents. Three pilot areas were selected for on-plot sanitation (Moshie Zongo, Ayigya and South Suntreso). The Kumasi Ventilated Improved Pit Latrine (KVIP) was the chosen technology to be piloted.
- *In 1990*: Work in pilot areas took place largely between 1989 and 1992, 60 KVIPs were built in Moshie Zongo, 22 in Ayigya and 18 in South Suntreso.
- *In 1991*: First version of the Kumasi Strategic Sanitation Plan completed as a flexible document to be later updated over time. Health Education Unit established (outside the Kumasi Strategic Sanitation Programme) with the support of the then British Overseas Development Administration.
- *In 1993*: Government of Ghana and the World Bank's Urban Development Strategy Review began. Review led to the planning of the Urban IV Programme in Ghana.
- *In 1994*: Kumasi Strategic Sanitation Programme ended in March. In total 256 units of KVIPs were built for 185 homes. Three public latrine sites in the Central Business District were built and the Franchise Management approach was introduced for public latrines. A simplified sewerage system was constructed in Asafo to serve a potential population of 20,000. Home latrine component of the Kumasi Strategic Sanitation Programme was taken forward under the National Community Water and Sanitation Programme.
- *In 1996*: Ghanaian cities adopt five-year plans. The Kumasi Strategic Sanitation Plan used in discussions with the World Bank to plan the Urban IV Programme. An Urban Environmental Sanitation Project (UESP) was undertaken and spanned between 1996 and 2003. It covered many components including the construction of Dompoase landfill and Faecal Sludge Treatment Plant, and construction of household, school and public toilets facilities.

- *In 2004*: The Urban Environmental Sanitation Project was perceived to be successful hence the intention to embark on a second phase (2004-2010) in order to maximize the benefits. The UESP-II began then in 2004 and is the current ongoing project for FSM.

4-2 Current situation in Faecal Sludge Management

The situation in FSM for the city will be described by considering the various processes of FSM as described in Chapter 2.

4-2-1 The FS production in Kumasi

In Kumasi, excreta are disposed in conventional on-site facilities located in households, on which most of the population are dependent. The small scale sewerage systems serve only a few part of the population. The various sanitation systems used and how the production process is organised in the city, will be described in this section.

4-2-1-1 Toilet facilities in Kumasi

The toilets facilities that have been used in Kumasi communities are the following:

- *Public latrines (aqua privies)*: Aqua privies function without water but they tolerate water.They are toilets outside buildings that are not owned by householders, and users need to pay for the use. In Kumasi, most the toilets are aqua privies, which are essentially small septic tanks located directly underneath a squatting plate (Frantzen, 1997). These have a drop-pipe which extends below the liquid level in the tank to form a simple water seal. The majority of the public toilets in Kumasi are over 35 years old (Saywell and Hunt, 1999).
- *WCs (Water closets)*: They are indoor toilets owned by well-off households, which required installation of piped water connection for the use. They are connected either to a sewer or to a septic tank. In Kumasi, the domestic WCs are not connected to a sewer (the only sewage systems in Kumasi are for hospitals and the university campus, where a few buildings, dormitories, and faculty houses are connected) (Wiftintn *et al.*, 1992).
- *KVIP latrines*: A VIP is a traditional latrine to which a vent pipe, covered with a screen, is added to minimise odour and fly problems. A VIP can have one or two pits which are usually lined with honeycombed cement block walls. It can be designed either with alternating (with two pits under each squatting slab) or non-alternating pits. The twin-pit alternating offset VIP was developed in Kumasi and is therefore referred to as the 'Kumasi Ventilated Improved Pit latrine' in Ghana. The twin-pit concept enables the content of one pit (once filled) to decompose while the other is in use, provided that sufficient time is allowed (two years or more). Afterwards, the decomposed materials can be dug out by hand without any serious health risks. VIP latrines are very easy to maintain and, aside from regular cleaning and repairs, need no further attention until the pit is full (Frantzen, 1997).
- *Bucket latrines*: Bucket latrines are officially forbidden in Kumasi due to many deaths by various illnesses among “conservancy workers” from the extremely unhealthy working conditions. These latrines consists of a squatting plate or seat immediately above a 20-30 litre bucket, into which faeces and urine fall. Removal is sometimes called 'nightsoil collection' because it is carried out at night. The bucket can be removed by a small door at the back of the latrine. This system is condemned because the servicing is very unpleasant (Frantzen, 1997).

- *Open defecation*: This is the defecation in open areas such as bush, river, over a watercourse, pigpen or fishpond. It is practised by people who don't have access to any sanitation facility and can not pay for public toilet. In the context of a city like Kumasi, the term "bush" is something of a euphemism; there is little unused open space within the city proper; households using the "bush" may find places to defecate along local streams or drainage areas, or many simply use the open space around dilapidated or abandoned public latrines (Wiftintn *et al.*, 1992).
- *Traditional pit latrines*: They are underground pits on which superstructures are built for the convenience. Pit latrines are primarily found in low density parts of the city; they are not very practical for large multifamily dwellings because they fill up rapidly and there is no space available to dig additional pits (Wiftintn *et al.*, 1992). They usually smell bad and they attract flies and other disease-carrying insects that breed in the pits (Frantzen, 1997).

4-2-1-2 Population coverage of Toilet facilities in Kumasi

According to Mensah (2005), 38% of the Kumasi population are using public toilets, 30% use household water closet facility connected to a septic tank, 8% use the unhygienic bucket latrines system, 8% use KVIP[10] and 2% use traditional pit latrines. The population relying on the city's five small scale sewage treatment systems which are Asafo, KNUST, Ahinsan, KATH and Chirapatre Housing Estates, is 10%, and the bush provides for the remaining 4% of the population.

The following chart shows the population coverage of the different sanitation facilities used in Kumasi.

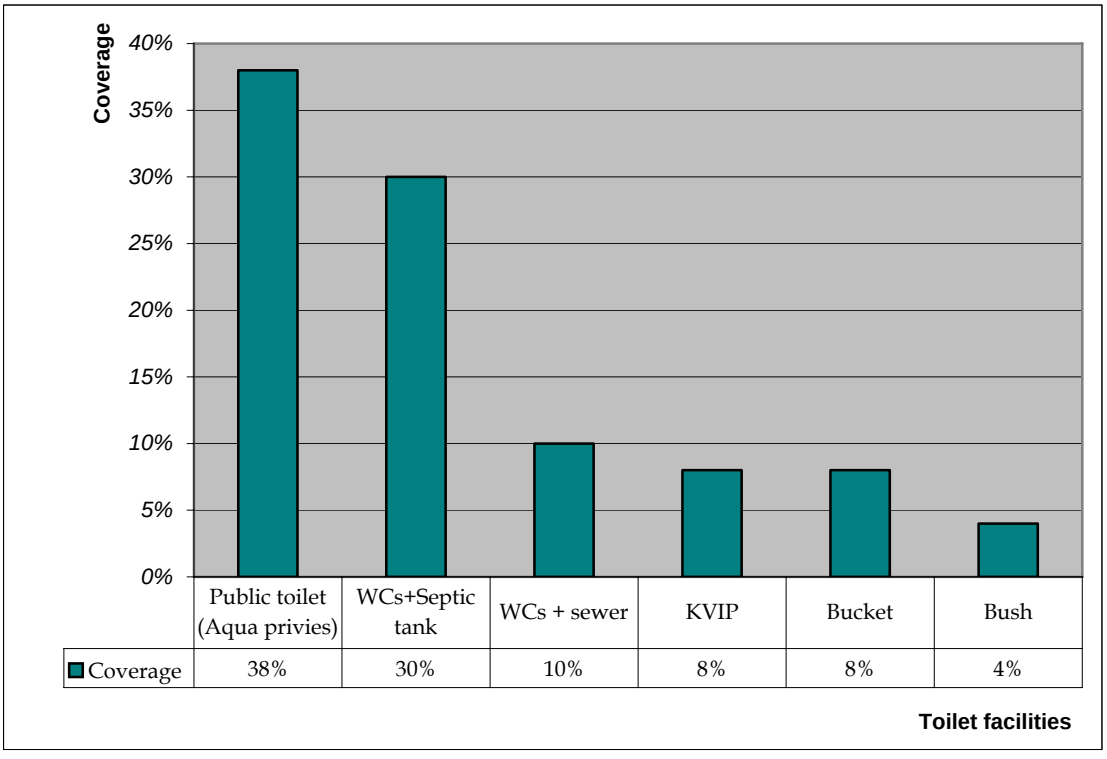


Figure 4-2: Population coverage of sanitation facilities in Kumasi. Source: Mensah (2005)

[10] Kumasi Ventilated Improved Pits: improved pit latrines introduced in the population since 1989, which are not different from the formal VIP latrines.

4-2-1-3 Organisation of the FS production in Kumasi

Kumasi has a Strategic Sanitation Plan (SSP) which prescribes suitable technologies (including Simplified Sewage System, WC-Septic Tank, KVIP and other on-site systems) for the various conditions based on set criteria (such as housing type, soil condition, water availability, user preference, etc.). The SSP encourages the provision of households facilities against public toilets which is only recommended for public places like lorry parks, markets, etc. It also aims to convert the unhygienic bucket latrines into acceptable systems trough subsidized household latrine promotion programmes. Sanitation intervention programmes are usually designed to follow the provision in the SSP which is reviewed periodically in response to current trends (Mensah, 2005).

One the other hand, households are free to build any sanitation facility they want. The type of toilets used depend on their affordability. From my households interviews (see Section 3-3-3), 100% of the respondents in high income and medium income areas own WCs, whereas in the low income area, the situation is more various: 30% of the respondents use publics latrines, another 30% use KVIP, 20% use pit latrines and the remaining 20% (chosen on purpose) used bucket latrines.

KMA tries to forbid the use of the unhygienic bucket latrine and promote the use of public latrine and KVIP, by building new public facilities and rehabilitating the old ones. A financial assistance (currently 50% subsidy for contruction) is also provided to households (mostly the poor[11]) willing to build household latrines in their yard.

The main problems identified at the FS production level, is the misuse of some facilities, mainly the KVIP. This particular facility is designed for few people (about 8 persons) and does not allow water use for anal cleansing. And moreover each pit (out of the two) must be in use for only a certain period. But the deplorable fact is that in some areas (mostly in low income areas) too many people use the two pits at the same period and they add water to the pit. Therefore the facility could not function as designed: the two pits are full in the same period and need to be emptying. Odor and flies spread around the house, resulting in improper sanitation condition.

The other problem is that some households are still using bucket latrines (for financial reasons) despite that it is forbidden by the local authorities.

4-2-2 Faecal Sludge collection and transport

The FS collection from households and public administrations[12] is assured presently by 22 FS collection companies in which five are publicly owned. All of the companies use pumping tankers of a capacity of 5 to 8 m^3 (most of them are of 5 m^3), for the service provision. They provide the mechanical emptying service for any type of toilet facility except bucket latrines and traditional pits latrines in some case. The Waste Management Department is also involved in the emptying service provision (the WMD operates as one of the five publicly owned companies) and is the only company providing the manual emptying service to help traditional pits owners to benefit from the emptying services (Figure 4-3).

[11] Households located in medium and low income areas.
[12] Public administrations such as Police, Army, TELECOM, Prison.

Figure 4-3 : Manual emptying service provision by KMA/WMD in a house at Zongo, Kumasi (Photo : Anselme Vodounhessi)

Another type of direct (but informal[13]) stakeholders are the "Manhole Managers", who take care of the buckets latrines owners' service provision. They provide the emptying services via conservancy workers[14]. The FS collected from households (see Figure 4-4) is stored in a manhole, which is emptied by truck collection companies at the same price as for households' service.

The surprising fact is that apparently all the collection companies discharge the collected FS at the treatment plant and there is no longer an illegal FS dumping in the city since 2001. This has been successful through the strictness of the District Assembly rules and the community participation in denouncing defaulters, according to the responses from key informant interviews with various stakeholders, mainly the WMD Director (see Section 3-3 for the details of the methodology).

The treatment site presently used is at the Dompoase landfill site, a sanitary landfill facility of 15-years life, which encompasses the solid waste landfill and FS treatment (Figure 4-5).

Figure 4-4 : Bucket latrines at Adoum suburb.

(Photo : Anselme Vodounhessi)

Figure 4-5: Solid waste landfill site at Dompoase (photo: Anselme Vodounhessi)

[13] The District Assembly does not allow bucket latrines emptying service provision, despite that it is vital for bucket latrine owners. It is a way to discourage the use of this particular type of latrines.

[14] Conservancy workers are people who empty the bucket latrines at night.

The households from my survey are satisfied with the faecal sludge collection service they receive from the collection companies. They are free to choose any company, and go to their office to pay before benefiting for the service. In most of the case, the companies come immediately or take less than 24 hours to respond to the service demand. There is no major problem during the service provision apart from the odor in some cases.

The

Table ***4-1*** shows, households satisfaction in the FS emptying service.

Figure 4-6: FS discharge at Dompoase (photo: Anselme Vodounhessi)

Income areas	Nb of respondents	Satisfaction on emptying service		
		Low	*Medium*	*High*
Low income areas	6	0%	33%	67%
Middle income areas	5	0%	0%	100%
High income areas	5	0%	40%	60%
Total / Average	**16**	**0%**	**25%**	**75%**

Table 4-1: Households satisfaction in the emptying services received (source: the author).

Per month, about 1255 trucks load of faecal sludge were collected by the 22 collection companies and discharged at Dompoase FSTP (average in 2005). Five of these companies are publicly owned and they collect the sludge from public administrations, except the WMD which collects FS from households in competition with the 17 private companies.

The Figure 4-7 shows the partition of the FS collected amongst the collection companies. Apart from the 6% collected by four publicly owned collection companies from public administrations buildings, all the FS collected comes from households.

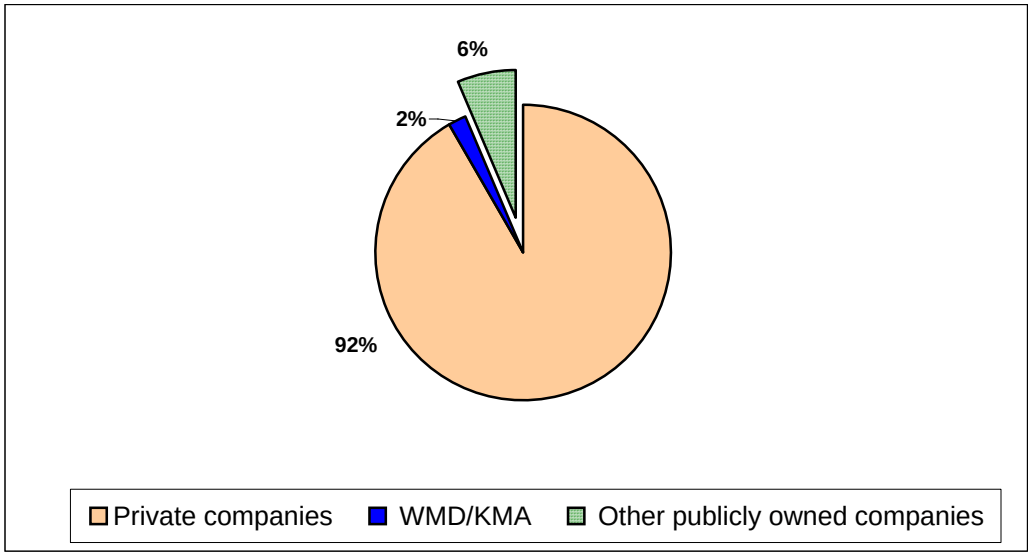


Figure 4-7: Partition of the amount of FS collected by the collection companies.

4-2-3 FS treatment and transfer

The FS treatment plant (FSTP) at Dompoase is a 9-stabilisation ponds system which became operational in January 2004. The former FSTP, Buobai pond system which had been operating for two years (2001-2003), is now abandoned because the sedimentation ponds are full and there is at the moment no means to empty them. The other reason given is that the community surrounding the FSTP at Buobai are not happy with the quality of the effluent discharged in the neighboring river.

On average 1255 truck load of faecal sludge are monthly discharged at the Dompoase FSTP, which amount to 6,300 m^3 of FS collected monthly from the city (see data processed in Annex A2-1). As regard to the "collectable FS amount" of about 18,300 m^3 (estimated in Section 4-2-5) produced monthly in the various emptyable toilets, the FS collection service coverage of the city has been estimated at 34%. From the FS flow shown in Section 4-2-5, the total environment FS load of the city, has been estimated at about 12,400 m^3 per month, which is about 54% of the total FS produced in the city.

The environmental FS load represents the FS stored underground due to the low full frequency[15] of toilets pits, and the FS directly deposited on soil. The average full frequency of toilets pits in Kumasi has been estimated at 4.2 years (see Annex A2-3), meaning that it can take on average 4.2 years before a household empties its toilet pit. This value is strongly linked to the pit volume and the number of person using; it reaches 10 years (can even be more) in high income areas, and 3 months in low income areas.

The 6,300 m^3 of FS monthly discharged at Dompoase are treated in the ponds system in combination with the leachate from landfilled solid waste. The treatment process is through a series of 5 anaerobic ponds, 1 facultative pond and 2 maturation ponds. But unfortunately the quality of the effluent to be discharged into Wewe River, is not good for the environment. The mixed effluent (see Figure 4-8) is of black color and foamy, showing that the environmental protection is still questionable.

Figure 4-8 : Foamy black effluent from Dompoase FSTP discharged into the Wewe River. (photo: Anselme Vodounhessi)

4-2-4 FS disposal and reuse

Kumasi has until now no experience in faecal sludge disposal or reuse. The former Buobai FSTP was the first in the city and has not been emptied when it was full. The Dompoase FSTP ponds currently used are not full yet.

There is currently no treated FS reuse in agriculture, but the potential for reuse exists. According to Cofie (2003) all actual compost users and 83% of the non-compost users perceived municipal co-compost[16] as positive or 'good' material for soil amelioration and crop growth, and 70% of them are willing to pay for it. Those farmers who did not express willingness to pay argued e.g. that they first have to test the product to know its effectiveness (in terms of yield and returns). More details on this issue is provided in Section 0.

[15] Time necessary for a toilet pit to be full. A "low full frequency " means that pits fill up quickly.
[16] The final product from the FSTP (see 2-5-4 for the benefit)

4-2-5 Estimated faecal sludge quantities in Kumasi

Based on the specific FS production of 1.0 l/ca/day for septic tank sludge and 0.2 l/ca/day for heavy sludge[17] (Heinss *et al.*, 1998), and the current population coverage (section 4-2-1-2), the total FS production of the city has been estimated (in Table 4-2) at 23,100 m^3 per month. Of this amount 18,300 m^3 go the toilets that can be emptied. The remaining 4,400 and 400 m^3, go respectively to the sewage system and to the bush.

Table 4-2 : Faecal Sludge flow estimation for Kumasi.

Toilets facilities	Specific prod. (l/cap/day)	Coverage	Population covered	FS production m3/d	FS production m3/month
Collectable FS					
Aqua privies (Public toilet)	0.2	38%	563,342	113	3,400
WCs+Septic tank	1.0	30%	444,744	445	13,300
Bucket	0.2	8%	118,598	24	700
KVIP[18]	0.2	8%	118,598	24	700
Pit latrine	0.2	2%	29,650	6	200
Total collectable		86%	1,274,933	611	18,300
Non Collectable FS					
WCs + sewer	1.0	10%	148,248	148	4,400
Bush	0.2	4%	59,299	12	400
Total all		100%	1,482,480	771	23,100

The estimate amount of 34% of collected faecal sludge is highly sensitive to the specific production used. For example if I use a specific production of 0.8 l/ca/day for WCs, the collection coverage would be 40%. Moreover the system is not yet at steady state (analysis would be done over five years or so, to take in the average pit fill period of four years.

The Figure 4-9 presents the faecal sludge flows for Kumasi. From this flow, the environment load is estimated as 12,400 m^3 per month.

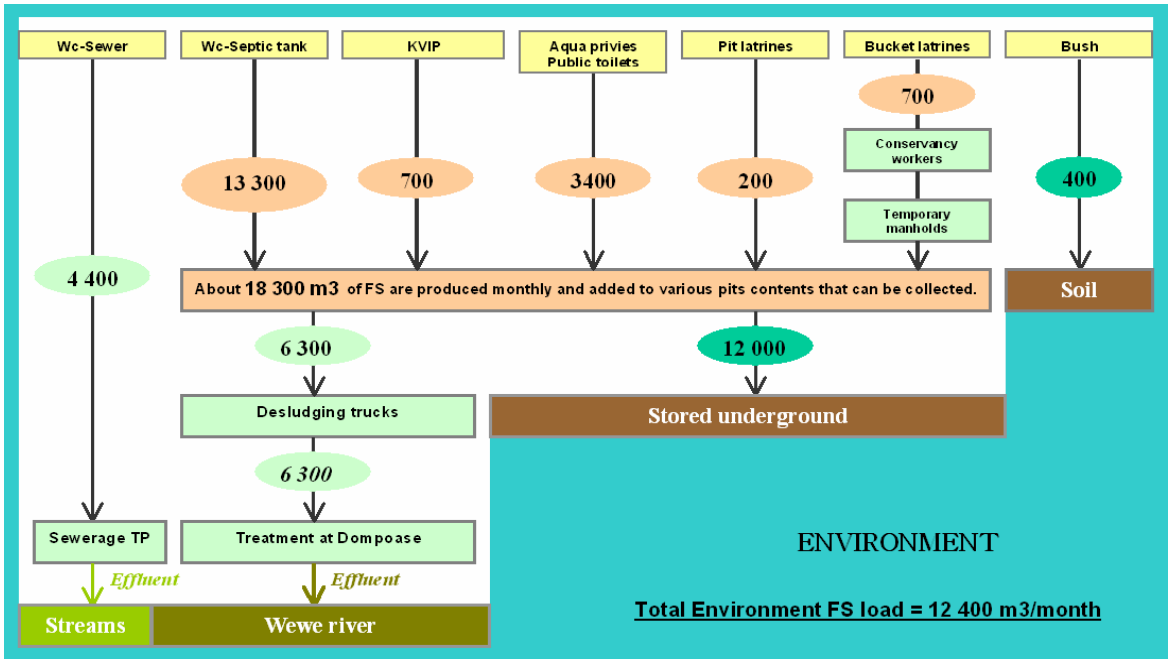


Figure 4-9: Monthly Faecal Sludge flow in Kumasi in m^3

[17] Heavy sludge is the sludge which comes from toilets where there is no water use.
[18] KVIP should have lower figure but doesn't.

5 ANALYSIS OF THE CASE STUDY

5-1 Institutional analysis of the key stakeholders in FSM

5-1-1 Description of the key stakeholders

In Ghana, the waste management services provision is in the hands of District Assemblies[19]. The institutions currently involved in the waste management issue are despite the relevance of many other institutions.

According to Drechsel *et al.* (2004), the relevant institutions in waste management at national level are:

- The *Ministry of Local Government and Rural Development (MLGRD)*, which is the leading sector agency for waste management issues on the national level. It is responsible for: (i) formulation of the Environmental Sanitation Policy; (ii) developing and issuing technical guidelines on environmental sanitation services and their management; (iii) and promulgation of national legislation and model bye-laws.
- The *Ministry of Environment, Science and Technology*, responsible for the setting of standards and guidelines for environmental quality.
- The *Environmental Protection Agency*, which is the regulatory organism of the Ministry of Environment for environmental quality monitoring.
- The *Ministry of Education*, responsible for hygiene education in schools, universities and technical institutions.
- The *Ministry of Health*, which provides health data, supports hygiene education activities, and contributes to regulation and standard setting. Data generated by this ministry are used for disease prevention and control.
- The *Ministry of Food and Agriculture***,** the institution in charge of regulation and coordination of the utilisation of agricultural inputs. It designs and coordinates strategies and policies on food production at the national and sub-national level as well as provision of assistance and extension services to farmers.
- The *Ministry of Works & Housing* regulates estate development.

The institutions/stakeholders presently involved in FSM in Kumasi are:

- At national level:
  - The *Government of Ghana* (GoG), which main role is the budget provision for all KMA's activities;
  - Donors, mainly the *World Bank*, which provides financial support for initiatives;
  - The *Environmental Protection Agency* (EPA), which is the regulatory body.
- At local level:
  - Local authorities, which are *Kumasi Metropolitan Assembly* (KMA) and its decentralized office, the *Waste Management Department* (WMD);
  - Direct providers, which are mostly private partners such as *FS collection companies*, the Private *Contractor of the Dompoase treatment plant* and *publics toilets managers*.
  - The beneficiaries of the FS services, which are mainly the *households*.

[19] The domination and power of the District Assembly depends on the settlements population. The assembly is a Metropolitan Assembly when the settlement has more than 250,000 inhabitants, Municipal Assembly when it is more than 100,000 inhabitants, and simply District Assembly when it is less, according to Drechsel (2004).
Kumasi Dictrict Assembly is a Metropolitan Assembly: The *Kumasi Metropolitan Assembly (KMA).*

5-1-1-1 The Kumasi Metropolitan Assembly: KMA

The main objectives and functions of the Kumasi Metropolitan Assembly, in consonance with the laws establishing the district, municipal and metropolitan assemblies in the country, are to maintain a high quality of community life and raise living standards to appreciable levels in order to bring relief to the people of the communities (Mensah, 2005).

One of the major functions of the Assembly towards its goal is the provision of environmental sanitation services including the collection and disposal of both solid and liquid wastes as well as cleansing of streets and drains in the Metropolis (Mensah, 2005).

To achieve this goal, KMA has created the Waste Management Department. KMA is the owner of the sanitation services provision to the population, which it does through the Waste Management Department. It has therefore the authority to decide whether or not any other stakeholder can participate in the service provision activities.

5-1-1-2 The Waste Management Department: WMD

The WMD is the core Department (of KMA) in the waste service provision. A decentralized office with separated management from KMA, it has clear mission and functions.

The following points derive from the open discussion and key informant interviews I did at the WMD:

- Mission of the WMD

Keep the Metropolis clean and healthy by ensuring the efficient and effective removal and safe disposal of solid waste and liquid waste from all premises and public spaces, to create enabling environment for development and recreation.

- Functions
  - *f1.* Keep the Metropolis tidy;
  - *f2.* Clear away mess and nuisance;
  - *f3.* Develop and continuously update a metropolitan environmental sanitation plan;
  - *f4.* Educate the public on how to keep the local environment clean;
  - *f5.* Provide conveniently situated refuse disposal points;
  - *f6.* Remove solid;
  - *f7.* Dispose of waste safely;
  - *f8.* Identify needs for publics toilets;
  - *f9.* Manage public toilets;
  - *f10.* Manage promotion and subsidy programs from household toilets ;
  - *f11.* Evacuate liquid waste from homes and public toilets;
  - *f12.* License and enforce standards on private liquid waste haulers;
  - *f13.* Manage sullage disposal;
  - *f14.* Cleanse and carry out routine maintenance of drains.

The underlined functions are the most related to the faecal sludge management, and that the Department accomplishes directly or indirectly through privates contractors or via sub-councils, depending on the decision from KMA.

- Organisational autonomy

Although the WMD is a decentralized office and has separated management. The organisational autonomy is still far from being effective. Indeed, the autonomy of the Department is very low, it is strongly depended on KMA for its activities and for the overall

financial management. It has no decision making power regarding financial issues. The investment decision as well as the financial management of contracts with private contractors, are in the hands of KMA.
However, the role of facilitation and coordination of all waste management activities is well carried out by the WMD.

- Performance targets and accountability for results

They are no clear targets set for the WMD. Some own targets (for some of the quantifiable activities) are internally set by the WMD itself and are evaluated at the end of the year. But the evaluation is not too strict as regards to the achievement of these targets since the resources required are very limited. The WMD tries to do its best for better service provision to the population, for which it is not strictly accountable. There is no clear accountability for results, but clear enough accountability for the discharge fee collected from the collections companies at the FS treatment plant.

- Market Orientation

Liberalizing the FS collection services and involving private contractor for the treatment plant management (see more about the private sector involvement in Section 5-1-2) are good strategies to ensure more efficiently the function *f11*. About the internal organization of the WMD, good internal strategies are developed including staff motivation (during internal meeting) to reach certain internal targets, and some capacity building. But the Human Resource Management (hiring and firing) and Financial Management functions escape from the Department due to its limited autonomy (staff depend on the central office, KMA). Therefore, there can not be any good incentive tool for staff motivation for better efficiency.

- Private Providers orientation

The tariff range set for the service provision to households and the discharge are favorable enough for the collection companies to make good profit (see section 5-2-3-1). Hence there is no trigger for illegal dumping of faecal sludge in the city by these private companies. Moreover there are some capacity building programmes organized by the Department to the private providers for better service provision to the population, as well as some information meeting. But there is currently no motivation system such as benchmarking or simple congratulations or visit of the companies. And moreover, there is no accountability to the private providers from the system (mostly the FSTP) management.

- Service beneficiaries orientation

The WMD is trying to achieve its role of good services provision to households which are the main beneficiaries of the FSM services. Households seem to be satisfied by the service they receive (see Table 4-1), but are not happy with their current expenditures that they think are high (see Table 5-2). There is no accountability relationship with them and the public participation is low since there is no information and communication system. There is also no special arrangement for poor households, since poor and rich households are paying the same price to benefit from the service.

5-1-1-3 Private operators

The private operators involved in faecal sludge management in the city are:

- The private Operator managing the FS treatment plant under management contract;

- The informal Manhole Managers providing the FS collection service to buckets latrines owners' service; and
- The private faecal sludge collection companies.

The following information is based on my interviews with four private FS collection companies and the WMD.

The institutional analysis shows that they all well performing because of their private status, despite the low educational level of their managers (ranging from primary to secondary school, with no background in sanitation). Indeed the four companies surveyed have:

- Good financial management: efficient billing and collection system (beneficiaries pay before the service provision);
- Good human resource management: good staff motivation (financial rewards) and almost all the staff have job satisfaction;
- Good customers orientation: 100% customers' complains coverage, and 100% revenue dependent of customers.
- Good operational performance: 100% demand satisfaction; quick response for the service provision; no longer illegal dumping; and 0.07 to 0.2 staff per monthly number of households served.

This latter performance indicator is an adaptation of the operational efficiency indicator of water utility provided by Tynan and Kingdom (2002). It refers to the lowest cost use of labor and has no normalization in this case. I use it to compare the studied companies. It implies that the lower the number of staff used by a company to serve a certain number of households, the better is its operational performance.

The Table 5-1 shows how the indicator varies between the private companies studied compared to the publicly owned one, the KMA/WMD.

Table 5-1: Operational efficiency of the studied companies.

Companies identification	Private Company 1	Private Company 2	Private Company 3	Private Company 4	WMD
Number of HH served per month	369	165	29	59	24
Number of staff[20]:	26	*16*	*6*	*6*	*12*
Number of staff per monthly HH served	**0.07**	**0.10**	**0.21**	**0.10**	**0.50**

These private companies are maintaining a good competitive environment which is a key factor of good service provision. However they are not free[21] in the service tariff setting. The tariff is set by KMA. Their external environment is favorable since they benefit (i) from a capacity building programme from the authorities (KMA organize sometimes some training programme for them), and (ii) from a good perception of their activities from the community (households are aware of the importance of the service the companies provide).

5-1-1-4 The regulator

The regulatory body in FSM is EPA. EPA is the Environmental Protection Agency transformed from the former advisory body EPC, Environment Protection Council, since

[20] Staff who work only in FS collection in the companies. Some of the companies have other activities.

[21] Official tariff (minimum tariff) is set by KMA, but the company can charge more according to the distance to the FSTP. The Section 5-2-3 shows the average tariff used by the surveyed companies.

30th December 1994, by *Environmental Protection Agency Act 490 of 1994*. It is a national level body which has a responsibility of regulating the environment and ensuring the implementation of government policies on the environment. Involved in all aspects of waste management in the country, EPA carries out its function in collaboration with the District Assemblies.

District Assemblies are responsible for all the operational aspects of waste management, with the EPA playing the role of control and prevention of discharge of waste into the environment, issuance of environmental permits and pollution abatement notices, prescriptions of standards and guidelines relating to the pollution of air, water and land, and compliance and enforcement as prescribed by the *EPA Act 490* (Allotey, 2004).

EPA has a de-concentrated agency in Kumasi, which is also carrying out the regulatory action in faecal sludge management. The following points derived from my open discussion with the Director of EPA Kumasi.

- Effectiveness of the regulation
  - Clarity of roles and objectives: The local Agency of EPA in Kumasi seeks to ensure sound environmental management by: (i) giving technical supports and guideline for the landfill to the WMD by the way of advice; (ii) assist development of training manual; and ensure environment education for community and at the Assembly level. It acts under the *Act 490 of 1994* and the *legislative instrument 1652 of 1999*. The regulatory process is based on environmental impact assessment, environmental education, inspection and monitoring. The key stakeholders involved in EPA roles in the city are: KMA, CSIR (Council for Scientific and Industrial Research), KNUST (Kwame N'Krumah University of Science and Technology) and Ghana Standards Board. The community and faecal sludge collection companies are not taken as stakeholders. The problem faced by the local agency is that these stakeholders in decision making do not do right thing themselves. The level of collaboration is very low and there is delay in getting feedback from them on any action.
  - Autonomy / credibility: Theoretically the local agency is autonomous from the local government, but the political influence can not be avoid mostly for good collaboration reason.
  - Participation: a good participation mechanism exists and involves relevant stakeholders depending on the programme. Some operating committee such as Technical Review Committee (TRC) and Regional Environmental Network do exist for this purpose.
  - Transparency: Guidelines are written and communicated to applicants.
  - Accountability: Reports are regularly writing and sent to wherever is necessary, such as KMA and the Central EPA.
  - Capability: Well trained professionals are available and some capacity building opportunities are also offered to the staff.
- Powers of the regulation
  - Standards setting: Guidelines are set by the central agency for effluent discharge in river. There is no clear guideline for proper sanitation service to the population, but assistance is giving to KMA to provide through the private providers. Some guidelines are also set in partnership with KMA.
  - Information gathering: Information on the waste management system are collected during inspection and compared with performance indicators developed by the agency.

- Enforcement and sanctions: The court system is used for sanctions. But first, the enforcement notice which is a call for good practice is necessary. A this step advice is giving to the defaulter. The court system can only be applied when the advice is not followed.
- Arbitration: The agency is not carrying out this function which is ensured by the local government.

5-1-2 Overview of stakeholder interactions at each level of FSM

The institutional arrangements in FSM in Kumasi are characterized by private sector involvement at all levels of the services provision. KMA is the owner of the sanitation services provision and has mandated the WMD to be responsible for the service provision. In FSM, the WMD is responsible for toilets provision to the community, responsible for the coordination of the FS collection activities and responsible for the FS treatment plant management. But these responsibilities are not be entire. The next sub-sections describes more about the actual institutional arrangements for the service provision at each FSM level, that I know from open discussion and key informant interviews at WMD.

5-1-2-1 Stakeholders interaction at FS production level

At the FS production level, the WMD provides financial assistance (50% subsidy) to the poor to build toilet facilities at their home, under UESP-II (see section 4-1-4). This programme also include replacement and construction of new public toilets in some areas such as markets and other commercial locations where full cost can be recovered.

The public toilets services provision are ceded to sub-metro councils which manage them under management contracts for facilities built by KMA, and BOT[22] contracts for the private built ones, with no accountability to KMA. The Figure 5-1 shows the institutional arrangements at FS production level.

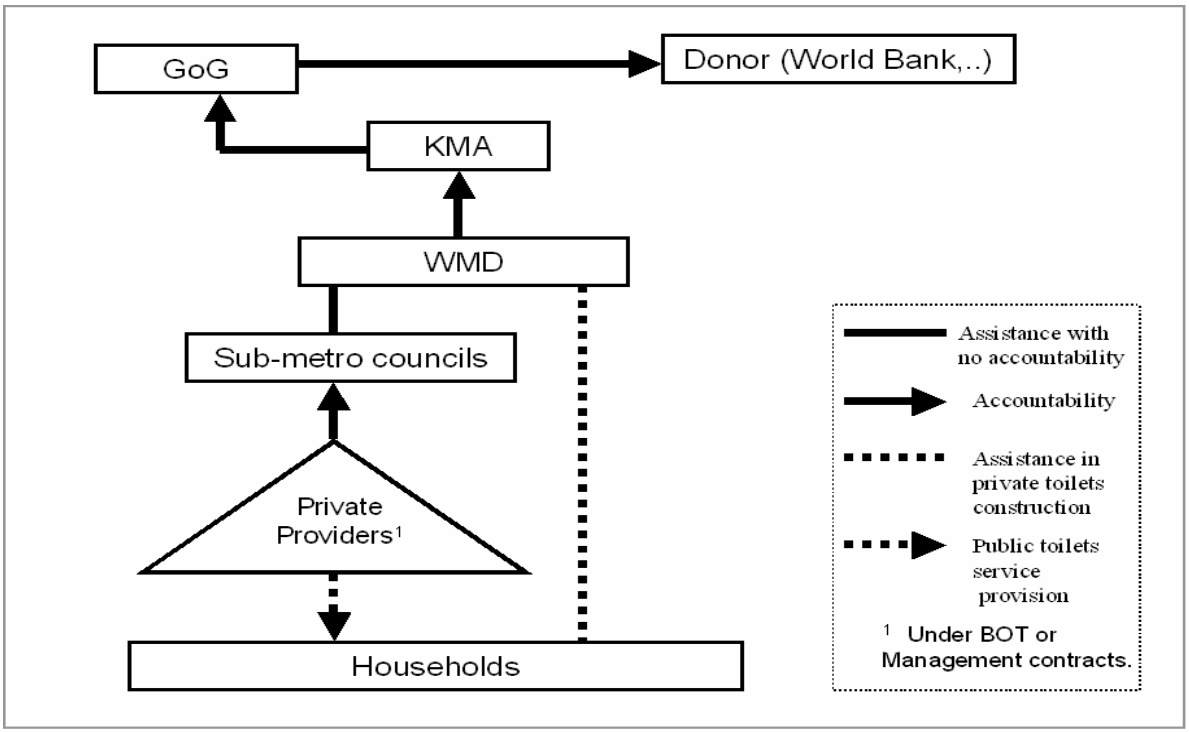


Figure 5-1: Stakeholder interactions at FS production level

[22] Build Operate and Transfer.

5-1-2-2 Stakeholder interactions at FS collection and transport level

At the FS collection level, there is a liberalization of the services provision where 17 private companies are currently competing. Between the further five publicly owned companies - the Police, the Army, Prisons, TELECOM and KMA/WMD - also operating, only KMA/WMD provides the service to households in competition with private companies. The private companies need for license from KMA to operate and pay a discharge fee for each discharge at the treatment plant, but the publicly owned companies do not except for TELECOM.

The Figure 5-2 shows the institutional arrangements for FS collection and transfer to the FS treatment plant.

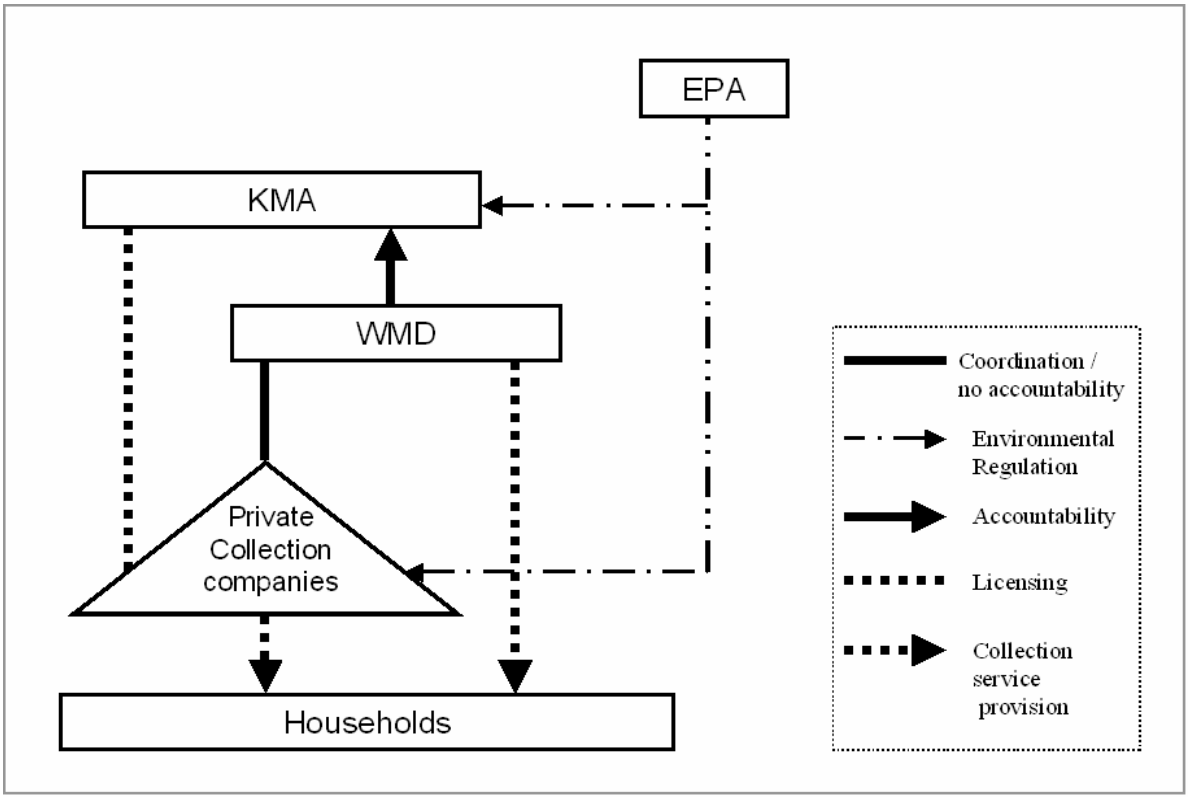


Figure 5-2: Stakeholder interactions at FS treatment and transfer level

5-1-2-3 Stakeholder interactions at FS treatment and transfer level

At the FS treatment level, the sanitary landfill facility of Dompoase, built under UESP-I, has been put under Management Contract under UESP-II. A single private contractor has been operating both the solid waste landfill and FS treatment ponds system since January 2004. Technical monitoring of the contract is assured by the WMD and the financial affairs is controlled by KMA.

The Figure 5-3 shows the institutional arrangements at FS production level.

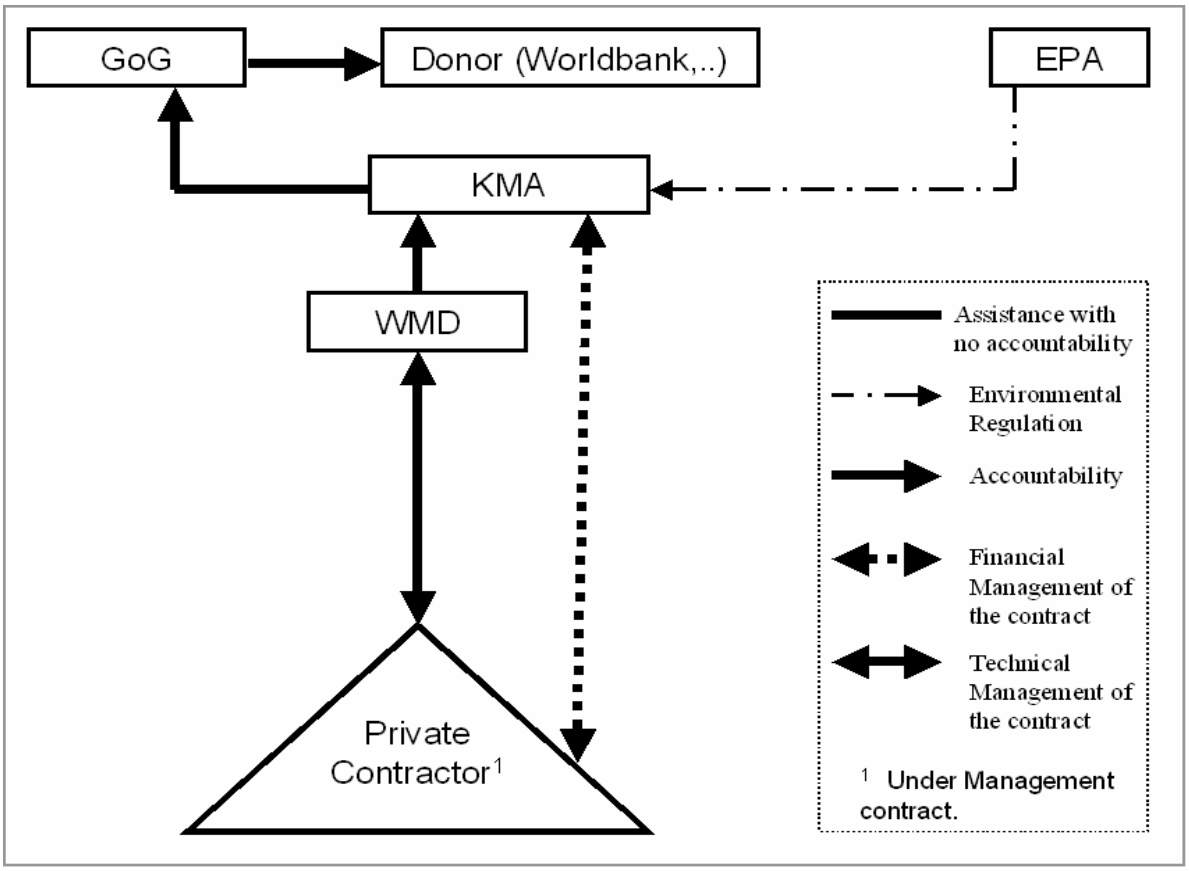


Figure 5-3: Stakeholder interactions at FS treatment and transfer level

5-1-2-4 Stakeholder interactions at treated FS disposal and reuse level

There is currently no treated FS disposal and reuse and therefore no institutional arrangement at this level.

5-2 Analysis of the financial situation in FSM

5-2-1 Stakeholders involved in the financial mechanism

The keys stakeholders involved in the financial mechanism can be clustered as follows:

- Cluster 1: *Sources of revenue* of the System
  They are people benefiting from the services and are supposed to pay for the costs of the services provision. They are currently only households and some public administrations[23].
- Cluster 2: the *System Operators*
  They are people/companies operating and making profit from the system. They include the private FS collection companies, the private operator of the FS treatment plant and the informal manholes managers.
- Cluster 3: the *System Managers*
  They are institutions that are supposed to (i) stimulate the potential revenue of the system from its various beneficiaries, and (ii) well allocate this revenue amongst operational stakeholders to avoid excess profit in the system. KMA is assuring this function through the WMD.
- Cluster 4: *External supporters* of the system
  They are institutions who provide external funds for the financial support of the system. They ensure the running of the system without cost recovery. They include the Government of Ghana (GoG) and Donors (World Bank).

5-2-2 Source of revenue analysis (cluster 1)

Households are the main source of revenue of the system since they are the only direct beneficiaries. This analysis will assess the current expenditures of the households in the emptying services compared to their capacity to pay for the service, and calculate the current revenue of the FS system.

5-2-2-1 Household Capacity To Pay (CTP) for emptying services

I assume that households can spend 0.5% of their income on the faecal sludge emptying service. This assumption is based on a reasonable split of the WHO's standard of 5% [24] of household income that households can spend on water and sanitation services. The remaining 4.5% can be spent on other water and sanitation services. The overall water and sanitation services can be broken down as shown in Figure 5-4 into:

- Water supply services;
- Solid waste services;
- FS facilities maintenance at the household level; and
- Toilets facilities emptying service.

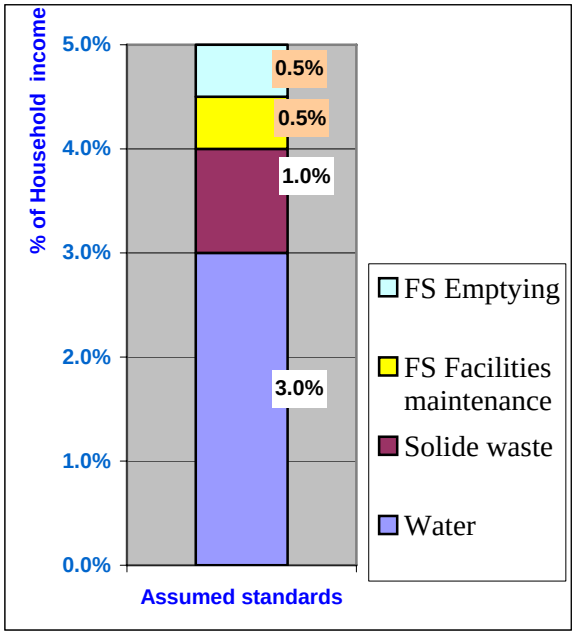


Figure 5-4: Standardized expenditures in water and sanitation as % of households' income for Kumasi

[23] Police, Army, Prison, TELECOM

[24] This figure seems to be commonly quoted (e.g. (van der Zaag and Savenije, 2004)) but I have not been able to find the original reference for it.

5-2-2-2 Households' income and current expenditures in emptying service

From the households interview (see Annex A2-3-2), the Figure 5-5 shows the average monthly income per income area of the city.

The capacity to pay (CTP) for the emptying service (which represents 0.5% of the income) has been compared with the current expenditures in the service.

From the comparison presented in Figure 5-6, it can be seen that low income areas are currently paying 3.5 times their CTP, while high income areas are paying 3.5 times less than their CTP.

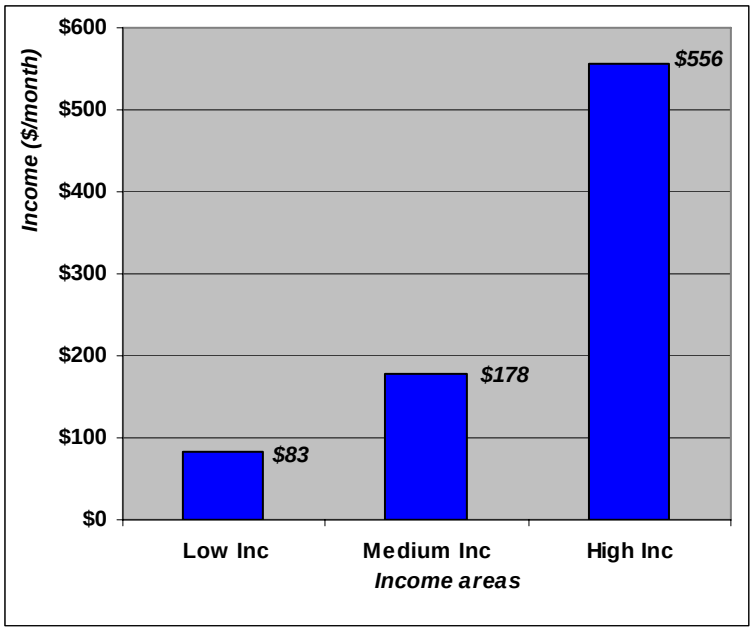


Figure 5-5: Average monthly households income per area in Kumasi based on the households survey.

The low income areas are the ones which have presently the highest expenditures in emptying service. That is due to the bad state of their toilet facilities which need to be emptied more frequently. The lowest emptying time (number of years between events of emptying) is seen in low income areas as shown in Figure 5-7.

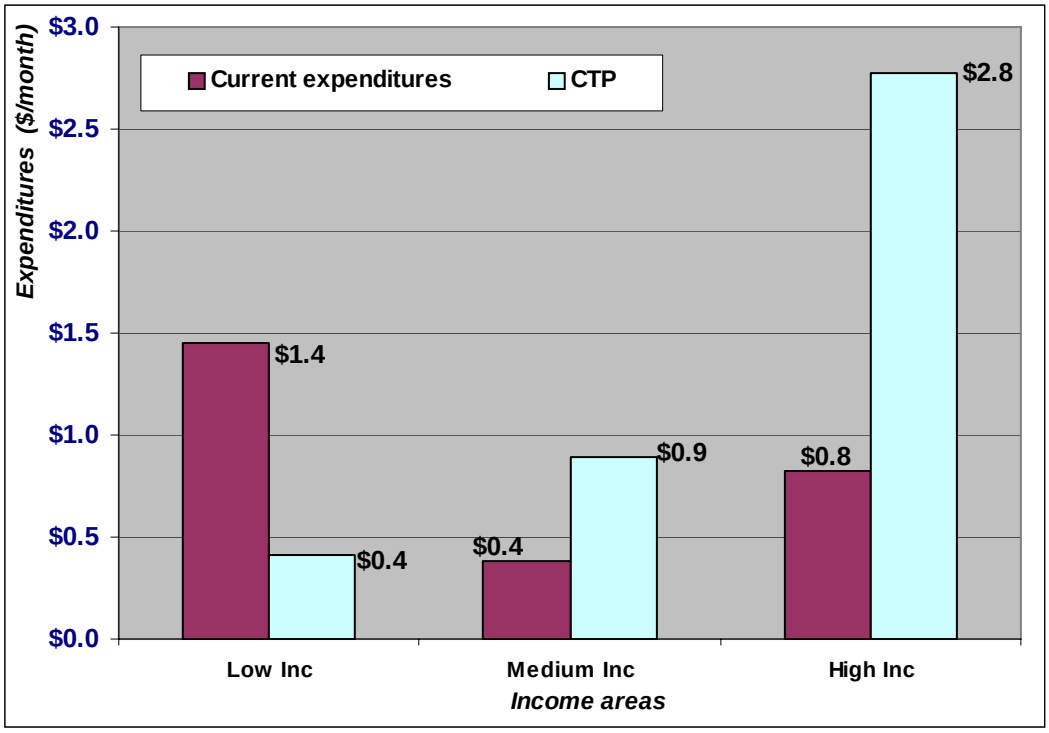


Figure 5-6: Comparison of households monthly expenditures in FS emptying service and their capacity to pay (CTP).

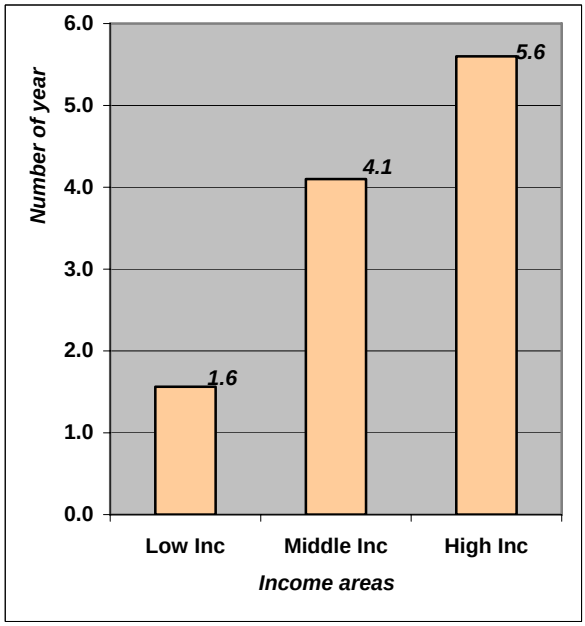


Figure 5-7: Years between emptying events of toilets facilities in Kumasi

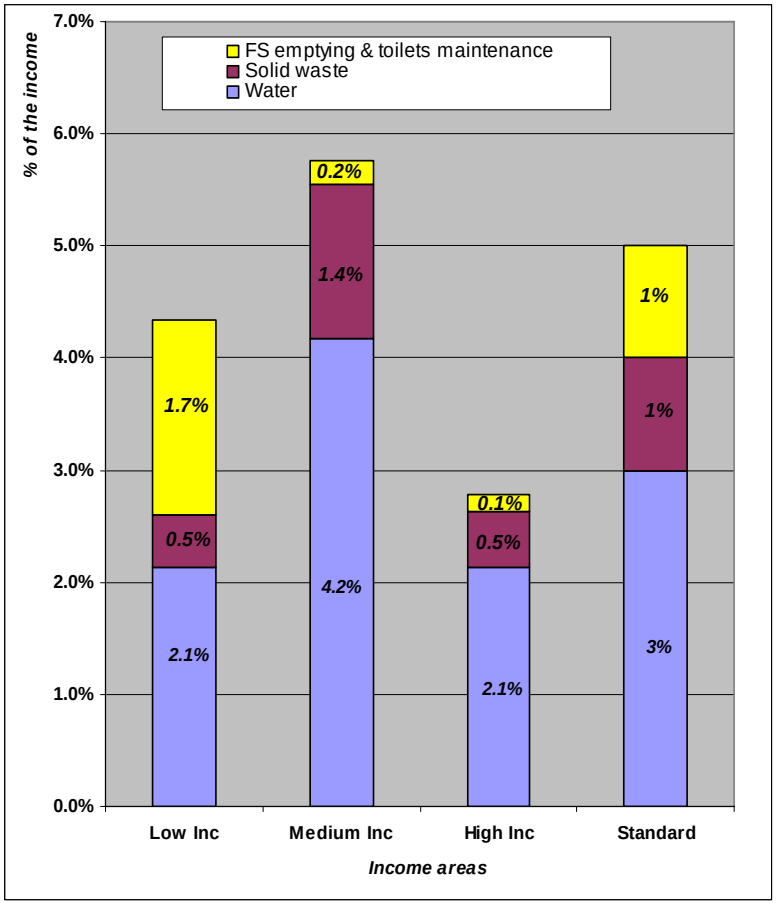


Figure 5-8: Households expenditures in water and sanitation as % of their income ("standard" refers to Figure 5-4)

My next step was to compare the overall households' expenditures in water and sanitation with the WHO's standard of 5% of their income that households can spend in water and sanitation services.

Figure 5-8 shows that only medium income areas are spending higher than the standard of 5%, while the high income areas are spending much less. The medium income areas have the highest percentage of expenditures on water service. It appears that the variation of water use in high and medium income areas (the ones which have more access to water) is at lower rate than the variation of their income.

With regards to FSM, people with a high and medium income are paying very little part of their income on FS emptying services. Despite this fact, few households are willing to pay more than what they are currently paying to benefit from service: only 5% of households (all in low income areas) think that their expenditure in the emptying service is low. The Table 5-2 shows more about the households' perception on their current expenditures in emptying service (from the household interviews).

Table 5-2: Households' perception on their current expenditures in the emptying services.

Income areas	*No. of respondents*	Perception on the current expenditures in emptying service		
		Low	***Acceptable***	***High***
Low income areas	10	10%	30%	60%
Middle income areas	5	0%	0%	100%
High income areas	5	0%	60%	40%
Total / Average	**20**	**5%**	**30%**	**65%**

5-2-2-3 The current revenue of the system

The current revenue of the FS system comes only from households via the faecal sludge collection services, and is the result of the current households' expenditures in emptying service. There is no charge for the collection from public administrations.

The tariff of emptying service provision ranges currently from US$ 33 to US$ 66 per truck load[25] with an average of US$ 45 (or 400,000 cedis[26]) used by most of the companies. Based on the average monthly number of 1175 faecal sludge truck trips that comes from households, I estimated in Table 5-3 that about **US$ 52 200** per month, comes from households as current effective revenue in the FSM system (see detailed figures in Annex A2-1). If public owned collection companies were paying the discharge fee at the FSTP, the revenue (potential) would reach US$ 52 200.

Table 5-3: Monthly revenue of the FS system

FS trips collected	Average number	Revenue (US$)	Observation on the revenue
Total from HH collection	1175	52 200	Effective (paid)
Total from public administrations	80	3 600	Not effective (not paid)
Total trips	1255	55 800	Potential

5-2-3 System Operators financial analysis (cluster 2)

5-2-3-1 Private collection companies

As explained in the analytical framework, the net profit margin is the tool used to assess the financial situation of the four studied private collection companies.

The net profit margin is calculated in this research, based on the monthly income statement as explained in Annex A2-2-1.

[25] One truck load is 5 or 8 m^3

[26] Local currency, which rate is currently about 9,000 cedis for 1 US$, and about 10,000 cedis for 1 euro.

Table 5-4 shows the net profit margin calculated which is derived from the income statement expressed in cedis. It shows that collection companies are doing good business having a net profit margin ranging from 11 to 28%, or an average of 24%.

The comparison with the net profit margin calculated based on a previous study[27] of Kaelin (2005), presented in Table 5-5, shows a better situation about one year ago, where the net profit margin was up to 74%.

Indeed the situation in which the collection companies are operating has changed. In fact at the time of the previous study, the treatment plant used was the former Buobai stabilisation pond system (closer to the city), and only 13 collection companies (of which 8 were private) were operating. The increased number of 22 collection companies today can obviously result in a decrease in the net profit margin.

The collection companies are paying about 5% of their revenue as discharge fee at the FS treatment plant (i.e. 20,000 cedis paid per trip divided by the average emptying fee of 400,000 cedis) but they do not pay the officially levied license fee of about US$ 220 per year required to operate in the collection activities in the city.

The FS collection companies retained therefore in total 95% (US$ 49 600 per month) of the system's monthly revenue of US$ 52 200. This 95% of the total revenue is split as 24% for their profit and 71% for their operation and maintenance cost.

Unfortunately their capital expenditures could not be estimated. According to Kaelin (2005) "It is very complicated to characterize the assets of the companies due to the lack of long term record keeping or the difficulties to find out information that are several years old. In most of the case "acquisition" of the first assets date back at the time where entrepreneurs were able to buy trucks, generally one in a first time and more later on as the business goes on".

[27] This study (conducted by SANDEC) covered six private collection companies and focused only on the financial assessment of these companies. A three months field survey was conducted from April to June 2004 and the data compiled and analyzed in August and September 2004. It therefore went deeper in collecting the financial information and can be used as good reference, even if the **situation has slightly changed**.

Table 5-4: Monthly income statement in cedis and net profit margin (compiled from own research).

COMPANIES IDENTIFICATION	*PRIVATE 1*	*PRIVATE 2*	*PRIVATE 3*	*PRIVATE 4*	*KMA/WMD*
Emptying tariff per trip	400,000	400,000	350,000	400,000	3/ 600,000[1]
Fuel per trip	-100,000	-80,000	-100,000	-75,000	
Shop money per trip	-100,000	-90,000	-70,000	-150,000	100,000
Oil per trip	-20,000	-20,000	-10,000	-10,000	
Discharge fee per trip	-20,000	-20,000	-20,000	-20,000	
Operating income per trip	**160,000**	**190,000**	**150,000**	**145,000**	
Av monthly number of trips	x 369	x 165	x 29	x 59	24
Monthly Gross profit	**59,040,000**	**31,350,000**	**4,350,000**	**8,555,000**	
Salary per month	-11,000,000	-6,800,000	-2,600,000	-1,000,000	
Maintenance cost per month	-5,000,000	-2,000,000	-500,000	-500,000	
Monthly Income before tax	**43,040,000**	**22,550,000**	**1,250,000**	**7,055,000**	
Tax per month	-3,228,000	-1,691,250	-93,750	-529,125	
Net profit per month	**39,812,000**	**20,858,750**	**1,156,250**	**6,525,875**	
Turnover per month	147,600,000	66,000,000	10,150,000	23,600,000	9,600,000 [2]
Net profit margin	**27%**	**32%**	**11%**	**28%**	

could not be estimated

1 *300 000 for mechanical emptying and 600 000 for manual emptying*

2 *(= 300 000 x 16 + 600 000 x 8) because about 8 manual emptying over the 24*

Table 5-5: Yearly income statement in euros (Source: Kaelin (2005)) and net profit margin.

				Income			
COMPANIES	**1**	**2**	**3**	**4**	**5**	**6**	**average**
Emptying revenue	9,687	36,000	72,000	28,800	129,600	45,000	53,515
Other services	0	0			0	0	0
Other (subsidies,…)	0	0			0	0	0
Total income	**9,687**	**36,000**	**72,000**	**28,800**	**129,600**	**45,000**	**53,515**
				Expenses			
Salaries	2,400	4,020	6,090	8,640	11,952	1,070	5,695
Rent (office)	240	144	450	0	0	144	163
Fuel and oil	2,160	8,000	16,000	15,156	42,133	1,000	14,075
FSTP tipping fee	646	2,400	3,200	1,920	8,640	3,000	3,301
Truck maintenance and repairs	960	1,200	2,240	2,400	5,600	0	2,067
Income tax	35	200	1,548	0	0	240	337
VAT	0	0	0	120	0	0	20
Annual registration KMA	0	0	0	0	0	0	0
Insurances	268	160	492	510	1,342	450	537
Bank charges, interests	0	0	203	0	0	0	34
Total Taxes, insurances, bank	**303**	**360**	**2,243**	**630**	**1,342**	**690**	**928**
Office expenditures	0	0	475	0	0	5,947	1,070
Total expenses	**6,709**	**16,124**	**30,697**	**28,746**	**69,667**	**11,851**	**27,299**
Profit	**2,978**	**19,876**	**41,303**	**54**	**59,933**	**33,149**	**26,216**
Net profit margin	**31%**	**55%**	**57%**	**0%**	**46%**	**74%**	**49%**

5-2-3-2 Manholes managers

The manholes managers are not directly involved in the financial mechanism. They are intermediaries between some households (which own bucket latrines) and the collection companies. They are informal stakeholders but their existence is vital for the bucket latrines owners.

My survey covered only one of them. As shown in Table 5-6, this manholes manager is also making good profit with a net profit margin of 25% .

Table 5-6: Monthly income statement and net profit margin of a Manholes Manager (see detail in Annex A2-2-4)

Income statement	
Revenue	1,600,000
Desludging fee	-800,000
Salary	-400,000
Operating income per trip	**400,000**
Net profit margin	**25%**

5-2-3-3 The FS treatment plant operator

The FS treatment plant operator is under management contract with KMA, and obtains a management fee for the combined management of the solid waste landfill and the faecal sludge treatment plant, and is not responsible for the plant's revenue collection (the discharge fee), which is collected by KMA.

According to Mensah (2005), the agreed management service fee to be paid to the contractor is 72,000 cedis per ton of waste deposited at the landfill. This translates into about 1.2 billion[28] cedis per month based on the average of 600 tons of waste deposited a day.

I could not find more information on the actual financial management of the contract nor on the financial assessment of the private operator, due to the limited time.

It is highly likely that this private operator is also making a good profit. It is operating the plant for WMD/KMA (the FS System Manager), which takes care of the overall financial management of the plant.

5-2-4 System Manager financial analysis (cluster 3)

The main expenditure of the WMD/ KMA in faecal sludge management is the faecal sludge treatment plant (FSTP), which is the central point of the financial problems in FSM.

[28] This figure amounts to US$133,300 and was found in (Mensah, 2005). It has probably changed since it is not the same figure given by the WMD Director -*also the author of (Mensah, 2005)*- during the open discussion with him.

The study sought to evaluate the financial situation of the System Manager by analysing the operational expenditures (OPEX) and the capital expenditures (CAPEX) of the treatment plant.

These expenditures were given for the whole landfill plant including the FSTP, whose cost represents about 10% of the total cost according to the WMD Director. The figures given for the whole plant are:

- US$ 100,000 per month for the OPEX, and
- US$ 4,000,000 for the CAPEX (15 years depreciation period at 5% interest rate, the 1st year of operation was 2004).

This implies that the financial costs of the FSTP are:

- **US$ 10,000 per month** for the **OPEX**, and
- US$ 400,000 for the CAPEX (15 years depreciation period at 5% interest rate).

It is necessary to estimate the monthly CAPEX to be able to calculate the total monthly expenditures on the treatment plant.

The monthly CAPEX is the amount payable monthly[29] in order to attain reimbursement of the capital investment of the plant and interests at the end of the depreciation period.

The following equation is used to calculate the annual capital costs:

$$CC = C_{tot} \frac{(1+i)^n \cdot i}{(1+i)^n - 1} \qquad \textit{Equation 1}$$

with: CC = annual capital cost; C_{tot} = total capital cost; i = interest rate; n = depreciation period in years.

The monthly CAPEX can then be calculated (assuming that there is no other investment over the course of the years) as:

$$CAPEX_{month} = \frac{1}{12} C_{tot} \frac{(1+i)^n \cdot i}{(1+i)^n - 1} = \frac{1}{12} \times 400{,}000 \times \frac{(1+0.05)^{15} \times 0.05}{(1+0.05)^{15} - 1} = 3{,}211$$

The **monthly** capital expenditure (**CAPEX**) for the FSTP is therefore equal to **US$ 3,200.**

5-2-5 External supporters (cluster 4)

The Government of Ghana (GoG) with the help of the World Bank assists in providing external support in the FSM. Unfortunately the financial analysis of these stakeholders could not be covered during the research because of the limited time.

[29] Although calculated always yearly, I calculate it monthly to be in phase with the monthly cost in Section 5-2-2-3.

5-2-6 Financial flow of the FSM system

The financial flow represents the expression of how the revenue of the system is allocated amongst the stakeholders. As shown in Figure 5-9, it gives a picture of the amount, source and use of the revenue each stakeholders receives.

Figure 5-9 shows the schematic of the financial flow of the faecal sludge management system in Kumasi. This schematic helps to visualize the whole FSM system. It will be the basis for the system's cost recovery calculation in the next section, and the basis for discussion about the new proposed mechanism in Chapter 6.

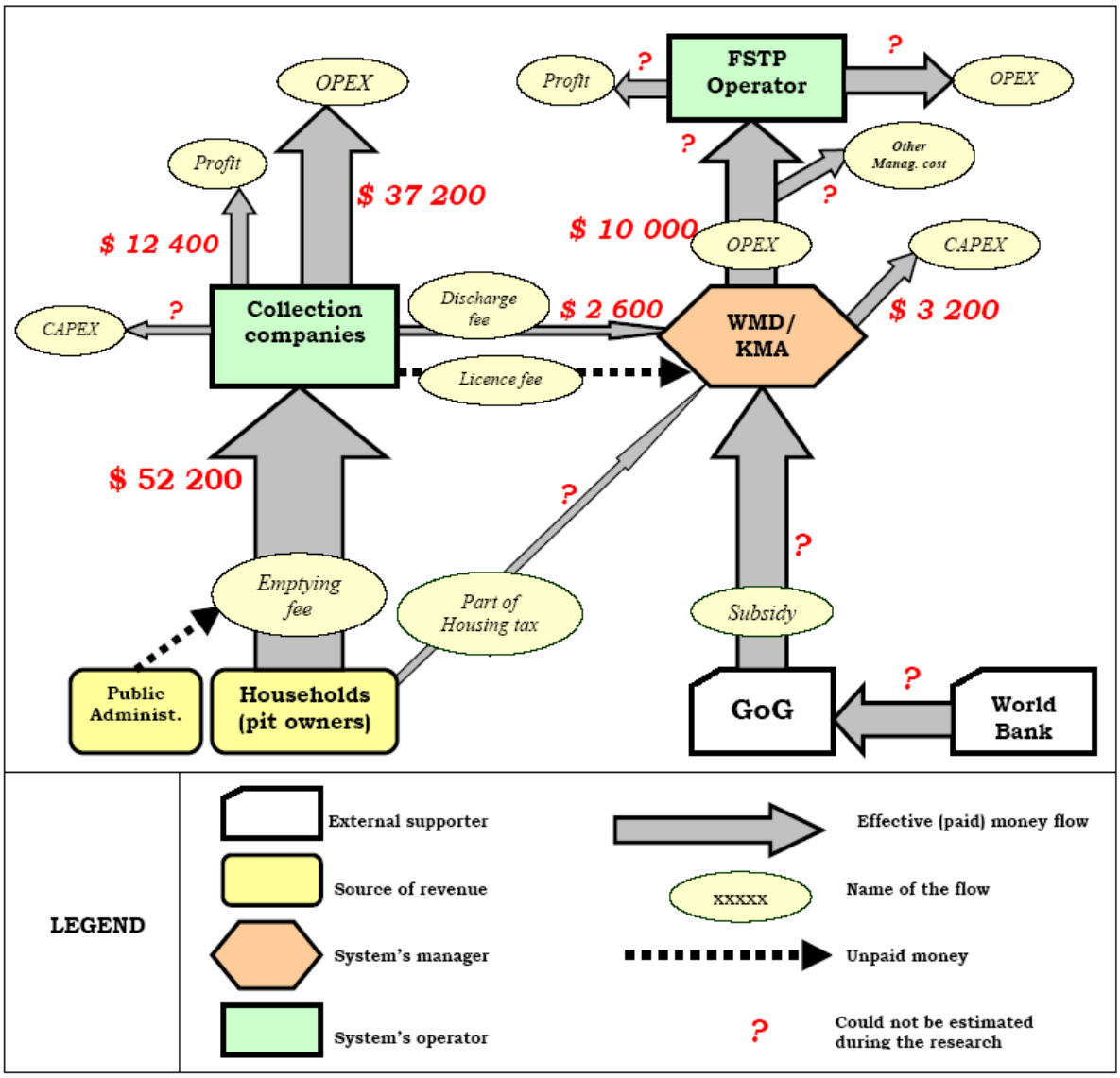


Figure 5-9: Estimated current financial flow of the FSM system in Kumasi expressed in US$ per month.

The key observation is that only five percent (US$ 2,600 per month) of the system's total monthly revenue of US$ 52,200, is collected by the system manager (WMD/KMA). However the total expenditures of system manager is about US$ 13,200 of which US$ 3,200 is the capital expenditure. This expenditure is possible through the Government's and Donors' (World Bank) financial support, and some contribution from the local Government (KMA) from a part of housing tax.

During the households' interview, most of the households answered that they are paying 60,000 cedis per year for the housing tax, which is about US$ 0.55 per month per household collected by the local government to finance many activities for the cities, of which the FSM activities are not given much importance. I was not able to estimate in more details this secondary revenue from households in the FS system.

5-2-6-1 Comparison with earlier study

Steiner *et al.* (2003) have also built the financial flow for FSM in Kumasi. This financial flow shown in Figure 5-10, is based on a number assumptions (see Box 2-1) and on theoretical figures from other studies (e.g. (Steiner *et al.*, 2002)) as presented in Table 2-3. It is not actually the existing financial flow but a projection since there is currently no biosolids sale.

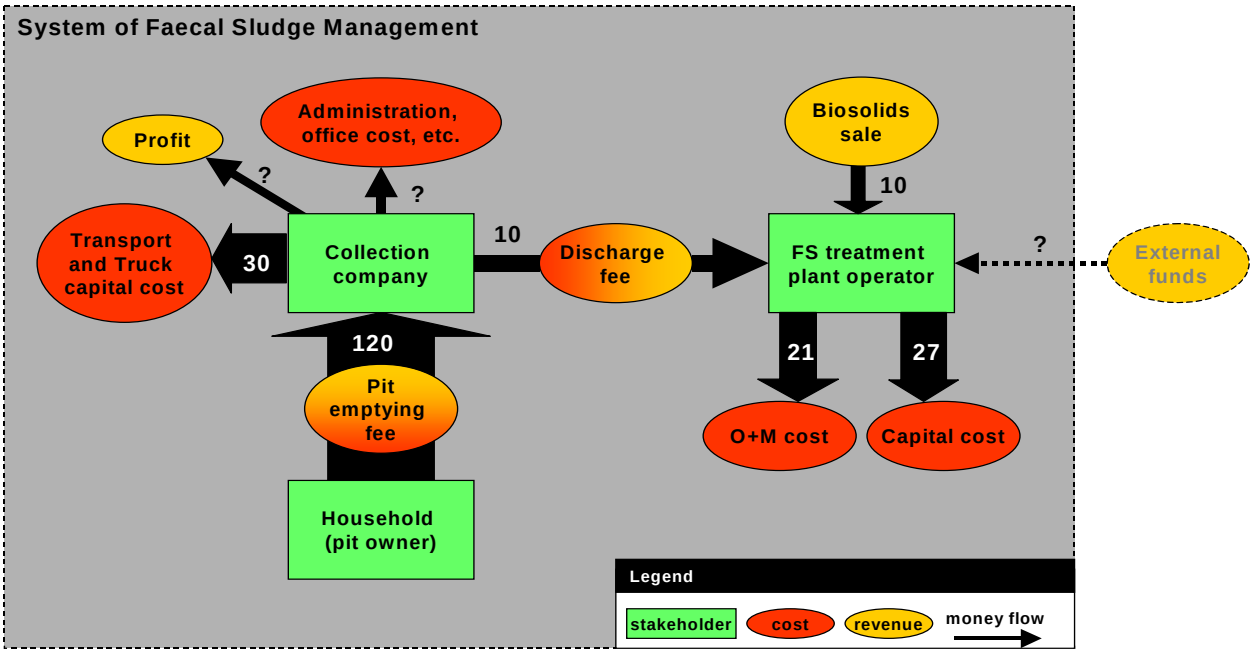


Figure 5-10: Money flow in US$ per ton TS of FS by independent collection/haulage companies (Source: (Steiner et al. (2003))

It is not clear to me why they expressed their cost figures in US$ per ton TS (it might be to make it comparable for cities with different sizes) but I prefer to use the US$ per month in my analysis to make my audience more comfortable in understanding the actual financial issue. I prefer to not base my analysis on theoretical figures, but rather conduct it in a more accurate way (using actual figures from the existing financial arrangements) so that my research outcomes might be more useful for sanitation planners in Kumasi.

I would not compare all the figures from my study to the figures of Steiner *et al.* (2003) because the situation in FSM has changed considerably. For example the FSTP used is not the same and it is meaningless to compare the OPEX and CAPEX of the FSTP. But I can compare the revenue from households.

In fact from the 6,300 m3 of FS monthly collected in the city, of which 94% comes from households (see Figure 4-7), I can estimate the amount of tons TS30 at 148 tons TS per month coming from households. And then the amount of US$ 52,200 in Figure 5-9 can be converted into US$ 353 per ton TS compared to the theoretical figure of US$ 120 per ton TS in Figure 5-10, estimated by Steiner et al. (2003). Quite huge difference, even if the collection tariff and the FS collected have increased31 the effect would not that high.

5-2-7 Cost recovery estimation

The cost recovery estimation in this thesis is limited to the *O&M cost recovery* and *financial cost recovery* since the research does not cover the economic externalities (such as environmental damage, pollution, effects of effluent on river and its downstream users, etc.) and the opportunity cost (cost of not being able to use the financial resource for another social or economic activities). The *full cost recovery* is hence not calculated in this thesis.

The *O&M cost recovery* of system is the coverage of the operational expenditures (OPEX) with the revenue of the system irrespective of any external financial support or subsidy.

The *financial cost recovery* is the coverage of the *financial costs* which are the sum of the operational and capital expenditures with the revenue of the system, irrespective of any external financial support or subsidy.

The following formulae can be derived from these definitions, and be applied for both the FSM system's components and the whole system. Knowing the cost recovery (CR) level of each component of the system can help to know where new revenues of the whole system must be allocated. For a financially healthy system, the financial CR should be higher than 100% in order to cover the financial costs and be profitable.

- For each component (i) of the system, we have:

$$O\&M \quad CR = \frac{(Net \quad Revenue)_i}{OPEX_i} \quad and \quad Financial \quad CR = \frac{(Net \quad Revenue)_i}{(OPEX + CAPEX)_i}$$

Equation 2

- For the whole system, we have:

$$O\&M \quad CR = \frac{System \quad Revenue}{\sum_{i=component}(OPEX + Profit)_i} \quad and \quad Financial \quad CR = \frac{System \quad Revenue}{\sum_{i=component}(OPEX + Profit + CAPEX)_i}$$

Equation 3

[30] From the assumptions used, the TS (total solid) content of a FS is 0.025 tons TS/m^3

[31] The average collection tariff has increased from 300,000 in 2003 to 400,000 cedis in 2005 (from my collection companies survey) meaning an increase of 33% and not 194% as derived from the difference in the two figures of households revenue.

Table 5-7: Cost recovery level of the FSM system and its components (US$/month)

Systems	Net Revenue	CAPEX	OPEX	O&M cost recovery	Financial cost recovery
Collection companies (Cluster 2)	$49,600	?	$37,200	**133%**	**133%**
System manager: WMD/KMA (Cluster 3)	$2,600	$3,200	$10,000	**26%**	**20%**
FSM system (Clusters 2+3)	$52,200	$3,200	$59,600	**88%**	**83%**

From the Table 5-7, it can be seen that the whole FSM system does not operate with full cost recovery. Even the O&M cost recovery is not achieved, implying that even if all the assets of the system were donated, the system could not be financially sustainable.

That is due to the low cost recovery at the system manager level where the FSTP cost is difficult to cover. In fact, the FSTP service does not serve directly the service beneficiaries and that makes it difficult to channel the revenue collected from households directly to the FSTP. Only 5% of the system revenue is allocated to the FSTP, which represents only 26% of the operating costs and 20% of the total financial costs.

But based on the households capacity to pay estimated in Section 5-2-2-2, more money can be expected from households to cover the overall cost of the system, if a good strategy is found for the effective collection of this money. And moreover a good strategy for compost reuse in agriculture can be a way to stimulate revenue from farmers, as demonstrated in Chapter 6.

5-3 Institutional and financial problems that hamper FSM to be ecosan

5-3-1 Problems

The institutional and financial problems which stop FSM in Kumasi from being part of an ecosan approach have been identified during the research. They are:

1. Strong government and donors dependence instead of households orientation;
2. High political interference in the management: the decentralisation of the Waste Management Department (WMD) is not effective;
3. Accumulation of roles by the District Assembly: KMA is Owner, Provider, Regulator, Financial Manager and Decision maker of the sanitation services;
4. Low autonomy for the WMD who is responsible for the service provision;
5. No powerful regulatory body: the action is collaboration-oriented, which hampers the effectiveness of the regulation;
6. Low cost recovery of the system (especially for the FSTP) mostly because of political fear (election) to charge the FS services at its right cost;
7. No strategy for waste reuse in agriculture;

8. Farmers are not among the direct stakeholders;
9. No Information System for better FSM planning: the FSM Information System is limited to trucks trips counting at the FSTP, no information on where the waste comes from (type of toilets facilities, areas, etc.) ; and
10. Lack of awareness on FSM problems amongst stakeholders.

5-3-2 Short discussion

With regard to the point 2, KMA initiatives of creating a decentralized office (WMD) for the sanitation services provision and involving private sectors at many levels is a good example in West Africa. But the decentralization is not effective and more needs to be done to improve the organisational autonomy of the WMD. In fact the WMD has limited autonomy in the execution of its activities, mostly the ones related to the financial issues. It has no decision making power in any investment, nor in the financial management of contracts. The actual role of the department is limited to the facilitation and coordination of the services provision. Its internal organization is not results-oriented since there is no clear strategy for staff incentives and internal accountability. It is also difficult to make the WMD accountable for result because there is no performance target due to the lack of resources to meet them. The department is thus working based its own targets.

With regards to point 3, the multi-role of KMA – owner, provider, regulator and supporter of the services - does not allow the regulatory body (EPA) to fully play its role. EPA is an autonomous regulatory body operating under the mandate Act 490 of 1994/Legislative instrument of 1999, to ensure sound environmental management by regulating any environmental activity. But despite its credibility, capability, transparency, accountability and power for enforcement and sanctions (see Section 5-1-1-4), the EPA can only work on collaboration basis with the KMA because of the context of local power. It has actually little power as regards to the local authorities. Its action is limited to advice provision instead of enforcement, because there is not enough resources available for the authorities to be conform to the standards.

With regard to the point 6, as I show in Section 0, the cost recovery at the FSTP level is the major problem of the current financial mechanism.

For the remainder of the thesis, the focus will be given to the financial issues (cost recovery issues).

6 POSSIBLE FINANCIAL MECHANISM

6-1 The ISFSM approach: approach to place FSM under ecosan

I give in this section my theoretical view about the relationship between FSM and ecosan. I draw the parallels between faecal sludge and water using the IWRM principles (see next section). I show that we can also use the ISFSM (Integrated and Sustainable Faecal sludge Management) approach which I develop based on ISWM concepts developed by Klundert and Anschütz (2001), to place FSM under ecosan in order to reduce developing countries' sanitation problems.

6-1-1 The integrated FSM

Integrated Water Resources Management (IWRM) is a process which promotes the coordinated development and management of water, land and related resources, in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems ((van der Zaag and Savenije, 2004) quoting the definition by GWP[32]).

According to Klundert and Anschütz (2001), an integrated waste system is a system that:

- uses a range of inter-related collection and treatment options, at different habitat scales (household, neighbourhood, city)
- involves all stakeholders, be they governmental or non-governmental, formal or informal, profit- or non-profit oriented
- takes into account interactions between the waste management system and other urban systems

From these definitions, I define the Integrated-FSM as a FSM that (i) considers all the processes of FSM; (ii) allows the participation of the relevant stakeholders in decision making at each process, (iii) takes into account interactions with other urban systems such as solid waste for co-composting and reuse in agriculture.

From this point of view, the principles of Integrated-FSM should go beyond the three '**E**'s of Postel defined for ISWM in (van der Zaag and Savenije, 2004), which are: *Equity*, *Efficiency* and *Ecological integrity*, and consider as well the *public participation* and *interaction* with other urban services.

- *Equity:* based on the human right and social characteristics of the FSM services, equity principle implies that all households have right of access to the services and care must be taken to not jeopardize poor people's interest in favour of rich people's. A good way needs to be found to provide adequate service to all the community.
- *Efficiency:* according to van der Zaag and Savenije (2004), the efficiency principle implies that institutional arrangements should be such that cost recovery of the services should be achieved. This will ensure sustainability of infrastructure and institutions, but should not jeopardize the equity principle. Here comes the issue of proper tariff setting to make service beneficiaries pay at it rights cost, for the service they have been provided.
- *Ecological integrity:* this principle implies good institutional and legal arrangement to avoid illegal dumping of FS for environment protection, and ensure that nutrients are returned back to the soil as would be implied in the ecosan approach (closing the loop).

[32] Global Water Partnership

- *Public participation:* the system must allow transparency and good accountability mechanisms at all levels of the services provision. A way must be found for good communication and information management with all stakeholders.
- *Interaction:* this principle implies the consideration of other similar urban services to increase the performances of the system, mostly the financial and environmental performances. In the case of FSM system, the association with solid waste management system for co-composting[33] could enhance the compost reuse in agriculture and allow the ecological sustainability.

Following the same school of thought as Klundert and Anschütz (2001), stakeholders (participation) must be the first dimension of FSM on the way to achieve the integrated approach.

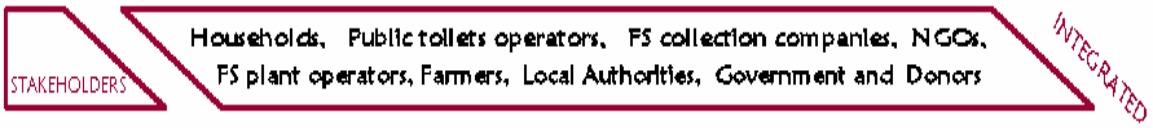


Figure 6-1: Stakeholders as the first dimension of Integrated FSM

6-1-2 The sustainable FSM

Brundtland defined sustainable development as "Development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs" (WCED, 1987).

Sustainable development is making efficient use of our natural resources for economic and social development while maintaining the resource base and environmental carrying capacity for coming generations. This resource base should be widely interpreted to contain natural resources but also knowledge, infrastructure, technology, and human resources. In the process of development, natural resources may be converted into other durable products and hence remain part of the overall resource base (van der Zaag and Savenije, 2004).

The sustainability implies therefore: the technical sustainability, environmental sustainability, financial and all aspects of sustainability as shown in Figure 6-2.

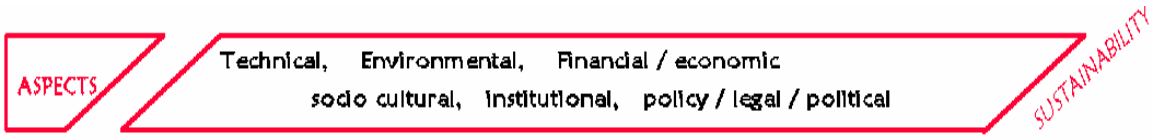


Figure 6-2: FSM aspects to be considered on the way to sustainability.

The two concepts "sustainability" and "integrated" are two interrelated concepts difficult to part. Klundert and Anschutz (1999) would say that: "*Sustainable and integrated are, in a sense, two sides of the same coin*". They also explain that: "If waste management systems are integrated with other systems, this could enhance sustainability as well."

They defined a sustainable waste system as a system that is:

[33] Compost made with both faecal sludge and organic solid waste (see section 2-5-4).

- appropriate to the local conditions in which it operates, from a technical, social, economic, financial, institutional, and environmental perspective, and;
- capable to maintain itself over time without reducing the resources it needs.

I can therefore define the sustainable-FSM as a FSM in which all aspects of sustainability are ensured, mostly the financial and institutional sustainability where there is a full cost recovery of the system irrespective of donors' financial support, and the environmental sustainability where there is no longer a FS crisis[34].

6-1-3 Integrated and Sustainable FSM as ecosan

Stakeholders is the first dimension of FSM. The second dimension is the FSM processes, and FSM aspects is the third dimension. These three dimensions characterizing both the Integrated FSM and Sustainable FSM (Figure 6-3), could merge the FSM into the ecological (and economical) sanitation, if the principles mentioned above are successfully applied to the institutional and financial arrangements.

I conclude that a FSM that meets the principles of ISFSM, will enable and promote treated FS reuse in agriculture and then can be considered as ecosan ("closing the loop").
And therefore ISFSM can be placed under the broad umbrella of ecosan which covers also waste water management and solid waste management.

FSM programmes and ecosan programmes should work hand in hand, and ecosan should not only focus on dry urine diversion toilets implementation and promotion.

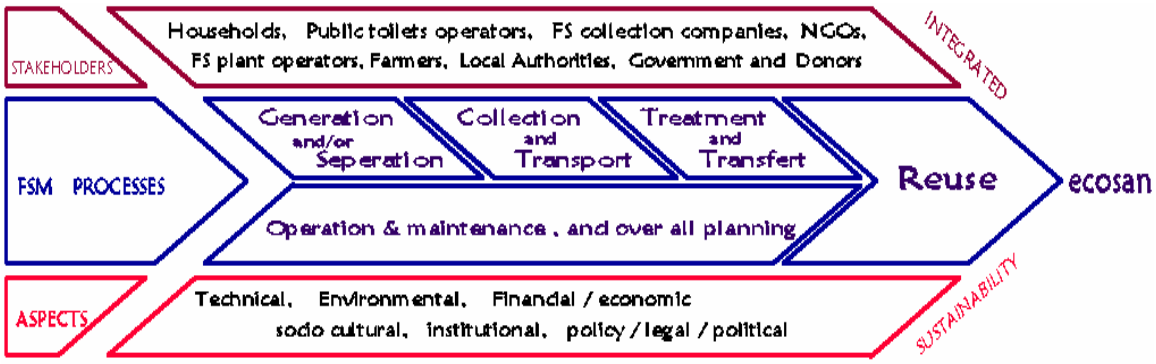


Figure 6-3: Approach of Integrated and Sustainable Faecal Sludge Management as part of ecosan approach.

[34] Know more about FS crisis in Section 2-3-2.

6-2 Proposed financial mechanism

I am proposing a revised financial flow as shown in Figure 6-4.

The main changes compared to the existing situation (Figure 5-9) are that:

- The current FSTP system needs to include facilities for compost production to transform the FS into compost ready to be used in agriculture[35], so that compost sale to farmers can be considered as new source of revenue.

  The existing combined site (Dompoase site) for both faecal sludge (FS) and solid waste disposal, offers a good opportunity for the Integrated-FSM for the city.

  A composting plant of both FS and organic solid waste can be effective, using the outcomes of the current co-composting pilot plant managed conjointly by SANDEC and IWMI at Buobai, the former FS discharge site of Kumasi.

  Obviously, the FSTP operating and capital costs will increase if a co-composting step is added, but sale of compost to farmers will be a new source of revenue in the system, even if this revenue may not cover the full additional cost caused by the compost production. Indeed the ecological integrity gained might not have enough financial benefits but has also some indirect benefits (improved health of population, environmental protection, etc.) which are difficult to quantify.

  Cofie (2003) has estimated the economic benefits derived from Buobai co-composting pilot plant at US$ 674 per ton of compost produced, of which the indirect benefits[36] amount to 30%.

- The revenue from households should be optimized using the CTP-approach and the cross-subsidy to meet both efficiency and equity principles.

  The CTP-approach implies that households have to pay the service they receive at the right cost, based on what they are capable to pay (capacity to pay: CTP), rather than what they are willing to pay (willingness to pay: WTP). The WTP figure can be low depending on the level of the households' awareness on the importance of the service (until now, many Africans consider sanitation services as less important than electricity for example due to the lack of awareness).

  Since the CTP is a function of income level, households from various income areas can not be expected to pay the same price for the service they receive. The difference in tariff in various income areas is necessary to meet the efficiency principle. And thus, people in low income areas will pay less for FS services in absolute terms than people in high income areas (cross-subsidy).

Figure 6-4 shows the new financial flow proposed for Integrated and Sustainable FSM for the city, where:

- A represents the potential revenue from households (see Section 6-3-1);
- B represents the part of this potential revenue which is allocated to the system manager (see Section 6-3-1);
- C_1 and C_2 represents the operational and capital expenditures of the system manager respectively (see Section 6-3-3-2);
- D represents the potential revenue from farmers (see Section 6-3-3-2).

[35] FS could also be treated in other ways to achieve a valuable fertilizer, but in this thesis I restrict the analysis to co-composting (because previous results for this type of technology were available). The product from FS treatment has also been called "biosolids", or "humanure". In my thesis I will refer to it as "compost".

[36] These indirect benefits include the public health bill saved, the landfill space cost saved and the waste transportation to the landfill sites cost saved.

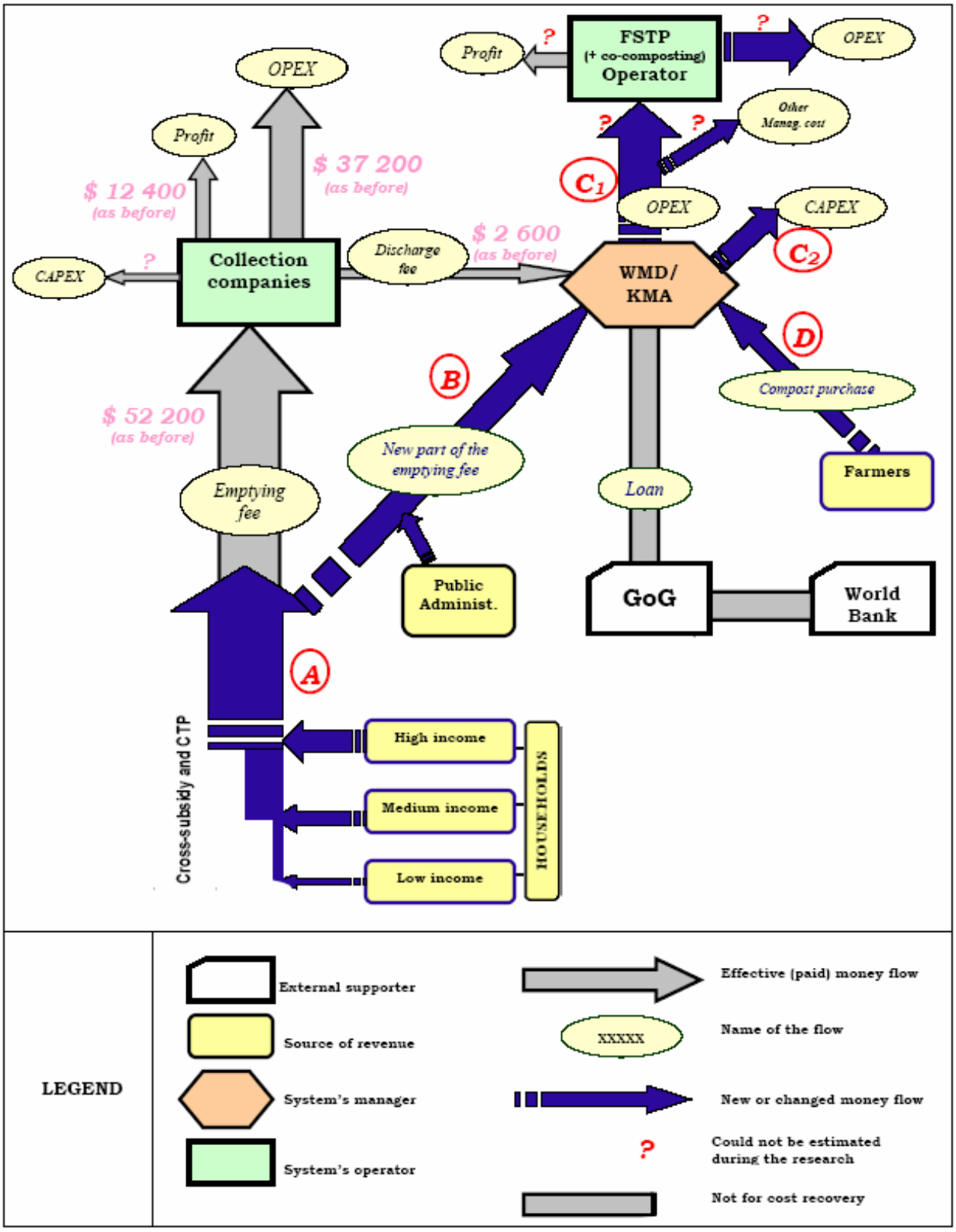


Figure 6-4: Proposed financial flow (in US$ per month) for ISFSM in Kumasi: Values A to D are discussed in Section 6-3.

6-3 Calculation of new cost items of the ISFSM system

This section estimates values for A to D in Figure 6-4.

6-3-1 Potential revenue from households (value of A and B)

In order to know how successful the CTP-approach for cost recovery can be, a simple estimation of the potential revenue from households has been done. The estimation considered all the residential areas of the city, the updated number of households in each area and their income level.

The whole statistical data of 1996 found in (GoG/MoLGRD, 1996), was processed and updated as explained in Annex A3-3. From a statistical repartition of households of various residential areas and their incomes, into quintiles and then into income classes, the average income and CTP values for each class have been determined (see Figure 6-5)[37].

Table 6-1 shows how the total potential revenue from the households has been estimated based on the updated number of households in each class and the CTP for FS collection services (which is 0.5% of the monthly income, as explained in Section 5-2-2-1).

The total revenue that we can except from households for the emptying service based on the CTP this service is estimated at US$ 321,300 per month for a 100% collection coverage. With the actual coverage of 34%[38] of the FS that is produced (see section 4-2-5), the potential revenue from households is US$ 109,200 per month. This means that the value of A in Figure 6-4 can be estimated as:

$$A = 109{,}200 \text{ US\$}$$

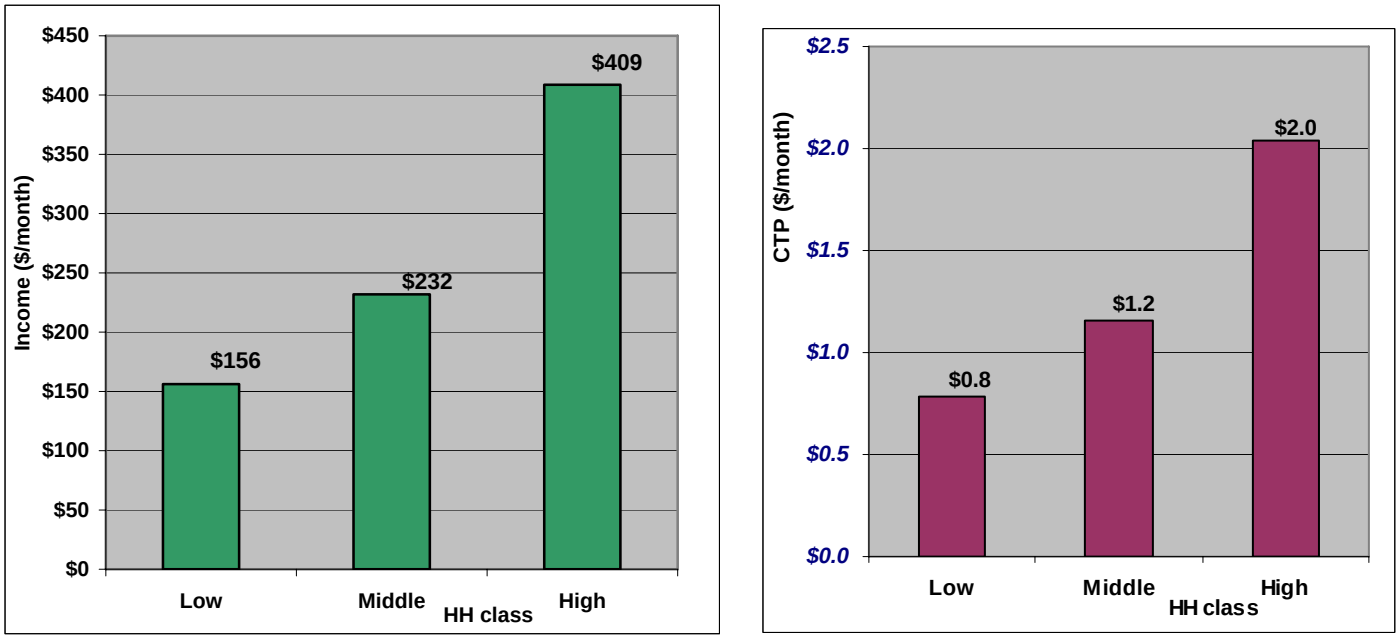


Figure 6-5: Average monthly income and CTP for FS collection services of households grouped by three income classes (based on statistical data updated from 1996)

[37] The income figures from this analysis compare well with my own small household survey (20 households), see data shown in section 5-2-2-2. I decided to use the dataset from 1996 here because it gives detailed information about the income level in each residential area and the number of people that have a certain level of income.

Table 6-1: Estimation of the monthly potential revenue from households based on CTP for FS collection services and cross-subsidy.

HH INCOME CLASS	Quintiles[39]	Number of HH	Av. monthly HH income per class (US$)	Av. monthly CTP per class (US$)	Potential revenue per class (US$)
HIGH	*Q1*	51,209	409	2.0	**104,700**
MIDDLE	*Q2* *Q3* *Q4*	133,538	232	1.2	**154,900**
LOW	*Q5*	79,042	156	0.8	**61,700**
Total revenue at 100% FS collection coverage					**321,300**
Revenue at the current FS collection coverage of 34% (A value)					**109,200**

The value of B is the difference between A (total money from households) and the US$ 49,600 which (currently) goes to the private companies (see Table 5-7). I assume that this revenue of the collection companies will not change in the new system.

Therefore

$$B = 109,200 - 49,600 = 59,600 \quad US\$$$

B will entirely go to the system manager (KMA), to ensure the overall FS system cost recovery. A way for effective collection of B is needed and in section 6-6-1, I propose a voucher system for that.

6-3-2 Potential revenue from sale of compost to farmers (value of D)

This section describes an approach to estimate the value of D in Figure 6-4, which is the potential revenue from compost sale. This estimate is based on the farmers' willingness to pay (WTP) since they are not beneficiaries of the sanitation service but rather clients of the system. They might not be interested in the use of compost produced from the sanitation system since they have many alternatives such as chemical fertilizers or poultry manure.

In the case of Kumasi, the main fertilizer that is abundant and widely used by farmers, is the poultry manure.

According to Drechsel *et al.* (2004), "in Kumasi, large amounts of household and market waste are available, together with a very large supply of sawdust and poultry manure. The high poultry manure production around the city will, however, influence any compost

[38] This figure of 34% is highly dependent on the assumption on the specific production made in Section 4-2-5.
[39] More details about the quintiles figures in are provided in Annex A3-3.

market. As long as the manure is abundant and **free**, any attempt to establish a financially viable composting project will fail unless regulations are in place (and enforced) to urge the construction business to use waste compost for landscaping and estate development."

However the results of an assessment of compost demand, show that there is some potential for compost use in agriculture. This compost demand assessment study in (Drechsel *et al.*, 2004), was based on farmers' willingness to pay (WTP).

According to Drechsel *et al.* (2004), the WTP approach used (see Box 6-1) in that study was based on dichotomous choice (willing to pay: yes or no), followed up with an open-ended question to elicit the spontaneous WTP of the interviewed farmers. All responses together were used to calculate the "mean WTP". Wherever possible, compost samples were shown and distributed.

In that study, all the various types of farmers in and around the city have been identified and the number of farmers falling in each type has been estimated. A sample of 200 farmers has been covered, and the actual number of farmers was extrapolated from the results of the sample.

Box 6-1: WTP approach used to determine farmers' willingness to pay for compost and the theoretical demand for it (Source: Drechsel et al. (2004)).

WTP Questions: At the start, the farmer had an opportunity to explain his/her current soil inputs, their advantages and disadvantages. After this, co-compost samples were handed out where the product was not yet known. Farmers compare it with known soil inputs, described experiences, or in those cases where farmers were not familiar with the product the interviewer explained both advantages and disadvantages without biased promotion. Then farmers were asked whether they are willing to pay (or not) for co-compost as a soil improver. If yes, they were asked how much they are willing to pay for a common 50 kg sack. This allowed assessing also zero willingness to pay and the mean WTP. Further questions were on socio-economic characteristics, income, experience with/without compost and perception of compost quality to get estimates for explanatory variables for the probit analysis.

To give the WTP answers a reality check, the different UPA (Urban and peri-urban Agriculture) farming systems were analyzed for their farm finances and de facto ability-to-pay for compost**.**

The results of the WTP study by Drechsel *et al.* (2004) are shown in Table 6-2, which also the WTP of the various clients and their potential demand for compost.

Table 6-2: Farmers' WTP and theoretical demand estimate (ton/year) for compost in Kumasi, Source: Drechsel et al. (2004)

Potential Clients (Kumasi)	Estimated number of farming households in and around the city (total)	Average farm size per farmer (ha)	Number of farmers willing to pay (extrapolated from sample size)	Average WTP (US$) per bag of 50 kg	Qty/year in 50 kg-bags per farming household	Total demand of compost in tons per year
Vegetable (urban)	200	0.1	126	0.1	214	1348
Vegetable (peri-urban)	280	0.8	260	3.0	28	364
Staple crops (urban)	115	0.2	67	2.0	5	17
Staple crops (peri-urban)	15000	0.8	5550	2.7	14	3885
Urban backyards	85000	0.02	71000	1.4	3	10650
Urban ornamentals	50	0.02	40	0.6	33	66
Total	100645		73043		297	16330

Notes from Drechsel *et al.* (2004)

- The Sample size was 200 farmers
- Calculation example of total compost selling potential (urban vegetable farming): 214 bags y^{-1} x 50kg ÷1000 = 10.7t y^{-1}. 10.7 x 126 farmers willing to pay = 1348t y^{-1}. However, there were no urban vegetable farmers willing to pay 3 or even 5 US$ per bag. This is based on the actual WTP of all the farmers in the respective system, i.e. not the average WTP. Thus the actual market is zero.
- Although 8 of 10 backyard owners were willing to pay for compost it is assumed that only 50% could actually use compost for their crops (the same for the other two cities).
- Total number of farmers based on statistics of the Ministry of Food and Agriculture and own surveys on urban agriculture.

Evaluating the potential revenue implies the simulation of the highest revenue that can be derived from farmers based on their WTP which is "the maximum sum that an individual, over a given time period, is prepared to pay rather than forgo his or her purchase". It is the price at which the compost will be sold to farmers.

At a tariff set to correspond to a certain WTP, the corresponding revenue can be calculated from the amount of products demanded.

For the product sold at the lowest WTP where all the farmers are buying it (highest demand), or the highest WTP where only few farmers can buy (lowest demand), the generated revenue is not necessarily the highest. Therefore careful simulation is required to determine at which WTP the revenue is highest.

Table 6-3: Estimation of the monthly potential revenue from farmers based on their WTP for compost (shaded in grey the end result of the evaluation).

Potential Clients	Estimated number of farming households and around the city (total)	Number of farmers willing to pay (extrapolated from sample size)	Average WTP (US$) per bag of 50 kg	Qty/ year in 50kg bags per farming household	Total Qty/ year in 50kg bags	Total cumulative Qty/ year in 50kg bags	Total theoretical demand of compost in tons per year	Total cumulative theoretical demand of compost in tons per year	Total annual Revenue per WTP	Mo nthly Revenue per WTP
Vegetable (peri-urban)	280	260	$3.0	28	7280	7280	364	360	$21,840	**$1,820**
Staple crops (peri-urban)	15000	5550	$2.7	14	77700	84980	3885	4,250	$229,450	**$19,120**
Staple crops (urban)	115	67	$2.0	5	335	85315	16.75	4,270	$170,630	**$14,220**
Urban backyards	85000	71000	$1.4	3	213000	298315	10650	14,920	$417,640	**$34,800**
Urban ornementals	50	40	$0.6	33	1320	299635	66	14,990	$179,780	**$14,980**
Vegetable (urban)	200	126	$0.1	214	26964	326599	1348.2	16,340	$32,660	**$2,720**

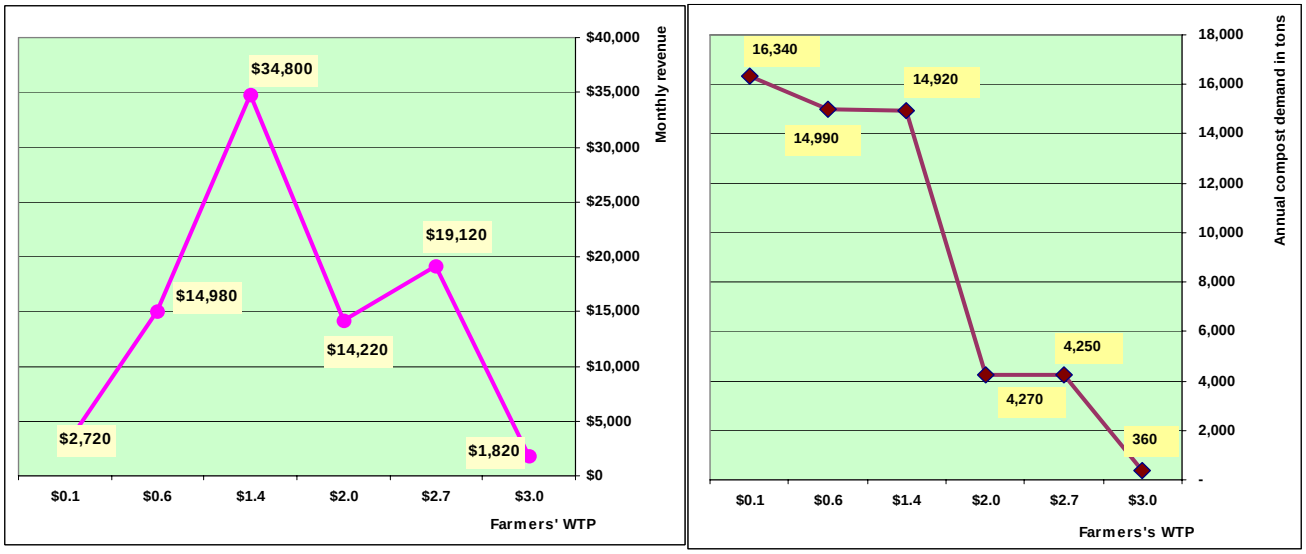


Figure 6-6: Simulation of the highest revenue from farmers based on their WTP (in $ per 50 kg bag)

Table 6-3 shows how the monthly revenue from sale of compost to the farmers can be estimated from the farmer's WTP. The analysis presented in Figure 6-6, shows that the highest revenue from compost sale can be obtained at a WTP of US$ 1.4 per 50kg bag of compost. This corresponds to a compost sale of about 14,920 tons per year, and a monthly revenue of the FSM system of US$ 34 800. As shown in Section 6-3-3-2, this figure of compost sale is higher than the amount of compost that the co-composting plant can produce. Therefore the value of D estimated in Section 6-3-3-2 takes into account the actual capacity of the composting plant.

6-3-3 Additional cost of the FSTP for co-composting

This Section estimates the values for C_1 and C_2 in Figure 6-4.

The assumption made in the analysis is that the current FSTP will be extended to include co-composting of organic solid waste and faecal sludge. The outcomes of the Buobai pilot plant will therefore be used to design a composting process which will produce compost ready to be used in agriculture.
Indeed during the open discussion with the WMD Director in the phase of the field survey (see Annex A1-2-1), he showed his positive view about the pilot plant research and was ready on behalf of KMA to implement the recommendations from the pilot plant study.

The cost of the full scale composting plant can be estimated based on the cost of the pilot plant, using the economy of scale principles provided by Steiner *et al.* (2002).

According to Steiner *et al.* (2002), a simple way to achieve a financial upscale of a pilot plant to a full-size plant is to apply the principles of the economy of scale based on the pilot plant cost, and assuming an appropriate value for the parameter α. A more time-intensive, but also more accurate alternative is to do a detailed design and cost estimate for the full scale plant.

6-3-3-1 Characteristics and costs of Buobai co-composting pilot plant

According to Steiner *et al.* (2002), the pilot plant is designed to treat about 500 m^3 FS annually (three monthly FS loadings, each containing 15 m^3 FS) composed of a mixture of septage and public toilet sludge at a 2:1 ratio (assumed TS = 25 g/l).

The plant includes the ramp for vacuum trucks, a sludge storage tank (15 m^3), two parallel drying beds (each 5.5 x 5.5 m), a dewatered sludge storage area, a solid waste delivery area, an unloading and handling area, a composting area (for composting, maturation, screening and bagging, compost storage), a closed building, and a percolate storage tank (Steiner *et al.*, 2002).

Cofie (2003) has estimated the capital expenditures (CAPEX) and the operational expenditures (OPEX) of the pilot plant at US$ 21,753 and US$ 1800/year respectively, at the time where the currency rate was 7,500 cedis for 1 US$ [40].

Taking into account the current exchange rate of 9,000 cedis for 1 US$, the updated cost would be about **US$ 18,130** and **US$ 1,500/year** respectively for the CAPEX and the OPEX of the pilot plant.

[40] Original costs in cedis and converted afterwards in US$ according to (Cofie, 2003).

6-3-3-2 Costs of the full scale composting plant (values for C_1, C_2 and D)

The full scale composting plant would have to treat about 6300 m^3 of faecal sludge per month, or about 75,000 m^3 per year, which is 150 times the throughout of the pilot plant (the *150- scale plant*).

The determination of the economy of scale parameter α is normally done through a detailed design of the full scale plant which was outside the scope of this thesis. I will use therefore the parameter α of a full scale plant of 50 times the pilot plant (the *50-scale plant*) already calculated by Steiner *et al.* (2002), who used the design figures given in Box 6-2 for the design of the 50-scale plant in Figure 6-7.

Box 6-2: Calculation base of the upscaled plant (50-scale plant) of a capacity of 50 times the pilot plant. Source: Steiner et al. (2002)

- Annual load: 25,000 m^3 FS ($\rightarrow$ 625 t TS FS per year).
- Average TS content in FS mixture: 25 g/l.
- FS mixture: 2:1 septage and public toilet sludge.
- Loading cycle: after loading, 10 days of drying period.
- FS loading rate: 200 kg TS/m^2·y.
- Loading cycle: after loading 10 days of drying period.
- 9 drying beds, every bed is loaded with about 80 m^3 at an interval of 10 days; every day, one bed is thus loaded with all incoming sludge (no loading on Sunday), no sludge storage tank is needed; the volume is reduced about 10 times during drying.

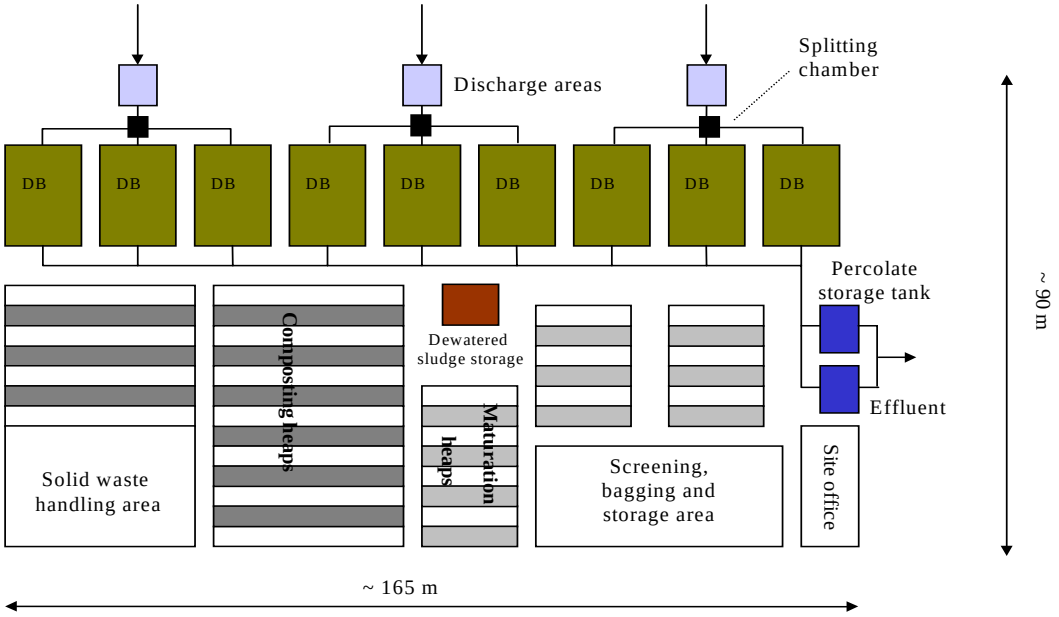


Figure 6-7: Diagram of upscaled plant of 50 times the pilot plant. Source: (Steiner et al., 2002)

I assume that the 150-scale full scale plant cost (OPEX and CAPEX) can be taken as 3 times the 50-scale plant cost even though this simplified approach may over estimate CAPEX and OPEX since it does not follow the economy of scale principle.

The economy of scale principle given by Steiner *et al.* (2002) is the following:

$$P_0 = a \cdot C_0^{\alpha}$$
$$P_1 = a \cdot C_1^{\alpha}$$

Equation 4

P_0, P_1 are the pilot and full-scale plant costs (CAPEX and OPEX), and C_0, C_1 are the pilot and full-scale plant capacity (m^3/year) respectively.

The economy of scale parameter of the 50-scale plant is $\alpha_{50} = 0.72$.

From the equation 4, I can write:

$$\begin{cases} \dfrac{P_{50}}{P_1} = \left(\dfrac{C_{50}}{C_1}\right)^{\alpha_{50}} \Rightarrow P_{50} = \left(\dfrac{C_{50}}{C_1}\right)^{\alpha_{50}} P_{50} = \left(\dfrac{50}{1}\right)^{0.72} \times P_1 \Rightarrow \underline{P_{50} = 16.72 \times P_1} \\ and \quad P_{150} = 3 \times P_{50} = 50.16 \times P_1 \end{cases}$$

Equation 5

Where P_1, P_{50} and P_{150} correspond to costs belonging to the pilot plant, the 50-scale plant, and the 150-scale plant respectively.

Table 6-4 shows the costs of the up-scaled plant using equation 5 and 1 to calculate the annualised CAPEX.

Table 6-4: Estimation of the cost of the full scale co-composting plant (150 times Buobai pilot plant)

Costs	Pilot Plant (P_1)	150-scale plant (P_{150})
Monthly OPEX (US$)	$125	**$6,300**
CAPEX total (US$)	$18,130	$909,300
Annualized CAPEX	$1,747	$87,600
Monthly CAPEX	$146	**$7,200**

Therefore:

$$C_1 = 10{,}000 + 6{,}300 = 16{,}300 \quad US\$$$

and

$$C_2 = 3{,}200 + 7{,}200 = 10{,}400 \quad US\$$$

According to Cofie (2003), the realistic capacity of the Buobai pilot plant is to produce 37 tons of compost per year from a total of 180 m^3 of municipal solid waste and 360 m^3 of raw faecal sludge.

The compost production capacity of the full scale plant can therefore be estimated as:

$$\frac{37}{360} \times 75000 \ = 7700 \ \text{ tons/ year.}$$

According to Section 6-3-2, the potential total compost demand is 14,920 tons per year. So less compost is produced than what could be sold (at US$ 1.4 per 50 kg according to the WTP approach).

Therefore the tariff can be set at the WTP of 1.4 US$ in order to sell all the produced compost. The revenue from the compost sale to the farmers is thus estimated at:

$$1.4 \times \frac{1}{12} \times \frac{7700 \times 1000}{50} = \underline{18{,}000 \ \ US\$} \text{ per month.}$$

Therefore:

D = 18,000 US$

This revenue alone covers the financial costs of the co-composting plant (estimated in Table 6-4 as US$ 6,300 for the OPEX and US$ 7,200 for the CAPEX, or a total monthly cost of US$ 13,500) at a financial cost recovery value of 133%. I was not expecting this favourable result.

Based on the estimated values of A to D, the money flow for Kumasi for integrated and sustainable faecal sludge management for Kumasi is summarised in Figure 6-8.

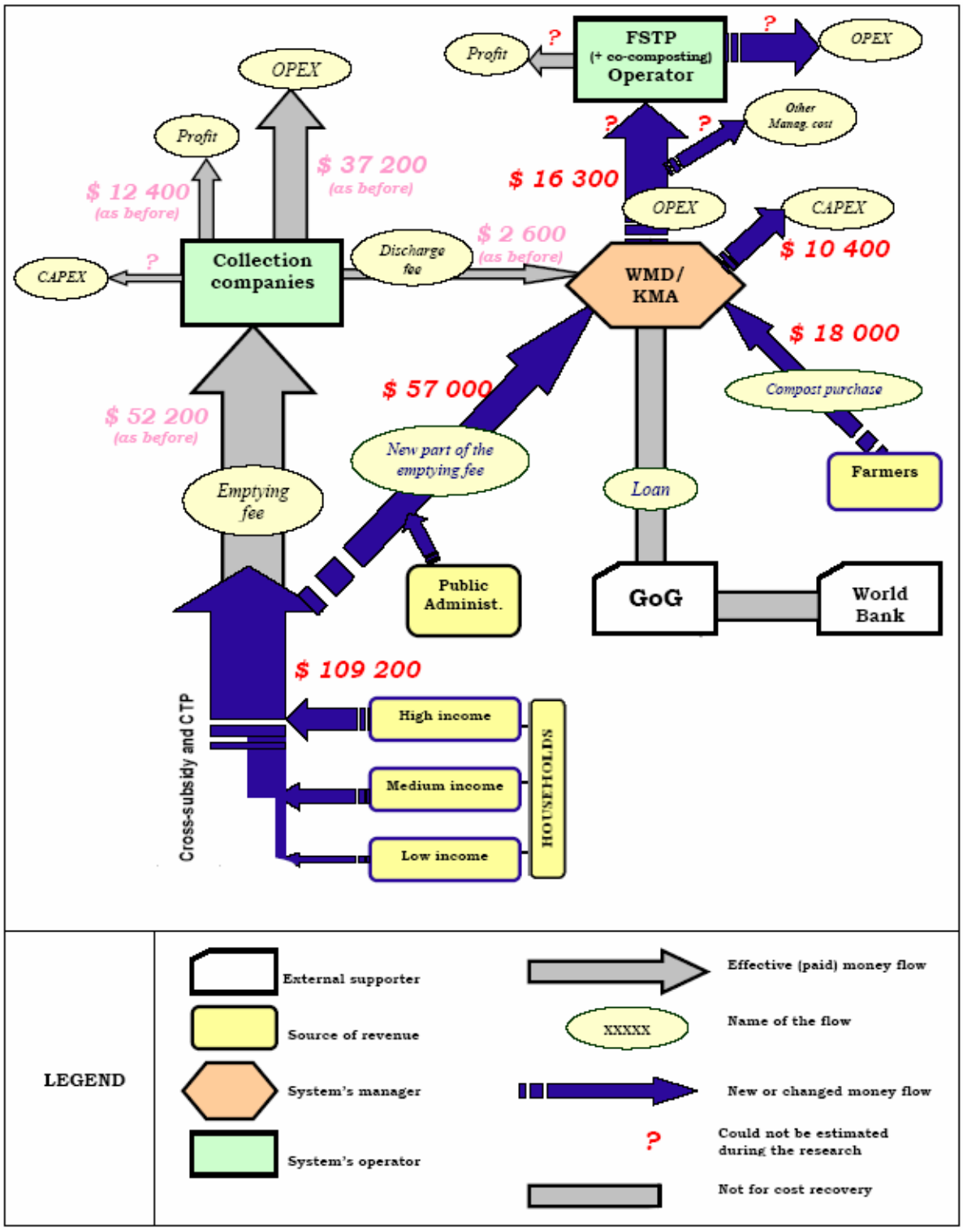


Figure 6-8: Financial flow for ISFSM in Kumasi (in US$ per month) based on estimated values.

6-4 Cost recovery level under the new financial mechanism

The estimated monthly revenue streams of the new proposed FSM system Figure 6-4 are US$ 109,200 (A) from households and US$ 18,000 (D) from farmers. The new costs of the FSTP are increased by US$ 6,300 (C_1) for the OPEX and increased by US$ 7,200 (C_2) for the CAPEX.

In the new proposed mechanism, the extra revenues of the FS system are allocated to the System Manager (KMA) which has most difficulty for the system cost recovery. The profit for collection companies will remain the same. The cost recovery level presented in Table 6-5 is calculated on this basis.

Table 6-5: Cost recovery level of the new proposed FSM system

Systems	Net Revenue	CAPEX	OPEX	**O&M cost recovery**	**Financial cost recovery**
Collection companies (Cluster 2) -*unchanged*	$49,600	?	$37,200	**133%**	**133%**
System manager: WMD/KMA (Cluster 3)	$77,600	$10,400	$16,300	**476%**	**291%**
FSM system (Clusters 2+3)	$127,200	$10,400	$65,900	**193%**	**167%**

The cost recovery of the system is very high (193% for the O&M cost recovery and 167% for the financial cost recovery). It implies that a cost recovery of greater than 100% can also be achieved at a collection tariff set lower than the CTP. The sensitivity analysis in the next section shows at which rate the tariff can be set for a reasonable (100%) cost recovery.

6-5 Sensitivity analysis of the financial model

This analysis looks at the effect of the various sources of revenue (from households and from compost sale) on the financial cost recovery of the system.

Figure 6-9 shows the evolution of the financial CR for different households CTP values and for different situations of compost sale which are:

- D0 where no compost is sold;
- D25 where 25% of the compost is sold;
- D50 where 50% is sold;
- D75 where 75% is sold; and
- D100 where all the compost is sold.

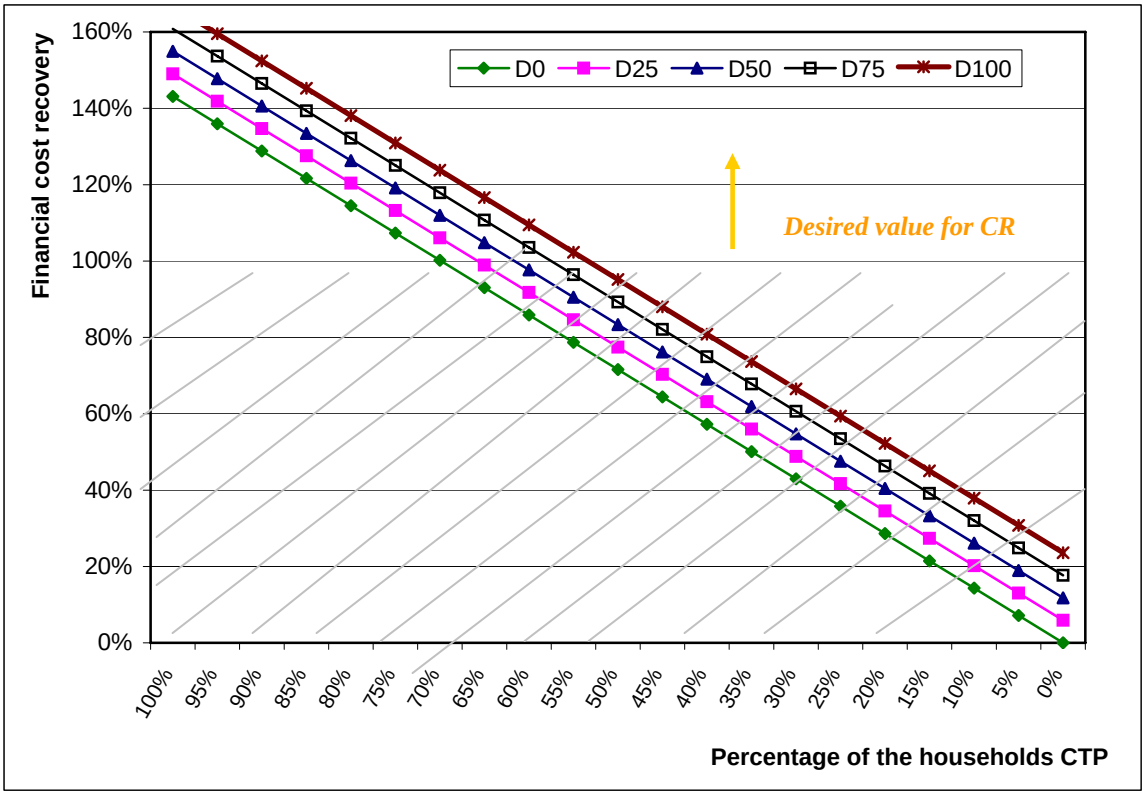


Figure 6-9: Sensitivity of the FS system financial cost recovery in dependent of D (the fraction of compost sold) (see detailed figures in Annex-4)

Figure 6-9 shows that in the worst case scenario situation where no compost is sold (D0 curve), 70% of the CTP will be needed to have 100% financial recovery of the system; while at the 100% compost sale (D100 curve), only 55% of the CTP will be needed.

The impact of compost sale on financial CR is that: (i) at a certain value of the CTP-based fee, the decrease in compost sale from 100% (D100) to 0% (D0), results in the decrease of the CR of 24% ; and (ii) for a fixed cost recovery rate, this variation of compost sale will require an increase of the CTP-based fee to 15% of the CTP. This shows that the CR is more sensitive towards CTP than compost sale.

6-6 Weaknesses of the methodology

6-6-1 Limitations of the CTP approach

- The assumption of 0.5% of household income (made in Section 5-2-2-1) that households can spend on FS collection service is my own assumption. The assumption can be a source of discussion or even controversy since it has no strong basis. A change in this assumption will change the calculated future revenue from households.
- The main limitation of the CTP approach is the right identification of households. The average CTP-based fee can only be applied to a residential area which is characterized by the living standards. Households living in the same areas do not necessary have the same level of income. Therefore a rich household living in “low income area” might be

paying much less than its CTP, and a poor household living in "high income area" may be paying higher than its CTP.

As an example the data statistical processing in Table 9-5 (Annex A3-1), show that Angola residential area which is considered a "low income area" (based on the classification in Table 9-12, AnnexA3-2), has higher average monthly household income than many residential areas in "high and medium income areas".

- The new financial model rests on two components: the CTP-approach together with cross-subsidy for the FS collection tariff (CTP-based fee) and the WTP approach for the compost tariff (WTP-based fee).

  The CTP approach used to address the financial issue is an appropriate tool and can help to set a better tariff for the FS service provision in a theoretical view.

  But in practice, the issue is how to convert the theoretical CTP-based fee into the practical emptying fee (paid after the service provision), which is strongly dependent on the number of years between emptying events which is a function of the toilet pit volume. The approach could be easier if households empty their pits at the same frequency.

- The other issue is the effectiveness of the collection of CTP-based fee, mainly in poor areas, where households earn and expend their money on daily basis. They may not be able to pay a whole monthly fee in one go. A micro-finance system (where households are organized to collect a daily fee that can reach the CTP-based fee at the end of the month) might be an adequate solution.

6-6-1-1 Proposed voucher system for revenue allocation to the FS system manager

The issue of how to transfer the extra money B (difference of the CTP-based fee to the current expenditure) from households to the FSTP can be problem. This problem is due to the fact that households do not benefit directly from the services of the FSTP. They have thus no contact with the FSTP operator and can only pay for the service via the collection companies (FS discharge fee). And this way might not be efficient or even cause illegal dumping if the discharge fee to be paid at the FSTP is very high. And that will be the case for B value collection.

Therefore, I propose the following system to solve the problem:

"Households buy a voucher from KMA and give this voucher to the collection company together with the normal fee for the emptying service. The collection company hands in the voucher at the FSTP before the collected FS is discharged at the FTSP."

This will also help for the system's information management (e.g. quantity and origin of the waste) for better planning.

6-6-1-2 Stakeholder views regarding the voucher issue

I asked households and the WMD Director about their views on the voucher issue. As presented in Table 6-6, 53% of households agreed. But the WMD Director did not. He

argued that it can be costly to implement such a mechanism. And he was confident that collection companies would pay to KMA the part of its money collected from households, however high it is.

Table 6-6: Households' view on paying a part of their emptying fee to KMA through a purchase of a voucher

Income areas	No. of respondents	Perception		
		Agree	Neutral	Disagree
Low income areas	7	71%	0%	29%
Middle income areas	5	80%	0%	20%
High income areas	5	0%	20%	80%
Total / Average	**17***	**53%**	**6%**	**41%**

**Three households in my sample of 20 used public toilets and have therefore no experience in dealing with the emptying fee. They were not able to give an answer to this question.*

As shown in Table 6-6, 80% of households in high income areas were against this voucher issue because they think that it is too complicated for just toilet emptying. People from the low income areas were generally in favour of this proposal.

6-6-1-3 Stakeholder views regarding the cross-subsidy

The other point of which the stakeholders' views have been taken is about the cross-subsidy. The issue was if the respondent accepts the fact that the FS collection tariff will be different from residential area to area, where people in poor areas will pay less than those in rich areas. And the question asked to households, collection companies and the WMD Director is:

"*Do you agree if the faecal sludge collection tariff is different from residential area to area in the city, where rich people are paying more than poor people?"*

Only 41% of the households accepted the principle. As shown in Table 6-7, surprisingly the poor people do not accept the difference in tariff. The results of the households' perception on the cross-subsidy is in fact not conclusive.

Table 6-7: Households perception on the cross-subsidy proposal

Income areas	No. of respondents	Perception		
		Agree	Neutral	Disagree
Low income areas	7	14%	0%	86%
Middle income areas	5	60%	0%	40%
High income areas	5	60%	0%	40%
Total / Average	**17**	**41%**	**0%**	**59%**

Amongst the collection companies interviewed two out of the five interviewed do not accept this mechanism because they think that it may affect their revenue since most of the rich areas do not empty their pits regularly.

The WMD Director accepted the principle and pointed out that the WMD has started implementing it for solid waste collection in some residential areas in Kumasi (pilot phase), where high income areas are paying higher fee for garbage collection.

6-6-2 Weaknesses in connection with composting aspect

- The additional (co-composting) cost estimation for the FSTP did not consider the transport cost of the compost to the farmers. In fact it might be costly and time consuming for the farmers to go the treatment plant to buy the compost. They will be more motivated if the compost is transported to them.
- The economy of scale principle is applied in a simplified way (see Section 6-3-3-2) to determine the cost of the composting plant.

6-6-3 Other identified weaknesses

- The coverage rate of 34% (estimated in Section 4-2-5) used for the revenue estimation is highly dependent on the specific FS production of 1 l/ca/day for septic tank sludge and 0.2 l/ca/day for heavy sludge[41] from Heinss *et al.* (1998).
- The issues related to the households in this thesis are based on the limited sample of only 20 households which is not representative for the whole city.
- Data updating (1996's data for 2004) for the households income calculation is based on several assumptions explained in Annex A3-1 and this may not be accurate.

[41] Heavy sludge is the sludge which comes from toilets where there is no water use.

7 CONCLUSION AND RECOMMENDATIONS

7-1 Conclusion

From the literature review, the FSM problems faced by our Africans cities have been described as well as the appropriate technologies to face them. The importance of the treated FS reuse in agriculture has also been showed. And finally the old proposed (by previous study) financial arrangements for FSM in Kumasi have been summarized.

The main findings of my research are:

- **About the research question RQ 1 (***How is faecal sludge managed in Kumasi?***):**
  - In total 86% of the Kumasi's population are producing faecal sludge in on-site sanitation facilities (namely aqua privies -public toilets-, water closets - flush toilets - connected to a septic tank, KVIP and bucket latrines) and are thus dependent on faecal sludge collection service. The remaining 10% and 4% depend on a small-scale sewage system and bush respectively.
  - Amongst the various toilets facilities used, only the KVIP which serves 8% of the population, can be considered as a dry sanitation system (even though it is not a urine diversion toilet). But the misuse of this type of toilet (too much water use) makes it also dependent on the FS collection service.
  - 22 collection companies are currently competing to provide the FS collection service to the whole city (17 private companies and 5 publicly owned companies).
  - 75% of the 20 households which I interviewed are satisfied by the collection service they received.
  - I estimated that about 34% of the monthly FS produced in the city is collected and discharged at Dompoase FS treatment plant, a new faecal sludge treatment plant (FSTP) which became operational in January 2004; about 12% of the produced FS goes to the sewage system; and the remaining 54% is still stored underground or in the bush and is considered as environmental FS load, estimated as 12,400 m^3 per month. Since my analysis covered only one year, but the average pit emptying interval is 4 years, my analysis is not evaluating the system at a steady state.
  - The average monthly FS collected from the city is about 6,300 m^3/month.
  - There is no longer illegal dumping in the city since 2001.
  - The technical performance of the FSTP is still questionable since the quality of effluent discharged in the river is not acceptable, based on my visual observation.
  - There is no treated faecal sludge reuse scheme in the city. Poultry manure is the fertilizer of choice in Kumasi since it available for free.

- **About the research question RQ 2 (***What are the institutional situation and the interactions of the keys stakeholders in FSM?***):**
  - The stakeholders currently involved in FSM are the Government of Ghana, the World bank, the Environmental Protection Agency (EPA), Kumasi Metropolitan Assembly (KMA), the Waste management department (WMD), the private operators and the households.
  - There is good private sector involvement at all levels of the FS service provision: the collection service is liberalized and the treatment plant management is under a management contract.

- Private operators are operating in favourable (internal and external) institutional environment and have better operational efficiency characterized by the number of staff per monthly households served which range from 0.10 to 0.21 compared to 0.50 for the WMD collection service (one of the five publicly owned companies).
- There is a good initiative of decentralizing the FSM system management from the local government (KMA). But the autonomy of the decentralized department (WMD) is too limited resulting in no relevant accountability by lack of clear performance targets.
- There is currently no accountability mechanism to the services beneficiaries (households) and means they have little appreciation of the importance of the service (pit emptying) they receive. The accountability mechanism is rather focused on the donors.
- The accumulation of roles by the local government (KMA) makes it difficult to fulfill the regulatory role. As a consequence the environmental regulator EPA cannot fully play its regulatory role.

- **About the research question RQ 3 (***What is the current financial situation in FSM?***):**

- For the financial analysis for FSM, I made an assumption that a household can spend 0.5% of his or her income in the emptying service. Based on the assumption made for the capacity to pay, I found that low income areas are currently spending 3.5 times their CTP while high income areas are paying 3.5 times less.
- Only medium income areas have exceeded the WHO's recommended standard of 5% of household income that a household can spend on water and sanitation services, due to their higher expenditure of 4.2% on water services alone.
- 65% of the households interviewed think that their expenditure on the emptying service is high, while 5% think it is low.
- The four FS collection companies are making good profit and their net profit margin range from 11% to 28%.
- The current revenue of the whole FSM system is currently about US$ 52,200 per month which comes from households.
- Of this monthly revenue, only US$ 2,600 goes to the FSTP (as discharge fee from collection companies) and the remaining US$ 49,600 covers the operating costs and the profit of the collection companies.
- The current financial cost recovery of the whole FSM system is 83% while the financial cost recovery of the FSTP is 20%, meaning that the FSTP is currently subsidized at 80%. Financial cost recovery was defined as the coverage rate of the financial costs which represent the operating and capital cost.

- **About the research question RQ 4 (***Can the faecal sludge management for the city be made integrated and sustainable?***):**

- Using the CTP and cross-subsidy approaches I found that there is a potential revenue of US$ 109,200 per month that can come from households, and this represents only 34% of the total money that can be expected from the households if the total (collectable) FS produced in the city are collected by the collection companies.
- From the WTP approach I show that the tariff of one 50 kg bag of compost can be set at US$1.4 to sell all the compost produced from the current amount of FS collected. And

the potential revenue from compost sale will be about US$ 18,000 per month, which is a new revenue for the FSM system.

- I estimated the cost of the co-composting plant to be associated to the current FSTP at US$ 6,300 per month for the OPEX and 7,200 per month for the CAPEX.
- The financial cost recovery is estimated at 167% for the whole FSM system and 291% for the FSTP in the new situation (a co-composting plant installation is built for compost production for reuse is agriculture).
- A sensitivity analysis was performed for two parameters. The results were that only 55% to 70% of the households CTP is needed to achieve the reasonable cost recovery of 100%. And this corresponds to the variation of the compost sale from 0% to 100% sale, which shows that that the FS system cost recovery is more sensitive towards revenue from households that compost sale.

Based on these results I can answer that: *"the FSM can be made integrated and sustainable if the proposed CTP and WTP approaches are incorporated in the system"* .

- **About the hypothesis (***"The existing financial mechanism and interactions of the stakeholders in faecal sludge management in Kumasi do not allow an Integrated and Sustainable Faecal Sludge Management (ISFSM) for the city"***):**

From the above points and based on the ISFSM principle, the following conclusions can be drawn:

- The current FSM is not *efficient* since the system is not cost recovered.
- The current FSM is not *equitable* since poor households are paying relatively more than rich people as regards to their income level.
- The current FSM service does not meet the *ecological integrity* (the loop is not closed) since there is no treated FS reuse in agriculture and therefore the nutrients are not returned back to the agriculture.
- The current FSM does not allow the *public participation* since there is no accountability to the households and households are not clearly involved or informed in the FSM issues.
- The current FSM does not allow the *interaction* with other urban service like solid waste association for co-composting (composting of faecal sludge and organic solid waste together to enhance the quality of the compost).

Therefore the existing financial mechanism and stakeholders interactions in FSM in Kumasi does not allow an Integrated and Sustainable Faecal Sludge Management for the city. Ecosan principles are not met with the current FSM system.

Hypothesis testing: The research hypothesis is then **true**.

Unfortunately the results of the research are not yet ready to be used directly by sanitation planners in Kumasi because of some limitation and weaknesses of the methodology mostly regarding the effectiveness of the CTP approach and the co-composting plant cost estimation.

The CTP and WTP approaches can be taken as a new tool for decision makers to overcome sanitation problems in a sustainable manner. Sanitation system planning must not only

focus on technologies but also on the stakeholders' capability to manage and households' capacity to pay for it.

The CTP-approach can address financial issues, but accompanying institutional arrangements must be found for its effective implementation, as well as good incentives or motivation for all stakeholders to play their financial role.

The reuse of the treated FS in agriculture must be taken as the essential element for decision making in waste management in West Africa, where food security needs to be assured through agricultural soil recovery.

The proposed new financial mechanisms would aid the FSM process to become part of an ecosan approach because financial sustainability would be achieved and treated FS would be returned to agriculture.

7-2 Recommendations

As recommendations I proposed the following points that could be covered by future studies, based on the weaknesses underlined in Section 6-6:

Future studies should:

- identify all the farmers willing to pay the compost and estimate the transport cost to their farms;
- perform a detailed design and cost estimate of the full-scale co-composting plant;
- repeat again the points covered in this research regarding households with a higher sample;
- determine the actual income level of each residential area of the city for better planning;
- investigate how the proposed voucher system (see section 6-6-1-1) could be made into an implementable system.

The Government of Ghana and the local government of Kumasi (KMA) could use these outcomes to go forwards in their way of better faecal sludge management in West Africa to reach an integrated and sustainable system.

The analysis was preformed using Kumasi as a case study, but the same methodology is applicable to address FSM problems in other West African cities.

8 REFERENCES

ADB (2005) *Water Action: Asia Credible Regulatory Bodies- Managing Water Interests*. [Online] http://www.adb.org/water/actions/REG/regulatory-bodies.asp [Access date: September 16th, 2005]

Allotey, J. A. (2004) Waste Management in Ghana: Future challenges for the EPA. Editorial. GHANA EPA, Accra, Ghana, 0.

Cofie, O. (2003) *Co-composting of Faecal Sludge and Solid Waste for Urban and Peri-urban Agriculture in Kumasi. Pilot project implemented by IWMI in collaboration with SANDEC, KMA and KNUST. Final report.*, IWMI, Kumasi, Ghana.

CREPA (2004) CREPAs network forum on Community Sanitation, Hygiene and Water for Poverty Alleviation. Ouagadougou, Burkina Faso.

Danso, G., Drechsel, P., and Gyiele, L. (2003) Urban household perception of urine-excreta and solid waste source separation in urban areas in Ghana. *Proceedings of the 2nd international symposium on ecological sanitation, incorporating the 1st IWA specialist group conference on sustainable sanitation.*, Lübeck, Germany, 7th- 11th April 2003.

Drechsel, P., Cofie, O., Fink, M., Danso, G., Zakari, F. M., and Vasquez, R. (2004) *Closing the rural-urban nutrient cycle. Options for municipal waste composting in Ghana. Final Scientific Report on IDRC project 100376.* IWMI-West Africa, Accra, Ghana.

Esrey, S. A. (2001) Ecosan - The Big Picture. 1st International Conference on Ecological Sanitation, Nanning, China.

Esrey, S. A., Andersson, I., Hillers, A., and Sawyer, R. (2001) *Closing the loop - Ecological sanitation for food security*, Swedish International Development Cooperation, Mexico, 1st edition.

Frantzen, A. (1997) *Public-private partnerships as a solution to the improvement of public toilet facilities, the case of Kumasi.* Catholic University of Nijmegen. [Online] http://www.hilbrands.nl/ankie/scriptie/contents.htm [Access date: september 20th, 2005]

GLSS4 (2000) *Ghana Living Standards Survey report of fourth round*. Ghana Statistical Service, Kumasi.

GoG/MoLGRD (1996) *IN: Korboe D., Kofi D. and Devas N. (2002) Urban Governance, Partnership and Poverty. Working paper 10*. International Development Department School of Public Policy, The University of Birmingham, Birmingham, UK.

Heinss, U., Larmie, S. A., and Strauss, M. (1998) *Solids Separation and Pond Systems. For the treatment of Faecal Sludges in the Tropics. Lessons Learnt and Recommendations for Preliminary Design.* SANDEC.

IWMI, and SANDEC (2002) *Co-composting of Faecal Sludge and Solid Waste. Preliminary Recommendations on Design and Operation of Co-composting Plants based on the Kumasi Pilot Investigation*. Kumasi, Ghana.

Kaelin, D. (2005) Short financial assessment of cesspit emptying companies in Kumasi (Ghana). EAWAG/SANDEC, Duebendorf, Swizerlands.

Klingel, F., Montangero, A., Koné, D., and Strauss, M. (2002) Fecal Sludge Management in Developing Countries. A planning manual. EAWAG/SANDEC, Duebendorf, Switzerland.

Klundert, A. v. d., and Anschutz, J. (1999) Integrated Sustainable Waste Management: the selection of appropriate technologies and the design of sustainable systems is not (only) a technical issue. Inter-Regional Workshop on Technologies for Sustainable Waste Management, held 13-15 July 1999, Alexandria, Egypt.

Klundert, A. v. d., and Anschütz, J. (2001) Integrated Sustainable Waste Management - The Concept. WASTE, Gouda, The Netherlands.
Klutsé, A., and Ahlgren, K. (2005) Inter-disciplinary research on Ecological Sanitation in seven west African countries. 3rd International Conference on Ecological Sanitation, Durban, South Africa, 71.
Korboe, D., Kofi, D., and Devas, N. (2002) Urban Governance, Partnership and Poverty. Working paper 10. International Development Department School of Public Policy, The University of Birmingham, Birmingham, UK.
Mensah, A. (2005) Action plan for the improvement of waste management in Kumasi Metropolis. Waste Management Department, Kumasi.
Moser, D. (2004) Determination of Maturity and Stability in Co-Compost of Faecal Sludge and Municipial Organic Waste in Kumasi., KNUST, Kumasi, Ghana.
Saywell, D., and Hunt, C. (1999) Sanitation Programmes Revisited. London School of Hygiene & Tropical Medicine,
WEDC, Loughborough University, Loughborough, UK.
Schmitt, W. (2003) Welcoming address. Proceedings of 2nd International symposium on ecological sanitation, Lubeck, Germany, 3.
Schouten, M. (2005) Financial Management. UNESCO-IHE. [Online] [Access date:
Steiner, M., Montangero, A., Koné, D., and Strauss, M. (2002) Economic Aspects of Low-cost Faecal Sludge Management. Estimation of Collection, Haulage, Treatment and Disposal /Reuse Cost., Duebendorf, Switzerland.
Steiner, M., Montangero, A., Koné, D., and Strauss, M. (2003) Towards More Sustainable Faecal Sludge Management Through Innovative Financing. EAWAG/SANDEC, Duebendorf, Switzerland.
Strauss, M., Barreiro, W. C., Steiner, M., Mensah, A., Jeuland, M., Bolomey, S., Montangero, A., and Koné, D. (2004) Urban excreta management - Situation, challenges, and promising solutions., Duebendorf, Switzerland,
Strauss, M., and Koné, D. (2005) Faecal Sludge Management (FSM). SANDEC News No.6, Dubenhdorf, Switzerland.
Tynan, N., and Kingdom, B. (2002) Effective water service provision: performance targets for a well-run utility. Water Supply and Sanitation Sector. The World Bank, Wachington.
UNDP (2005) About the Goals. [Online] http://www.unmilleniumproject.org/goals/goals02.htm#goal [Access date: August 15th, 2005]
UNDP (2005) Ecological sanitation. [Online] http://www.undp.org/water/ecol.html [Access date: August 15th, 2005]
Wiftintn, D., Uria, D. T., Wright, A. M., Cioe, K., Hugha, J., and Swarma, V. (1992) Household demand for improved sanitation services: a case study of Kumasi, Ghana. The World Bank, Washington, DC, USA.
Winblad, U., and Simpson-Hébert, M. (2004) Ecological sanitation - revised and enlarged edition, Stockolm Environment Institute, Stockolm, Sweden,
Zaag, P. v. d., and Savenije, H. H. G. (2004) Principles of Integrated Water Resources Management, UNESCO-IHE, Delft, The Netherlands,

9 ANNEXES

Annex-1 Information for the methodology (chapter 3)

A1-1 Overview of the fieldwork

A1-1-1 Role of IWMI - Accra for fieldwork preparation

The representation of IWMI for West Africa located in Accra in Ghana, accepted my internship for the fieldwork of my research. I was made very welcome by the director of IWMI-West Africa, Dr Pay and his staff with whom I had long discussion on the way to carry out my thesis.

They have given me orientation and relevant persons I need to contact for my fieldwork. They helped me to adapt my methodology to the realities of Ghana. During the first weeks of my research, discussions have been done through group e-mails to get me involved in the topic of my research. They provided me with logistical support for my work such as office and internet, and driving me to the hotel whenever needed.

Contact of IWMI-Accra staff involved in my coaching:

- Dr Pay Drechsel: p.drechsel@cgiar.org
- Dr Liqa Raschid l.raschid@cgiar.org
- Dr Cofie Olufunke o.cofie@cgiar.org

Figure 9-1: Dr Pay and his staff confident to solve the waste management problems in West Africa (on the right: the author).

A1-1-2 Work at IWMI office of Kumasi

The fieldwork was carried out at IWMI office at Kumasi, where I was also welcome by the head of the office, Mr Ben, who gave also relevant directions for my work and arranged when necessary the meeting with keys stakeholders for me. He gave me office space and assisted me for any request I undertook. He gave also an official letter that I used to introduce myself to any institution I met. He arranged for financial assistance for me from IWMI central office at the time of my interviews. He found an interpreter (in twi) for me and paid him. I was also paid for the expenditures (mostly taxi fee) I had during the interviews.
I had also some helpful discussion with other staff at IWMI office of Kumasi. Particularly Mr Noah Adamtey who is carrying out his PhD on (and managing) the Buobai pilot plant, showed me the plant and introduced me to the Director of the WMD. With his help this first meeting was successful and I was given an office at WMD that I have also used during the fieldwork.

Contact of IWMI-Kumasi staff I had discussions with:

- Keraita Bernard b.keraita@cgiar.org
- Noah Adamtey n.adamtey@cgiar.org
- Richard Kuffor

A1-1-3 Work at WMD

Because of the difficulty to have discussion with WMD staff at pre-set date (change in initial information, time and availability of people, identification of key informant staff), I chose to work in the office given for me by the WMD director. I stayed in the same office with Mr Charles Woahene whom I used for my key informant interview. He is the Head of the Support Service taking care of the FS collection companies contract management. He is the person who has all the information about the companies (e.g. which is the largest); and knows about all the residential areas in the cities and the households living condition. He helped to choose the collection companies for interview and gave me directions for my households interviews.
The other key informants I worked with are Mr Don Wantungo who is the WMD Officer monitoring Dompoase treatment plant, Mr N. A. Frimpong who is responsible for the FS collection from households.
My open discussion (covering the point in Section A1-2-1) with Mr Anthony Mensah, the director of WMD was carried out several times according to his availability.

Contact of WMD staff I had discussions with:

- Anthony Mensah, Director mensahanthony@hotmail.com
- Charles Woahene charles65woahene@yahoo.com
- Don Wantungo donwantungo@yahoo.co.uk
- N.A Frimpong
- Morrison Nyarko

Figure 9-2: Mr Don Wantungo explaining the FS treatment process at Dompoase FSTP (Author: Anselme Vodounhessi)

A1-1-4 Others persons with whom I had discussions:

- **Statistical service of Kumasi**
  - Steve Amoah: He helped to process statistical data on Kumasi on the population and income level. *Tel: (+233) 277401759*

- **Planning Department of Kwame N'Krumah University of Science and Technologies**
  - Dr Ronald Ademtey: He helped me to find 1996's data on Kumasi income level. *Tel: (+233) 244465892*
  - Prof S.E. Owusu: He told me if I wanted some data on income level for Kumasi city over tha 1996's data , I should undertake myself new survey.
  - Dr Rudith King: General discussion on studies carried out on Kumasi population.

  I also discussed with Dr Esi from the Environmental Departement, responsible for an UNESCO-IHE project in KNUST.

- **Metro-Planning Unit of KMA**
  - Bukari Dahamani: I had with him discussion about the population figures and he gave me the new repartition of the 2004 population for the city presented in

A1-2 Open discussion data collection

A1-2-1 Open discussion with the WDM about the FS system management

- **Process**

  Several times meeting in the Office of the Director according to his availability. Five times of about 30 min discussion.

- **Dicussion points (see next pages)**

A1-2-2 Open discussion with EPA, the regulator

- **Interviewee:** **Director of EPA Kumasi**
- **Name:** **Mrs Philomena Apprah Boakyes**
- **Process:** Only one time meeting for about 1h 30
- **Discussion points (see next pages)**

The Waste management Department (WMD)

Core department of Kumasi Metropolitan Assembly (KMA) in Waste management.

Discussion points

Assigned roles and functions ?

WMD external environment?

1. Degree of autonomy : Financial Management/autonomy and decision making?
2. Performance targets: Is there any performance target for the completion of the mentioned functions (eg: quantity of solid waste to be removed per month for f6, or quality requirement of the disposed waste in f7)?
3. Role of the WMD in public toilet service provision? Is there any relationship with the city councils?
4. Accountability mechanism: What WMD is accountable for to KMA? Who else WMD is accountable to?
5. Is there any direct involvement of MOFA (Ministry Of Food and Agriculture) and in waste management?
6. Private providers orientation for environment sustainability: what strategy is developed to avoid illegal dumping? How do you ensure that there is no illegal dumping? Training programmes for better services provision?
7. Key external support: Do you have any direct support from any institution?

WMD internal environment?

8. Discussion on the organization chart, …
9. Decentralization of responsibility: Is each head of service autonom in decision making related to their activities? Is there any performance targets set for them?
10. Internal accountability: What is the accountability mechanism?

11. Market orientation:
    - Level of cost recorvey : Revenue collection sources ?
        - % from dicharge fee from collection companies
        - % local taxes
        - % from GoG budget
        - why do some public collection companies not pay the discharge fee (Police, Prison, …) ?
    - Staff Capacity building?
    - Services beneficiaries orientations: Is there any strategy for equity (special arrangement for the poor in the tariffs), public participation, public awareness or any accountability to the beneficiaries of the services?

Views about probable future scenarios?

12. What is the KMA's view about the pilot co-composting plant: willingness of KMA to apply the research outcomes?
13. KMA's view about limiting the entry of private collection companies:
    - Attribute areas to capable companies?
    - Set benchmarking system for better competition?
14. KMA's view about using the standard percentage of HH income set WHO (capacity to pay) to determine the sanitation services tariffs, instead of focusing on the willingness to pay? Will the KMA be able to enforce the community to pay what they have to pay for the system cost recovery?
15. What about integrating fully MOFA in the waste management, as direct stakeholder, to find better strategy for effecive co-composting and compost re-use in agriculture?
16. Can KMA enforce the companies who are not paying for the discharge to pay it?

Others questions

17. Reasons for giving up the Buobai FSTP ?
18. Reasons for building Dompoase FSTP?
19. What is the way forward the improvement of the quality of effluent from Dompoase plant?
20. What is planning to do next at the Buobai FSTP (currently full)?
21. Existing of waste management information system at WMD: which data are recorded? Planning system (data used for the planning)?
22. Is it possible to implement the scaling up of Buobai pilot plant at Dompoase with the existing system where there is no drying bed?
23. What are the main reasons for the difference between the design and realistic capacities of Buobai pilot plant? Which ratio (raw solid waste/ raw FS/mature compost) must be considered for the up scaled plant? What is the density of the solid waste?
24. How can the extra capital and running cost for the up scaled plant (completing the exiting plant at Dompoase up to the co-composting)? Can we estimate the running cost by a simple multiplication of the per ton running cost of the pilot project with the quantity of waste handle at the plant?
25. What is the cost structure? Is there any marginal cost: incremental cost of a single ton of compost?

The Regulator
Environment Protection Agency (EPA)

Discussion points

Effectiveness of the regulation

1. Clarity of roles and objectives: What are the roles and objectives of EPA in waste management in Kumasi? Do EPA have a clear mandate to accomplish them? What are the stakeholders and government agencies involved in EPA roles, and what are the regulatory processes (procedures followed by EPA to carry out rules and responsibilities) ? What are the problems encountered with the stakeholders?
2. Autonomy / credibility: Are you free from political or local authorities influence while accomplishing the assigned tasks?
3. Participation: Do you involve or consult the keys stakeholders in yours activities?
4. Transparency: Do you have clear rules and guidelines that you follow for your decision making? Do you explain how and why decisions are made to all stakeholders?
5. Accountability: Are your decisions writing and accessible?
6. Predictability: What is the degree of confidence the rules made, assuring that there will not be a sudden change putting the serviceability at risk?
7. Capability: Is the regulation body well staffed by competent and well trained professionals who receive continuous training in waste management issues?

Powers of the regulation

8. Standards setting: Do you have a power for standards setting for environmental conditions and proper sanitation services provision for households by the multiple providers?
9. Information gathering: Do you have power and means to gather for the system or the operation performance monitoring?
10. Enforcement and sanctions: Do you have power to enforce and sanction by imposing fines and penalties for non-compliance?
11. Arbitration: How dispute among stakeholders are resolved? Do you have any power to settle dispute between households and operators and between operators and government or local authorities?

A1-3 Questionnaires-based data collection from FS collection companies

- **Name of private FS collection companies interviewed:**
  - **Afranie** **(Person interviewed: The Manager)**
  - **Albert Joseph** **(Person interviewed: The Manager)**
  - **Babdako** **(Person interviewed: The Manager)**
  - **Planet green** **(Person interviewed: The Manager)**

- **Publicly owned FS collection company interviewed:**
  - **KMA/WMD** **(Person interviewed: N.A Frimpong, Monitoring & Evaluation Officer in WMD)**

- **Manhole Manager**

  I also find by chance a manhole manager at Adoum and have a quick discussion with him. He didn't give me his name because his informal situation, but he accepted to give me all the information I needed.

- **Questionnaires used (see next pages)**

  There was a change in the financial data collection due to a change in my strategy to collect the data: the new elements used to collect financial data are:

  ⋆ *Income statement per trip*
  - Emptying fee charged per trip
  - Fuel cost: money given to the driver for fuel for the trip;
  - Shop money: money given to workers to eat before the service provision;
  - Oil cost for the trip;
  - Discharge fee for the trip.

  ⋆ *Monthly statement*
  - Number of trip per month;
  - Staff salary;
  - Maintenance cost;
  - Tax

  It means that the financial part of the questionnaires (section 2) has been changed.

- **Results (see Section A2-2)**

GENERAL INFORMATION

1. Company profile

Name: _____ Ownership: Public ☐ Private ☐ Year of creation _____

Owner/Manager: Same person ☐ Seperate person ☐ Shareholders: None ☐ Yes, Number _____

Education of the Manager: Never ☐ Primary school ☐ 2ndary school ☐ BSc ☐ MSc ☐ More ☐

Background of the Manager: Watsan ☐ Civil Enginering ☐ Accounting ☐ Other, specify _____

2. Operational performance

Number of trucks: Total _____ Operating _____ Inoperating _____ Age of the oldest _____

Daily no of trips _____ No of HH served/trip _____ Daily op. hours _____ Weekly op. days _____

Number of demand received/week _____ Duration for answer _____ Number of HH served/week _____

Type of toilets served WCs ☐ Public toilets ☐ Bucket latrines ☐ Trad pit latrines ☐ VIP latrines ☐ Others ☐

Where do you discharge your waste? Always at a TP ☐ Always illegal dumping ☐ Both practice ☐

Treatment(s) used? Buobai ☐ Dompoase ☐ Kaasi ☐ Other _____

What is the reason of the illegal dumping? Distance of the TP ☐ Dicharge fee ☐ Other _____

Quality of the services provided: (observation)

	Odour	Flies	Cleaness
Low	☐	☐	☐
Med	☐	☐	☐
High	☐	☐	☐

3. Internal organisation

Number of staff: Full time _____ Part time _____ Workload of part time staff: _____

Is each of the following task covered in the company, by who?

Operation Management

Tasks	No	if yes, by Who? Head Manager	Seperate Op.	Other/ specify
Planning/org of collections				
Spare part Management				
Assets maintenace				
Fourn./fuel procurment				

Which type of maintenace is done?

Breakdown ☐ Condition based ☐ Periodic ☐

Financial Management

Tasks	No	if yes, by Who? Head Manager	Seperate F. Manager	Other/ specify
Billing				
Collecton				
Tariff setting				
Staff payment				
Investment decision				

Human Resources Management

Who make hiring/firing staff decisions or bear HRM fonction?

Owner ☐ Manager ☐ HRM ☐ Other ☐

Is there any capacity building programme in the company?

Never ☐ Sometimes ☐ Often ☐

What do you do to encourage/motivate the (best) staff?

Nothing ☐ Fin. reward ☐ Compliment ☐ Other ☐

Do you think your employees are satisfied with the job?

None ☐ A part ☐ All ☐

Customer Management / Orientation

Who make the decision of service provision to a particularcustome

Owner ☐ Managemet ☐ Truck drivers ☐ Other ☐

Who make decision about customers complains?

Owner ☐ Managemet ☐ Truck drivers ☐ Other ☐

Number of customers' complains per week: _____

Number of complains answered per week: _____

At which rate your revenue is depended on customers?

100% ☐ Less ☐ → Other source _____

4. External environment

Have you ever received any incentives from the authorities to help you improve your activities?

Never ☐ Yes ☐ → Which? Benchmarking ☐ Compliment letter ☐ Company visit ☐ Other ☐

Do you participated in any capacity building programmes from the authorities Never ☐ Sometimes ☐ Often ☐

Have ever received external support from any institution? Never ☐ Authorities ☐ NGOs ☐ Other ☐

How does the community perceived your activities Bad and not accepted ☐ Bad but accepted ☐ Good & accepted ☐

How does the community accept the tariff change Easily ☐ With difficulty ☐ Have no choice ☐ Find alternatives ☐

FINANCIAL INFORMATION

1. Income statement

What have been your annual revenue for the last three years?	Year	2004	Year	2003	Year	2002
	Revenue		Revenue		Revenue	
What have been your annual cost for the last three years?	Year	2004	Year	2003	Year	2002
	Cost		Cost		Cost	
What have been your last three collection service tariff changes ?	Year		Year		Year	
	Tariff 1		Tariff 2		Tariff 3	
What have been the last 3 changes in the licence fee paid to the Authority?	Year		Year		Year	
	Lic. fee1		Lic. fee2		Lic. fee 3	
What have been the last 3 changes in the discharge fee paid to the FSTP?	Year		Year		Year	
	Dis. fee1		Dis. fee2		Dis. fee 3	

What do you use your benefit for? Newinvest. ☐ Storage ☐ Invest in other act. ☐ Pocket ☐ Other ☐

If there is any strategy from the Government which impacts on your benefit, at rate would accept the reduction to not give up the activity? 5% ☐ 10% ☐ 20% ☐ 30% ☐ 40% ☐ 50% ☐ No or less than 5% ☐ More than 50%, specify ☐

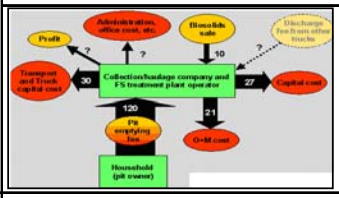
2. Financial performance

Percentage of service fees collected vs billed: ☐ Promptness of billing/collection (no of days after service): ☐

What have been your annual staff cost for the last three years?	Year	2004	Year	2003	Year	2002
	Cost		Cost		Cost	

3. Views about future or SANDEC's scenarios

Scenarios 1



Will you accept to manage a FS treatment plant in additional to the FS collection service provision?

Never ☐ Yes alone ☐ Jointly with other companies ☐ If shareholders exit for investment ☐

Which responsability (ies) will you accept for the FSTP contract arrangement?

Onwership of infrastructure ☐ Technical operation ☐ Managerial operation ☐ Capital investment ☐ Tariff collection ☐

What is your opinion about the current financial situation where you are paying a fee for the FS discharge at the treatment plant?	Good ☐ Neutral ☐ Bad ☐
What is your opinion about the discharge fee?	High ☐ Acceptable ☐ Low ☐
If you are asked to pay more without increasing the emptying fee, what will be your maximum? (Bidding game but from a max=200,000 to a min=20,000 cedis)	Price agreed ☐
What will be your opinion if you are asked to pay an annual or monthly licence fee to the authority for numberless discharge (or no discharge fee) at the treatment plant?	Agree ☐ Neutral ☐ Disagree ☐
What will be the maximum you will accept to pay with the current emptying fee? (Bidding game as % of its profit from a maximum of 30% to 5%)	Rate agreed ☐
What will be your opinion if you are asked to do your business in specific areas attributed to you by the authorities, with tariff and/discharge fee set by the authorities at a level which doesn't influence your current benefit?	Agree ☐ Neutral ☐ Disagree ☐
What will be your opinion if you are asked to provide proper service to the population of specific areas under a concession contract with the authorities, attributed after a bidding process?	Agree ☐ Neutral ☐ Disagree ☐
Will you mind if the tariff system is different from one area to another in the city?	Agree ☐ Neutral ☐ Disagree ☐

A1-4 Questionnaires-based data collection from households

The interviews have been carried out in local language (twi) and translated by an interpreter **Mr Michael.** The interviews took from 45 min to 1h 30min depended on how the respondent is interested to give more comments.

Figure 9-3: Interview in process in a household at Zongo suburb

- **Residential areas visited:**

  - High income areas: Bomso, Patase, Nhyiaso, Ridge and Asokwa.

  - Medium income areas: Amokrom, Kwadaso, Bantama, Ahinsen Estate and Buokrom estate

  - Low income area: Old Ayidja, West Ayidja, Adum, Zongo, Central market (2), Old tafo, Angola, and Santasi (2).

- **Questionnaires used (see next pages)**

- **Results (see Section A2-3)**

GENERAL INFORMATION

1. Household information

Interviewee identification

Sex: M ☐ F ☐ Age: ☐ Marital Status: *Single* ☐ *Maried* ☐ *Divorc.* ☐ *Widow* ☐

Education: *Never* ☐ *Primary school* ☐ *2ndary school* ☐ *BSc* ☐ *MSc* ☐ *More* ☐

Employment: *Employed* ☐ *Not Employed* ☐ Position in the HH: *Parent* ☐ *Child* ☐ *Other* ☐

Household identification

House type: *Apartment* ☐ *Pivate house* ☐ Ownership *Owner* ☐ *Renter* ☐ Size ☐ *persons*

No. pers. employed: ☐ Water access: *In-house tap* ☐ *Neighbor's tap* ☐ *Public tap* ☐ *Well* ☐ *Other source* ☐

No. HH in the house ☐

2. Sanitation facilities used

Which and how many sanitation facilities are you using in the household? How old are they?

Facilities	Number	Age (yrs)	No. pers. using	Full frequency	Current state (obs)	
					Clean	*Dirty*
WCs connected to sewer						
WCs connected to septic tank						
KVIP latrines						
Publics toilets						
Traditional pit latrines						
Bucket latrines						
Open defecation						

What are the main use problems?

Would you like to have another facilities?

No ☐ If yes, which one? ☐

3. Sanitation services received

Who provide the emptying service?

One same company ☐ *Many / any company* ☐ *Manuel emptyer* ☐ *Other* ☐

How do you contact the emptying service provider?

Going to their office ☐ *By telepone* ☐ *Via internet* ☐ *Other* ☐

How long it take to reveive their answer?

Immediatly ☐ *After 1 week* ☐ *After 1 month* ☐ *More* ☐

Is there any problem during the service provision?

No ☐ *Yes* ☐ *Which?* ☐

How much are you satisfied by the service provided?

Indifferent ☐ *Low* ☐ *Medium* ☐ *High* ☐

FINANCIAL INFORMATION

1. Household income statement

HH Revenue

Interview income

Total income of other HH members

Other revenue

HH expenditure Water & Sanitation Service

Services	Current monthly expenditures	Satisfaction **	**	*	Monthly WTP
Water					
Public toilet					
Pit Emptying					
Solide waste					
Wastewater					
Other WSS					

Taxes paid

Do you know something about taxes you are already paying?

No ☐ Yes ☐

If yes, how much you are paying? →

Amount paid:

Types	Amounts	Regularity Regular	Irregular
Housing tax			
Water tax			
Sanitation tax			
other tax			

2. Views about future scenarios

What is your opinion about what you are currently paying for the emptying service ? — High ☐ Acceptable ☐ Low ☐

What will be the maximum you would like to pay, if there is any strategy from the authority to increase the emptying fee? (Bidding game from a maximum to a minimum) — Price agreed

If there is any sanitation tax to better provide the faecal sludge management service to the population, would you like to pay? — Yes regularly ☐ Yes, but not ☐ No ☐

How much is the maximum you will easily accept to pay for this tax? — Price agreed

Do you mind for an arrangement in which, you are asked to buy a "green card" at a specific sanitation kiosk,as part of your emptying fee which will be given to the collection company in additional to the remaining fee for the service provision? — Agree ☐ Neutral ☐ Disagree ☐

Do you agree if the emptying fee is different from one area to another? — Agree ☐ Neutral ☐ Disagree ☐

3. Other points or observation during the interview

Annex-2 Survey data processing

A2-1 Dompoase FSTP data processing

From the 22 collection companies identified and which are presently discharging the FS at Dompoase FSTP, 4 are publicly owned and are not paying the discharge fee. They do not collect the waste from households, except KMA does. The Table 9-1, shows how much each company is discharging to Dompoase FSTP (this data was given to me by Mr Don Wantongo)

Table 9-1: Number of trucks trips discharged at Dompoase FSTP (Source: Dompoase FSTP worksheets - Discharge data from January to November 2005)

NUMBER OF TRIPS													
Num	COMPANY	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	AVERAGE
1	ALBERT JOE	25	19	31	31	17	35	26	59	22	27	23	***29***
2	PLANET G	66	43	66	20	33	58	61	80	101	57	61	***59***
3	BABDACO	409	360	329	313	388	357	376	450	386	385	301	***369***
4	AFRANIE	223	177	171	165	156	177	166	159	147	153	117	***165***
5	EUROPAL	91	72	92	81	111	122	121	123	106	111	88	***102***
6	DAN K	240	194	197	128	120	97	121	69	39	97	74	***125***
7	FREKO	54	46	65	54	57	57	52	68	66	53	55	***57***
8	OWNER	6	5	4	3	3	2	3	3	2	3	2	***3***
9	SAKM	28	0	0	0	0	20	20	19	23	17	14	***13***
10	POLICE*	45	34	36	47	36	46	49	42	26	40	33	***39***
11	SABTA	29	47	42	11	49	40	64	51	35	59	44	***43***
12	TELECOM*	6	8	21	8	14	4	7	5	6	0	12	***8***
13	KMA	20	29	24	27	10	27	19	43	18	27	21	***24***
14	NAFO	87	115	119	130	130	142	142	134	123	144	117	***126***
15	PRISONS*	9	10	0	15	35	38	40	37	37	21	38	***25***
16	ARMY*	8	1	0	11	4	3	9	6	14	11	13	***7***
17	SASS	16	35	48	80	29	0	0	0	0	0	54	***24***
18	SIC								22	0	0	0	***6***
19	FLOPORDIC									65	61	36	***54***
20	AIH.I										8	12	***10***
21	COHANA										61	93	***77***
22	ESGO											61	***61***
TOTAL TRIPS		1362	1195	1245	1124	1192	1225	1276	1370	1216	1335	1269	**1255**
TOTAL TRIPS PAID AT THE FSTP SITE		1280	1121	1185	1024	1107	1111	1159	1242	1121	1236	1164	1159
TOTAL UMPAID		82	74	60	100	85	114	117	128	95	99	105	96
TOTAL FROM HH COLLECTION		1294	1142	1188	1043	1103	1134	1171	1280	1133	1263	1173	1175
TOTAL PAID FROM HH COLLECTION		1274	1113	1164	1016	1093	1107	1152	1237	1115	1236	1152	1151
TOTAL FROM UTILITIES COLLECTION		68	53	57	81	89	91	105	90	83	72	96	80
TOTAL PAID FROM UTILITIES COLLECTION		6	8	21	8	14	4	7	5	6	0	12	8

**Police, Telecom, Prisons, and Army act as FS collection companies but do not collect the FS from households.*

Police, KMA, Prisons, and Army are not paying the discharge fee at the FSTP.

The 1255 trips of about 5 m^3 of FS each, give the total amount of *1255 x 5 =* ***6 275 m^3*** **of FS discharged monthly** at the plant.

A2-2-1 Net Profit Margin calculation: Adaptation of income statement calculation for FS collection companies in Kumasi

The net profit margin derives from the income statement which is a summary of operating performance over a period of time (e.g. a fiscal quarter or fiscal year).

- **Income statement calculation:**

The income statement is calculated for a fiscal year or quarter, and can also be for a month. The statement formal calculation is the following (Schouten, 2005).

Revenues
-Total costs

= Gross profit
- Operating expenses

= Operating income
+ Other income
- Interest expense

= Income before taxes
- Provision for income taxes

= Net income = Net profit

It can be simplified for the collection companies, as follows:

Revenues
- Total cost
- License fee
- Discharge fee
- Tax

= Net income = Net profit

For the informal manhole manager, it will be:

Revenues

- Emptying fee paid

- Staff salary

= Net income = Net profit

- **Net Profit Margin calculation:**

Net profit margin is the ratio of net income to sales. Indicates how much of each dollar of sales is left over after all expenses are paid (Schouten, 2005).

$$\text{Net profit margin} = \frac{\text{net profit}}{\text{sales}}$$

- **Adaptation of the income statement for FS collection companies in Kumasi**
  - The elements of the income statement used to collect data from the FS collection companies in Kumasi, were listed in Section A1-3.

The adapted income statement is then calculated as follows:

	Emptying fee charged per trip
-	Fuel cost
-	Oil cost
-	Shop money
-	Discharge fee
=	**Operating income per trip**
x	Number of trips per month
=	**Monthly Gross profit**
-	Salary
-	Maintenance cost
=	**Income before tax**
-	Tax
=	**Net profit**

(trip = truck load)

A2-2-2 Collection companies general data processing

GENERAL INFORMATION					
1. Company profile					
COMPANIES NAME	*PRIVATE 1*	*PRIVATE 2*	*PRIVATE 3*	*PRIVATE 4*	*KMA/WMD*
Ownership:	Private	Private	Private	Private	Public
Year of creation:	1999	1996	1988	1995	-
Owner/Manager:	Same pers	*Sep . Pers*	Sep. pers	Sep. pers	KMA/WMD
Shareholders:	None	None	None	None	
Education of the Manager:	Prim. Sch	2ndary Sch	Prim. Sch	2ndary sch	
Background of the Manager:	none	None	*none*	None	
2. Operational performance					
Number of operating trucks:	6	4	2	1	2
Age of the oldest (yr):	6	8	17	10	20
Daily numb of trips	14	10	4	4	2
Daily op. hours	8	8	8	10	8
Weekly op. days	6	6	6	6	7
No of HH served/trip	1	1	1	1	1
Number of HH demand answered	100%	100%	100%	100%	100%
Duration for answer	< 24 h	< 24 h	< 24 h	< 24 h	< 72 h
Type of emptying service provided	only mech.	only mech.	only mech.	only mech.	Man. & Mech.
Treatment plant(s) used?	Dompoase	Dompoase	Dompoase	Dompoase	Dompoase
Number of staff:	26	*16*	*6*	*6*	*12*
Number of staff per monthly HH served	0.07	0.10	0.21	0.10	0.50
3. Internal organisation					
Operation Management tasks					
Planning/org of collections	Manager	Manager	Manager	Manager	WMD Officer
Spare part Management	Sep. agent	Sep. agent	Manager	Manager	WMD workshop
Assets maintenace	Sep. agent	Outsourced	Manager	Outsourced	WMD workshop
Fourn./fuel procurment	Manager	Manager	Manager	Manager	WMD workshop
Type of maintenance done	Breakdown	Periodic	Breakdown	Breakdown	Periodic
Financial Management					
Billing & collection tasks	Manager	Manager	Manager	Manager	WMD Officer
Billing & collection coverage	100%	100%	100%	100%	100%
Tariff setting	Manager	Manager	Manager	Manager	KMA
Staff payment	Manager	Manager	Manager	Manager	KMA
Investment decision	Manager	Owner	Manager	Manager	KMA
Human Resources Management					
HRM fonction	Manager	Manager	Manager	Manager	KMA
Training programme within the company	none	Often	None	Sometimes	Sometimes
Staff motivation	Fin. Reward	Fin. Reward	Fin. Reward	Fin. Reward	None
Staff job satisfaction	All staff	All staff	All staff	All staff	All staff
Customer Management / Orientation					
Customers Managt function & decision	Manager	Manager	Manager	Manager	WMD Officer
Number of customers' complains/ month	1	2	1	2	16
Complains coverage	100%	100%	100%	100%	100%
Revenue depended on customers	100%	100%	100%	100%	< 100%
4. External environment					
Incentives from the authorities	Never	Comp visit	Never	Never	
Capacity building from the authorities	Sometimes	Sometimes	Sometimes	Sometimes	
External support from any institution	Never	Never	Never	Never	Not directly
Community perception on the activities	Good/accept	Bad/accept	Good/accept	Good/accept	Good/accept
Community reaction on tariff change	Easy	No choice	Easy	Not easy	Easy

A2-2-3 Collection companies financial data processing and views and perceptions

FINANCIAL INFORMATION

1. Financial Assessement (in cedis)

COMPANIES NAME	*PRIVATE 1*	*PRIVATE 2*	*PRIVATE 3*	*PRIVATE 4*	*KMA/WMD*
			Income Statement		
Emptying tariff	400,000	400,000	350,000	400,000	3/600000[1]
Fuel	100,000	80,000	100,000	75,000	
Shop money	100,000	90,000	70,000	150,000	100,000
Oil	20,000	20,000	10,000	10,000	
Discharge fee	20,000	20,000	20,000	20,000	
Operating income per trip	**160,000**	**190,000**	**150,000**	**145,000**	
Av number of trip / month	369	165	29	59	24
Monthly Gross profit	**59,040,000**	**31,350,000**	**4,350,000**	**8,555,000**	
Staff cost	11,000,000	6,800,000	2,600,000	1,000,000	
Maintenance cost	5,000,000	2,000,000	500,000	500,000	
Income before tax	**43,040,000**	**22,550,000**	**1,250,000**	**7,055,000**	
Tax	3,228,000	1,691,250	93,750	529,125	
Net profit	**39,812,000**	**20,858,750**	**1,156,250**	**6,525,875**	
			Net profit margin		
Turnover	147,600,000	66,000,000	10,150,000	23,600,000	9,600,000
Net profit margin	**27%**	**32%**	**11%**	**28%**	
Use of the profit	*New invest.*	*Invest in other activities*	*Take care of owner's family*	*Storage*	
Impact on the profit accepted	*< 5%*	*< 5%*	*< 5%*	*< 5%*	

2. Views and Perceptions

Opinion about the current system in which they are paying a discharge fee	*Neutral*	*Good*	*Bad*	*Good*	
Opinion about the current discharge fee	*Acceptable*	*Acceptable*	*Acceptable*	*Acceptable*	
WTP without charging more Households	*Not more*	*Not more*	*Not more*	*Not more*	
Willingness & capability to operate a FS treatment plant	*High*	*High*	*Low*	*Medium*	
Opinion about paying an annual or monthly fee for unlimited number of truck trips	*Agree*	*Agree*	*Disagree*	*Disagree*	
Opinion about operating in a specific areas attributed by the authorities	*Neutral*	*Neutral*	*Disagree*	*Disagree*	
Opinion about operating in specific areas under concession contracts attributed by the authorities after a bidding process.	*Agree*	*Agree*	*Disagree*	*Disagree*	
Opinion about difference in the emptying tariff from area to area in the city.	*Agree*	*Disagree*	*Agree*	*Disagree*	*Agree*

could not be estimated

1 *300 000 for mechanical emptying and 600 000 for manual emptying*

A2-2-4 Manhole Manager data processing

REVENUE

50,000	per Household / month (paid every month)
32	Houses connected
2	workers emptying households services every 2 to 3 days
	working during the night after 10,00 pm

COST

2	times manhold emptying every month
	Manhole managed by the owner
400,000	paid per the emptying service
200,000	monthly salary for each worker

INCOME STATEMENT

+ Revenue	1,600,000
- Desludging fee	800,000
- Salary	400,000
Profit	**400,000**
Net profit margin	**25%**

These service providers are the intermediary between bucket latrine owners and FS collection companies. They build manholes in which they store the FS collected from the households using bucket latrines. These manholes are emptied by the FS collection companies at the same price as the household service provision.

A2-3 Households data processing

A2-3-1 Households general data processing

High income areas

GENERAL INFORMATION

1. Households information

HOUSEHOLDS	*High 1*	*High 2*	*High 3*	*High 4*	*High 5*	***Average***
House identification						
House type	*Private house*	*Private house*	*Private house*	*Private house*	*Private house*	
House size (HH)	*1*	*1*	*1*	*1*	*1*	***1***
House size (persons)	*3*	*6*	*8*	*6*	*3*	***5.2***
Household identification						
Ownership	*Owner*	*Renter*	*Owner*	*Renter*	*Renter*	
Position of the interviewee	*Parent*	*Parent*	*Parent*	*Parent*	*Child*	
Household size (persons)	*3*	*6*	*8*	*6*	*3*	***5.2***
Number of employed in the HH	*1*	*3*	*2*	*2*	*3*	***2.2***
Water access	*In-house tap*	*In-house tap*	*In-house tap*			

2. Sanitation facilities used

Type	*Wc*	*Wc*	*Wc*	*Wc*	*Wc*	
Age	*33*	*30*	*-*	*-*	*-*	
Number of person using	*3*	*6*	*8*	*6*	*3*	
State	*clean*	*clean*	*clean*	*clean*	*clean*	
Full frequency (Yr)	*5*	*2*	*10*	*6*	*5*	***5.6***
Equivalent full frequency (in PYr[1])	*15*	*12*	*80*	*36*	*15*	***31.6***
Main use problem	*no*	*no*	*no*	*no*	*no*	
Facility desired	*no one*	*no one*	*no one*	*no one*		

3. Sanitation service received

Company providing the service	*any*	*any*	*any*	*any*	*any*	
Company contact	*to their office*	*to their office*	*to their office*	*to their office*	*to their office*	
Duration for answer	*Immediatly*	*Immediatly*	*Immediatly*	*Immediatly*	*Immediatly*	
Problem during the service provision	*odour*	*no*	*no*	*no*	*no*	
Satisfaction	*medium*	*high*	*high*	*high*	*medium*	

[1]Population-Year, which is an unit expressing the full frequency in an equivalent frequency for one person using the toilet, assuming that they produced the same amount of FS over the time. It will help to compare and to have an idea on pit volume. . .

Medium income areas

GENERAL INFORMATION

1. Households information

HOUSEHOLDS	*Middle 1*	*Middle 2*	*Middle 3*	*Middle 4*	*Middle 5*	***Average***
House identification						
House type	*Apart*	*Apart*	*Private house*	*Apart*	*Private house*	
House size (HH)	*3*	*4*	*5*	*5*	*3*	***4***
House size (persons)	*13*	*10*	*15*	*20*	*12*	***14***
Household identification						
Ownership	*Renter*	*Owner*	*Owner*	*Renter*	*Owner*	
Position of the interviewee	*Parent*	*Child*	*Parent*	*Parent*	*Parent*	
Household size (persons)	*5*	*3*	*4*	*3*	*5*	***4***
Number of employed in the HH	*1*	*1*	*2*	*1*	*1*	***1.2***
Water access	*In-house tap*	*In-house tap*	*In-house tap*	*In-house tap*	*In-house tap*	

2. Sanitation facilities used

Type	*Wc*	*Wc*	*Wc*	*Wc*	*Wc*	
Age	*-*	*-*	*-*	*40*	*-*	
Number of person using	*13*	*10*	*15*	*20*	*12*	
State	*clean*	*clean*	*clean*	*clean*	*clean*	
Full frequency (Yr)	*2*	*5*	*7*	*1.5*	*5*	***4.1***
Equivalent full frequency (in PYr[1])	*26*	*50*	*105*	*30*	*60*	***54.2***
Main use problem	*no*	*no*	*no*	*no*	*no*	
Facility desired	*no one*	*no one*	*no one*	*no one*	*no one*	

3. Sanitation service received

Company providing the service	*any*	*any*	*any*	*any*	*any*	
Company contact	*to their office*	*to their office*	*to their office*	*to their office*	*by telephone*	
Duration for answer	*Immediatly*	*Immediatly*	*Immediatly*	*Immediatly*	*Immediatly*	
Problem during the service provision	*no*	*no*	*no*	*no*	*no*	
Satisfaction	*high*	*high*	*high*	*high*	*high*	

[1]Population-Year, which is an unit expressing the full frequency in an equivalent frequency for one person using the toilet, assuming that they produced the same amount of FS over the time. It will help to compare and to have an idea on pit volume. . .

Low income areas

GENERAL INFORMATION

1. Households information

HOUSEHOLDS	Low 1	Low 2	Low 3	Low 4	Low 5	Low 6	Low 7	Low 8	Low 9	Low 10	**Average**
House identification											
House type	*Private house*	*Apartment*	*Apartment*	*Private house*	*Private house*	*Private house*	*Apartment*	*Private house*	*Apartment*	*Apartment*	
House size (HH)	*12*	*14*	*18*	*10*	*7*	*8*	*11*	*6*	*15*	*11*	***11***
House size (persons)	*35*	*21*	*87*	*35*	*32*	*32*	*23*	*35*	*25*	*36*	***36***
Household identification											
Ownership	*Owner*	*Renter*	*Renter*	*Owner*	*Owner*	*Renter*	*Renter*	*Owner*	*Renter*	*Renter*	
Position of the interviewee	*Parent*	*Parent*	*Parent*	*Parent*	*Parent*	*Single*	*Parent*	*Parent*	*Parent*	*Parent*	
Household size (persons)	*6*	*5*	*4*	*6*	*3*	*1*	*2*	*1*	*4*	*2*	***3***
Number of employed in the HH	*2*	*1*	*1*	*1*	*2*	*1*	*1*	*1*	*1*	*1*	***1***
Water access	*Neighbor tap*	*Public tap*	*In-house tap*	*In-house tap*	*Public tap*	*In-house tap*	*In-house tap*	*In-house tap*			

2. Sanitation facilities used

Type	*Public toilet*	*Public toilet*	*KVIP*	*KVIP*	*Public toilet*	*Bucket*	*Bucket*	*KVIP*	*Pit latrines*	*Pit latrines*	
Age			-	-		*55*	*20*	*7*	*45*	*24*	
Number of person using			*83*	*35*		*16*	*12*	*35*	*21*	*36*	
State			*dirty*	*clean*		*clean*	*clean*	*clean*	*clean*	*clean*	
Full frequency (Yr)			*0.25*	*0.25*		*0.01*	*0.01*	*8*	*2*	*0.42*	***2***
Equivalent full frequency (in PYr[1])			*20.75*	*8.75*		*0.13*	*0.07*	*280*	*42*	*15*	***52***
Main use problem	*No comfort*	*No comfort*	*smell, urine*	*no*	*no*	*no*	*no*	*no*	*can't be used just after emptying*	*no*	
Facility desired	*Wc*	*Wc*	*Wc*	*Wc*	*Wc*	*Wc*	*KVIP*	*no one*	*KVIP*	*KVIP*	

3. Sanitation service received

Company providing the service			*any*	*any*		*Manual emptyer*	*Manual emptyer*	*any*	*only KMA*	*one same*	
Company contact			*to their office*	*to their office*		*they come*	*they come*	*to their office*	*to their office*	*to their office*	
Duration for answer			*Immediatly*	*Immediatly*		*Immediatly*	*Immediatly*		*after 1 week*	*after 1 week*	
Problem during the service provision			*odour*	*no*		*no*	*go to the PT when delay*		*no*	*Smell*	
Satisfaction			*medium*	*medium*		*high*	*high*		*high*	*high*	

[1]Population-Year, which is an unit expressing the full frequency in an equivalent frequency for one person using the toilet, assuming that they produced the same amount of FS over the time. It will help to compare and to have an idea on pit volume. . .

A2-3-2 Households financial data processing

High income areas

FINANCIAL INFORMATION (figures in cedis)

1. Households Monthly Revenue

HOUSEHOLDS	High 1	High 2	High 3	High 4	High 5	Average
Interviewee revenue	12,000,000	4,000,000	1,500,000	3,000,000	1,500,000	
Total revenue of other HH members	-	2,500,000	1,500,000	3,000,000	3,000,000	
Total HH revenue	12,000,000	6,500,000	3,000,000	6,000,000	4,500,000	**5,000,000**

2. Watsan expenditures

Water						
Monthly exp.	41,000	70,000	300,000	60,000	62,000	**106,600**
As % of the revenue	0.3%	1.1%	10.0%	1.0%	1.4%	2.1%
Solid waste						
Monthly exp.	25,000	25,000	20,000	25,000	30,000	**25,000**
As % of the revenue	0.2%	0.4%	0.7%	0.4%	0.7%	0.5%
Liquid waste						
Public toilets monthly exp.	-	-	-	-	-	-
Contribution for the emptying fee	400,000	350,000	350,000	450,000	400,000	390,000
Frequency of the payment (months)	60	24	120	72	60	67.2
Average monthly exp. in emtying fee	6,667	14,583	2,917	6,250	6,667	7,417
Total monthly exp. in liquid waste	**6,667**	**14,583**	**2,917**	**6,250**	**6,667**	**7,417**
As %of the revenue	**0.1%**	**0.2%**	**0.1%**	**0.1%**	**0.1%**	**0.1%**
Total in watsan						
Total monthly exp.	**72,667**	**109,583**	**322,917**	**91,250**	**98,667**	**139,017**
As % of the revenue	**0.6%**	**1.7%**	**10.8%**	**1.5%**	**2.2%**	**2.8%**
Opinion about current exp in liq waste	acceptable	High	acceptable	acceptable	High	

3. Views about future scenarios

WTP for the emptying service	less	less	less	650,000	less	10% OK
Willing to pay a sanitation tax	no	no	no	no	no	0% OK
Opinion about paying a part of the emtying fee to the collection company and the remaning part to KMA at a sanitation kiosk or nearest sub-metro.	agree	neutral	agree	agree	agree	85% OK
Opinion about difference in the emptying tariff from area to area	disagree	disagree	agree	agree	agree	60% OK

Medium income areas

FINANCIAL INFORMATION (figures in cedis)

1. Households Monthly Revenue

HOUSEHOLDS	Middle 1	Middle 2	Middle 3	Middle 4	Middle 5	Average
Interviewee revenue	500,000	1,000,000	1,500,000	2,000,000	1,500,000	
Total revenue of other HH members	-	-	1,500,000	-	-	
Total HH revenue	500,000	1,000,000	3,000,000	2,000,000	1,500,000	**1,600,000**

2. Watsan expenditures

Water						
Monthly exp.	36,667	116,667	70,000	50,000	60,000	**66,667**
As % of the revenue	7.3%	11.7%	2.3%	2.5%	4.0%	4.2%
Solid waste						
Monthly exp.	30,000	20,000	20,000	20,000	20,000	**22,000**
As % of the revenue	6.0%	2.0%	0.7%	1.0%	1.3%	1.4%
Liquid waste						
Public toilets monthly exp.	-	-	-	-		-
Contribution for the emptying fee	166,667	125,000	80,000	100,000	100,000	114,333
Frequency of the payment (months)	24	60	84	18	60	49.2
Average monthly exp. in emtying fee	6,944	2,083	952	5,556	1,667	3,440
Total monthly exp. in liquid waste	**6,944**	**2,083**	**952**	**5,556**	**1,667**	**3,440**
As %of the revenue	**1.4%**	**0.2%**	**0.0%**	**0.3%**	**0.1%**	**0.2%**
Total in watsan						
Total monthly exp.	**73,611**	**138,750**	**90,952**	**75,556**	**81,667**	**92,107**
As % of the revenue	**14.7%**	**13.9%**	**3.0%**	**3.8%**	**5.4%**	**5.8%**
Opinion about current exp in liq waste	High	High	High	High	High	

3. Views about future scenarios

WTP for the emptying service	Less	Less	Less	Less	150,000	80% OK
Willing to pay a sanitation tax	No	No	No	No	No	0% OK
Opinion about paying a part of the emtying fee to the collection company and the remaning part to KMA at a sanitation kiosk or nearest sub-metro.	Agree	Agree	Disagree	Agree	Agree	80% OK
Opinion about difference in the emptying tariff from area to area	Agree	Disagree	Agree	Agree	Disagree	60% OK

Low income areas

FINANCIAL INFORMATION (figures in cedis)

1. Households Monthly Revenue

HOUSEHOLDS	*Low 1*	*Low 2*	*Low 3*	*Low 4*	*Low 5*	*Low 6*	*Low 7*	*Low 8*	*Low 9*	*Low 10*	***Average***
Interviewee revenue	*1,000,000*	*500,000*	*300,000*	*800,000*	*300,000*	*150,000*	*300,000*	*1,500,000*	*1,800,000*	*500,000*	
Total revenue of other HH members					*350,000*	-					
Total HH revenue	*1,000,000*	*500,000*	*300,000*	*800,000*	*650,000*	*150,000*	*300,000*	*1,500,000*	*1,800,000*	*500,000*	***750,000***

2. Watsan expenditures

Water											
Monthly exp.	*16,667*	*12,000*	*20,000*	*20,000*	*15,000*	*33,333*	*9,000*	*9,000*	*14,667*	*10,000*	***15,967***
As % of the revenue	*1.7%*	*2.4%*	*6.7%*	*2.5%*	*2.3%*	*22.2%*	*3.0%*	*0.6%*	*0.8%*	*2.0%*	*2.1%*
Solid waste											
Monthly exp.	-	-	-	-	-	*1,250*	*3,000*	*5,000*	-	-	***925***
As % of the revenue	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.8%*	*1.0%*	*0.3%*	*0.0%*	*0.0%*	*0.5%*
Liquid waste											
Public toilets monthly exp.	*36,000*	*30,000*	-	-	*18,000*	-	-	-	-	-	-
Contribution for the emptying fee	-	-	*33,000*	*50,000*	-	*7,200*	*5,000*	*66,667*	*40,000*	*20,000*	*31,695*
Frequency of the payment (months)			*3*	*3*		*1*	*1*	*96*	*24*	*5*	
Average monthly exp. in emtying fee			*11,000*	*16,667*		*7,200*	*5,000*	*694*	*1,667*	*4,000*	*6,604*
Total monthly exp. in liquid waste	**36,000**	**30,000**	**11,000**	**16,667**	**18,000**	**7,200**	**5,000**	**694**	**1,667**	**4,000**	**13,023**
As %of the revenue	**3.6%**	**6.0%**	**3.7%**	**2.1%**	**2.8%**	**4.8%**	**1.7%**	**0.0%**	**0.1%**	**0.8%**	**1.7%**
Total in watsan											
Total monthly exp.	***52,667***	***42,000***	***31,000***	***36,667***	***33,000***	***41,783***	***17,000***	***14,694***	***16,333***	***14,000***	***29,914***
As % of the revenue	***5.3%***	***8.4%***	***10.3%***	***4.6%***	***5.1%***	***27.9%***	***5.7%***	***1.0%***	***0.9%***	***2.8%***	***4.0%***
Opinion about current exp in liq waste	*High*	*High*	*High*	*Acceptable*		*High*	*Acceptable*	*Acceptable*	*High*	*High*	

3. Views about future scenarios

WTP for the emptying service			*Less*	*Less*		*Less*	*38,462*	*Not more*	*Less*	*Less*	*14% OK*
Willing to pay a sanitation tax			*No*	*No*		*No*	*No*	*No*	*No*	*No*	*0% OK*
Opinion about paying a part of the emtying fee to the collection company and the remaning part to KMA at a sanitation kiosk or nearest sub-metro.			*Disagree*	*Agree*		*Agree*	*Agree*	*Disagree*	*Agree*	*Agree*	*71% OK*
Opinion about difference in the emptying tariff from area to area			*Disagree*	*Disagree*		*Disagree*	*Disagree*	*Disagree*	*Disagree*	*Agree*	*14% OK*

A2-3-3 Summary of the financial information

- **Average income**

Areas	Av. monthly HH income (c 000's)	Av. monthly HH income (US$)
Low Inc	750	$83
Middle Inc	1600	$178
High Inc	5000	$556

- **Current expenditures in water and sanitation (watsan)**

Areas	*Exp in water*	*Exp in SW*	*Exp in FS*	*Total Watsan*
Low Inc	2.1%	0.5%	1.7%	4.3%
Middle Inc	4.2%	1.4%	0.2%	5.8%
High Inc	2.1%	0.5%	0.1%	2.8%
AVERAGE	2.6%	0.7%	0.6%	3.9%
Standard	3%	1%	1%	5.0%

- **Current expenditures in emptying service and CTP**

HH CLASSES	*Current exp in emptying ($/month)*	*CTP to based findings' income level*
Low Inc	$1.4	$0.4
Middle Inc	$0.4	$0.9
High Inc	$0.8	$2.8

Annex-3 Kumasi population statistical data processing (for Chapter 5 and 6)

A3-1 Raw data used

At the step of evaluating the potential revenue that can be expected from households in the financial arrangements, it was necessary to know more about the population, the number of households and houses, the suburbs composing the city and the income of each stratum of the population. The latest data on both suburbs composing the city and their population and income, dated from 1996 and was found in the report (Korboe *et al*., 2002) at the Planning Department of KNUST[a1](see Table 9-2).

Table 9-2: Original statistical data on Kumasi. Source: (GoG/MoLGRD, 1996)

Zone	Areas (Suburbs) covered	Population 1996	Income 1996	
			Av, monthly head of HH income (c 000's)	Av, monthly HH income (c 000's)
1	Central Market CBD)	11,328	225	330
2	Adum (CBD)	13,675	250	325
3	Bompata (CBD)	9,685	195	240
4	Cultural Centre, Doctors' Flats, Zoo (CBD)	3,425	155	290
5	4 Battalion, Kmfo Anokye Hospital	17,500	183	258
6	Kwadaso Estates	7,950	305	450
7	Bantama	45,168	235	300
8	Ashanti New Town	36,491	85	180
9	Akwatia Line	25,779	155	220
10	New Amakom, Asokwa	19,131	305	510
11	Ridge, Danyame	11,342	413	568
12	Angola	61,248	355	490
13	Asawasi, Aboabo	33,919	75	190
14	Dichemso, Krofofrom	94,248	115	210
15	Bomso, Sisanso	5,829	300	392
16	Ayigya West	6,478	260	345
17	Old Ayigya	17,010	242	325
18	Akrom	26,572	85	210
19	Asokore Mampong	9,008	155	210
20	Moshie Zongo, Sepe	16,700	59	125
21	Buokrom Estates	9,056	158	258
22	Ahinsan Estate	5,821	180	285
23	Adiebeba	10,449	65	220
24	Chirapatre, Chirapatre Estates	6,560	110	165
25	Nhyiaso, Ahodwo	8,526	300	465
26	Fankyenebra Santasi	8,680	275	530
27	Kwadaso	10,508	265	310
28	Kwadaso extension, Asuoyeboa, Brigade, Prempeh College	7,863	185	350
29	Suame, Abrepo, Anumanye, Maakro	25,034	195	280
30	Old Tafo	64,225	255	290
31	UST	7,428	231	282
32	Boadi	5,960	105	310
33	Kentinkrono, Nsenie, Oduom	3,200	145	260
34	Asuoyeboa SSNIT Flats	2,850	388	538

[a1] Kumasi University of Science and Technology

More data has been found on the city's population. In 2000, the whole city's population was estimated at 1,201,281 inhabitants (GLSS4, 2000). This figure has been updated to be 1,482,480 inhabitants by the Planning Department of KMA (crosschecked with the Statistical service of Kumasi). The Table 9-3 presents the new repartition of the 2004 population for the city.

Table 9-3: Population of Kumasi estimated by KMA planning department (Source: The KMA Planning Department worksheet)

No	SUBURBS	MAJORS SETTLEMENTS	POPULATION	
			2000	2004
1	SUBIN	Adum	12,005	14,814
		Amakom	45,883	56,619
		Asafo	18,457	22,776
		Fanti Newtown	25,312	31,238
		subtotal	**101,657**	**125,447**
2	BANTAMA	Bantama	**87,852**	**108,409**
3	NHYIAESO	Patasi/Suntreso	21,443	26,461
		Nhyiaeso	32,328	39,893
		Santasi	31,011	38,267
		subtotal	**84,782**	**104,621**
4	KWADASO	Kwadaso	**144,989**	**178,916**
5	MANHYIA	Buokrom	38,873	47,969
		Krofrom	76,041	93,834
		Manhyia	47,826	59,017
		subtotal	**162,740**	**200,820**
6	SUAME	Suame	**117,775**	**145,334**
7	OLD TAFO	Old Tafo	**128,080**	**158,051**
8	ASAWASI	Asawasi	46,243	57,064
		Aboabo	34,206	42,210
		Asokore Mampong	48,606	59,980
		subtotal	**129,055**	**159,254**
9	OFORIKROM	Ayigya	30,283	37,369
		Bomso	13,710	16,918
		Kentinkrono	39,257	48,443
		Oforikrom	38,155	47,083
		subtotal	**121,405**	**149,813**
10	ASOKWA	Atonsu Agogo	67,899	83,787
		Ahensan	36,300	44,794
		Asokwa	18,747	23,234
		subtotal	**122,946**	**151,815**
TOTAL			**1,201,281**	**1,482,480**

This new repartition was not used in my study because it was not possible to find the corresponding data on the population income. However the updated total population figure has been used to update the 1996's population to 2004's, using the coefficient $e^{rt} = 2.29$ calculated from Table 9-4.

Table 9-4: Population coefficient used for 1996's population updating for Kumasi

	1996	***2004***
Kumasi total population	*648,646*	*1,482,480*
Coefficient for suburbs' 2004 population estimation	***2.29***	

The initial classification of the suburbs (from Table 9-2, into income level has been done through key informants discussion with a WMD Officer who knows very well the field. This classification is presented in Table 9-5. It was helpful to identify respondents of households interview surveys according to their income level. The characteristics of each class as shown in Table 9-6 was also given and validated at the Statistical Service. They were used for the estimation of the number of households and houses.

Table 9-5: Classification of suburbs into income areas based on key informants discussion.

Zone	Areas (Surburbs) covered	CLASS
1	Central Market CBD)	M
2	Adum (CBD)	M
3	Bompata (CBD)	M
4	Cultural Centre, Doctors' Flats, Zoo (CBD)	H
5	4 Battalion, Kmfo Anokye Hospital	M
6	Kwadaso Estates	H
7	Bantama	M
8	Ashanti New Town	M
9	Akwatia Line	L
10	New Amakom, Asokwa	H
11	Ridge, Danyame	H
12	Angola	L
13	Asawasi, Aboabo	L
14	Dichemso, Krofofrom	M
15	Bomso, Sisanso	L
16	Ayigya West	L
17	Old Ayigya	L
18	Akrom	L
19	Asokore Mampong	L
20	Moshie Zongo, Sepe	L
21	Buokrom Estates	M
22	Ahinsan Estate	M
23	Adiebeba	H
24	Chirapatre, Chirapatre Estates	M
25	Nhyiaso, Ahodwo	H
26	Fankyenebra Santasi	M
27	Kwadaso	M
28	Kwadaso extension, Asuoyeboa, Brigade, Prempeh College	M
29	Suame, Abrepo, Anumanye, Maakro	L
30	Old Tafo	L
31	UST	H
32	Boadi	L
33	Kentinkrono, Nsenie, Oduom	L
34	Asuoyeboa SSNIT Flats	H

H= High income area; M = Medium income areas; L= Low income areas

The classification is made based on the living standard (type of houses) and not on the actual income level

Table 9-6: Characteristics of the households' classes.

SETTLEMENT CLASS	*AVERAGE HOUSEHOLD SIZE*	*AVERAGE NUM OF HH PER HOUSE*	*AVERAGE HOUSE SIZE / OCCUPANCY RATE (in persons per house)*
HIGH CLASS	*4*	*1*	*4*
MEDIUM CLASS	*5*	*6*	*30*
LOW CLASS	*6*	*12*	*72*

A3-2 Data updating

Additional to the population data, the 1996 data on households' income have also been updated accordingly with the Statistical Service. The assumption used to calculate the income updating coefficient is that the average monthly income of a head of households in *Ridge and Danyame* suburb is about 3000 thousands cedis in 2004. Based on this assumption the 1996's income data have been updated using the coefficient in Table 9-7.

Table 9-7: Income coefficient used for 1996's households income updating for Kumasi.

	1996	***2004***
Ridge-Danyame's Av monthly head of HH income evolution	*413*	*3,000*
Coefficient for income figures updating	***7.3***	

The Table 9-8 and Table 9-9 show the estimation of 2004's statistical data on Kumasi done with the help of Kumasi Statistical Service Officers.

Table 9-8: Kumasi residential areas data actualisation (part 1 of 2)

Zone	Areas (Surburbs) covered	CLASS	1996					2004				
			Population	Number of HH	Number of Houses	Av, monthly head of HH income (c 000's)	Av, monthly HH income (c 000's)	Population estimated	Number of HH	Number of Houses	Av, monthly head of HH income (c 000's)	Av, monthly HH income (c 000's)
1	Central Market CBD)	M	11,328	2,266	378	225	330	25,890	5,178	863	1,634	2,397
2	Adum (CBD)	M	13,675	2,735	456	250	325	31,254	6,251	1,042	1,816	2,361
3	Bompata (CBD)	M	9,685	1,937	323	195	240	22,135	4,427	738	1,416	1,743
4	Cultural Centre, Doctors' Flats, Zoo (CBD)	H	3,425	856	856	155	290	7,828	1,957	1,957	1,126	2,107
5	4 Battalion, Kmfo Anokye Hospital	M	17,500	3,500	583	183	258	39,996	7,999	1,333	1,329	1,874
6	Kwadaso Estates	H	7,950	1,988	1,988	305	450	18,170	4,542	4,542	2,215	3,269
7	Bantama	M	45,168	9,034	1,506	235	300	103,231	20,646	3,441	1,707	2,179
8	Ashanti New Town	M	36,491	7,298	1,216	85	180	83,400	16,680	2,780	617	1,308
9	Akwatia Line	L	25,779	4,297	358	155	220	58,918	9,820	818	1,126	1,598
10	New Amakom, Asokwa	H	19,131	4,783	4,783	305	510	43,724	10,931	10,931	2,215	3,705
11	Ridge, Danyame	H	11,342	2,836	2,836	413	568	25,922	6,481	6,481	3,000	4,126
12	Angola	L	61,248	10,208	851	355	490	139,982	23,330	1,944	2,579	3,559
13	Asawasi, Aboabo	L	33,919	5,653	471	75	190	77,522	12,920	1,077	545	1,380
14	Dichemso, Krofofrom	M	94,248	18,850	3,142	115	210	215,404	43,081	7,180	835	1,525
15	Bomso, Sisanso	L	5,829	972	81	300	392	13,322	2,220	185	2,179	2,847
16	Ayigya West	L	6,478	1,080	90	260	345	14,805	2,468	206	1,889	2,506
17	Old Ayigya	L	17,010	2,835	236	242	325	38,876	6,479	540	1,758	2,361
18	Akrom	L	26,572	4,429	369	85	210	60,730	10,122	843	617	1,525
19	Asokore Mampong	L	9,008	1,501	125	155	210	20,588	3,431	286	1,126	1,525
20	Moshie Zongo, Sepe	L	16,700	2,783	232	59	125	38,168	6,361	530	429	908
21	Buokrom Estates	M	9,056	1,811	302	158	258	20,697	4,139	690	1,148	1,874
22	Ahinsan Estate	M	5,821	1,164	194	180	285	13,304	2,661	443	1,308	2,070
23	Adiebeba	H	10,449	2,612	2,612	65	220	23,881	5,970	5,970	472	1,598
24	Chirapatre, Chirapatre Estates	M	6,560	1,312	219	110	165	14,993	2,999	500	799	1,199
25	Nhyiaso, Ahodwo	H	8,526	2,132	2,132	300	465	19,486	4,872	4,872	2,179	3,378
26	Fankyenebra Santasi	M	8,680	1,736	289	275	530	19,838	3,968	661	1,998	3,850
27	Kwadaso	M	10,508	2,102	350	265	310	24,016	4,803	801	1,925	2,252
28	Kwadaso extension, Asuoyeboa, Brigade, F	M	7,863	1,573	262	185	350	17,971	3,594	599	1,344	2,542
29	Suame, Abrepo, Anumanye, Maakro	L	25,034	4,172	348	195	280	57,215	9,536	795	1,416	2,034
30	Old Tafo	L	64,225	10,704	892	255	290	146,786	24,464	2,039	1,852	2,107
31	UST	H	7,428	1,857	1,857	231	282	16,977	4,244	4,244	1,678	2,048
32	Boadi	L	5,960	993	83	105	310	13,622	2,270	189	763	2,252
33	Kentinkrono, Nsenie, Oduom	L	3,200	533	44	145	260	7,314	1,219	102	1,053	1,889
34	Asuoyeboa SSNIT Flats	H	2,850	713	713	388	538	6,514	1,628	1,628	2,818	3,908
	Total		648,646					**1,482,480**				

Table 9-9: Kumasi residential areas data actualisation (part 2 of 2)

SETTLEMENT CLASS	AVERAGE HOUSEHOLD SIZE	AVERAGE NUM OF HH PER HOUSE	AVERAGE HOUSE SIZE / OCCUPANCY RATE	1996					2004				
				Population	Number of HH	Number of Houses	Av, monthly head of HH income (c 000's)	Av, monthly HH income (c 000's)	Population	Number of HH	Number of Houses	Av, monthly head of HH income (c 000's)	Av, monthly HH income (c 000's)
HIGH CLASS	***4***	***1***	***4***	71,101	17,775	17,775		431	162,501	40,625	40,625		3,132
MEDIUM CLASS	***5***	***6***	***30***	276,583	55,317	9,219		255	632,130	126,426	21,071		1,855
LOW CLASS	***6***	***12***	***72***	300,962	50,160	4,180		299	687,848	114,641	9,553		2,173
AVERAGE /TOTAL	***5.3***	***4.0***	***20.8***	**648,646**	**123,252**	**31,175**	**-**	**299**	**1,482,480**	**281,693**	**71,250**	**-**	**2,169**
			POURCENTAGE										
			HIGH CLASS	11%	14%	57%			11%	14%	57%		
			MEDIUM CLASS	43%	45%	30%			43%	45%	30%		
			LOW CLASS	46%	41%	13%			46%	41%	13%		
			TOTAL	100%	100%	100%			100%	100%	100%		
11	Ridge, Danyame	H		11,342	2,836	2,836	413	568	25,922	6,481	6,481	3,000	4,126
34	Asuoyeboa SSNIT Flats	H		2,850	713	713	388	538	6,514	1,628	1,628	2,818	3,908
10	New Amakom, Asokwa	H		19,131	4,783	4,783	305	510	43,724	10,931	10,931	2,215	3,705
25	Nhyiaso, Ahodwo	H		8,526	2,132	2,132	300	465	19,486	4,872	4,872	2,179	3,378
6	Kwadaso Estates	H		7,950	1,988	1,988	305	450	18,170	4,542	4,542	2,215	3,269
4	Cultural Centre, Doctors' Flats, Zoo (CBD)	H		3,425	856	856	155	290	7,828	1,957	1,957	1,126	2,107
31	UST	H		7,428	1,857	1,857	231	282	16,977	4,244	4,244	1,678	2,048
23	Adiebeba	H		10,449	2,612	2,612	65	220	23,881	5,970	5,970	472	1,598
26	Fankyenebra Santasi	M		8,680	1,736	289	275	530	19,838	3,968	661	1,998	3,850
28	Kwadaso extension, Asuoyeboa, Brigade, F	M		7,863	1,573	262	185	350	17,971	3,594	599	1,344	2,542
1	Central Market CBD)	M		11,328	2,266	378	225	330	25,890	5,178	863	1,634	2,397
2	Adum (CBD)	M		13,675	2,735	456	250	325	31,254	6,251	1,042	1,816	2,361
27	Kwadaso	M		10,508	2,102	350	265	310	24,016	4,803	801	1,925	2,252
7	Bantama	M		45,168	9,034	1,506	235	300	103,231	20,646	3,441	1,707	2,179
22	Ahinsan Estate	M		5,821	1,164	194	180	285	13,304	2,661	443	1,308	2,070
5	4 Battalion, Kmfo Anokye Hospital	M		17,500	3,500	583	183	258	39,996	7,999	1,333	1,329	1,874
21	Buokrom Estates	M		9,056	1,811	302	158	258	20,697	4,139	690	1,148	1,874
3	Bompata (CBD)	M		9,685	1,937	323	195	240	22,135	4,427	738	1,416	1,743
14	Dichemso, Krofofrom	M		94,248	18,850	3,142	115	210	215,404	43,081	7,180	835	1,525
8	Ashanti New Town	M		36,491	7,298	1,216	85	180	83,400	16,680	2,780	617	1,308
24	Chirapatre, Chirapatre Estates	M		6,560	1,312	219	110	165	14,993	2,999	500	799	1,199
12	Angola	L		61,248	10,208	851	355	490	139,982	23,330	1,944	2,579	3,559
15	Bomso, Sisanso	L		5,829	972	81	300	392	13,322	2,220	185	2,179	2,847
16	Ayigya West	L		6,478	1,080	90	260	345	14,805	2,468	206	1,889	2,506
17	Old Ayigya	L		17,010	2,835	236	242	325	38,876	6,479	540	1,758	2,361
32	Boadi	L		5,960	993	83	105	310	13,622	2,270	189	763	2,252
30	Old Tafo	L		64,225	10,704	892	255	290	146,786	24,464	2,039	1,852	2,107
29	Suame, Abrepo, Anumanye, Maakro	L		25,034	4,172	348	195	280	57,215	9,536	795	1,416	2,034
33	Kentinkrono, Nsenie, Oduom	L		3,200	533	44	145	260	7,314	1,219	102	1,053	1,889
9	Akwatia Line	L		25,779	4,297	358	155	220	58,918	9,820	818	1,126	1,598
18	Akrom	L		26,572	4,429	369	85	210	60,730	10,122	843	617	1,525
19	Asokore Mampong	L		9,008	1,501	125	155	210	20,588	3,431	286	1,126	1,525
13	Asawasi, Aboabo	L		33,919	5,653	471	75	190	77,522	12,920	1,077	545	1,380
20	Moshie Zongo, Sepe	L		16,700	2,783	232	59	125	38,168	6,361	530	429	908

A3-3 Income data classification by quintile an by class

Table 9-10: Households' repartition in quintiles

Num	Residential areas		Population	Number of HH	Number of Houses	Av, monthly HH income (c 000's)	Total monthly HH income per area (c 000's)	Av, monthly CTP per area (c 000's)	Total monthly CTP per area (c 000's)	Cumul HH	%tage	Quintile
11	Ridge, Danyame	H	25,922	6,481	6,481	4,126	26,738,084	21	133,690	6,481	2%	Q1
34	Asuoyeboa SSNIT Flats	H	6,514	1,628	1,628	3,908	6,363,843	20	31,819	8,109	3%	
26	Fankyenebra Santasi	M	19,838	3,968	661	3,850	15,274,883	19	76,374	12,077	5%	
10	New Amakom, Asokwa	H	43,724	10,931	10,931	3,705	40,494,884	19	202,474	23,008	9%	
12	Angola	L	139,982	23,330	1,944	3,559	83,040,326	18	415,202	46,338	18%	
25	Nhyiaso, Ahodwo	H	19,486	4,872	4,872	3,378	16,454,724	17	82,274	51,209	19%	
6	Kwadaso Estates	H	18,170	4,542	4,542	3,269	14,848,137	16	74,241	55,752	21%	Q2
15	Bomso, Sisanso	L	13,322	2,220	185	2,847	6,322,388	14	31,612	57,972	22%	
28	Kwadaso extension, Asuoyeboa, Brigade	M	17,971	3,594	599	2,542	9,137,736	13	45,689	61,566	23%	
16	Ayigya West	L	14,805	2,468	206	2,506	6,183,881	13	30,919	64,034	24%	
1	Central Market CBD)	M	25,890	5,178	863	2,397	12,412,220	12	62,061	69,212	26%	
17	Old Ayigya	L	38,876	6,479	540	2,361	15,296,382	12	76,482	75,691	29%	
2	Adum (CBD)	M	31,254	6,251	1,042	2,361	14,756,827	12	73,784	81,942	31%	
32	Boadi	L	13,622	2,270	189	2,252	5,112,214	11	25,561	84,213	32%	
27	Kwadaso	M	24,016	4,803	801	2,252	10,815,935	11	54,080	89,016	34%	
7	Bantama	M	103,231	20,646	3,441	2,179	44,991,908	11	224,960	109,662	42%	Q3
4	Cultural Centre, Doctors' Flats, Zoo (CBD	H	7,828	1,957	1,957	2,107	4,122,407	11	20,612	111,619	42%	
30	Old Tafo	L	146,786	24,464	2,039	2,107	51,535,105	11	257,676	136,083	52%	
29	Suame, Abrepo, Anumanye, Maakro	L	57,215	9,536	795	2,034	19,394,980	10	96,975	145,619	55%	
33	Kentinkrono, Nsenie, Oduom	L	7,314	1,219	102	1,889	2,302,101	9	11,511	146,838	56%	
21	Buokrom Estates	M	20,697	4,139	690	1,874	7,757,797	9	38,789	150,978	57%	
3	Bompata (CBD)	M	22,135	4,427	738	1,743	7,717,794	9	38,589	155,405	59%	
23	Adiebeba	H	23,881	5,970	5,970	1,598	9,540,908	8	47,705	161,375	61%	Q4
9	Akwatia Line	L	58,918	9,820	818	1,598	15,692,416	8	78,462	171,195	65%	
18	Akrom	L	60,730	10,122	843	1,525	15,439,904	8	77,200	181,316	69%	
19	Asokore Mampong	L	20,588	3,431	286	1,525	5,234,181	8	26,171	184,748	70%	
14	Dichemso, Krofofrom	M	215,404	43,081	7,180	1,525	65,716,396	8	328,582	227,828	86%	Q5
13	Asawasi, Aboabo	L	77,522	12,920	1,077	1,380	17,831,903	7	89,160	240,749	91%	
8	Ashanti New Town	M	83,400	16,680	2,780	1,308	21,809,242	7	109,046	257,429	98%	
20	Moshie Zongo, Sepe	L	38,168	6,361	530	908	5,776,005	5	28,880	263,790	100%	

Table 9-11: Repartition in class from the quintiles

Quintile	Number of HH	Total monthly HH income (c 000's)	Av, monthly HH income per QQ (c 000's)	Av, monthly CTP per QQ(c 000's)	Total monthly CTP per QQ (c 000's)	CLASS	Number of HH	Total monthly HH income (c 000's)	Av, monthly HH income per class (c 000's)	Av, monthly CTP per class (c 000's)	Total monthly CTP per class (c 000's)
Q1	51,209	188,366,743	3,678	18	941,834	HIGH	51,209	188,366,743	3,678	18	941,834
Q2	37,806	94,885,720	2,510	13	474,429						
Q3	66,389	137,822,092	2,076	10	689,110	MIDDLE	133,538	278,615,220	2,086	10	1,393,076
Q4	29,343	45,907,408	1,565	8	229,537						
Q5	79,042	111,133,545	1,406	7	555,668	LOW	79,042	111,133,545	1,406	7	555,668
	263,790				2,890,578		263,790			cedis	2,890,578

Table 9-12: Summary of statistical data processed

HH INCOME CLASS	Quintiles	Number of HH	Av. monthly HH income per class (US$)	Av. monthly CTP per class (US$)	Potential revenue per class (US$)
HIGH	*Q1*	51,209	409	2.0	**104,700**
MIDDLE	*Q2* *Q3* *Q4*	133,538	232	1.2	**154,900**
LOW	*Q5*	79,042	156	0.8	**61,700**
Total revenue at 100% FS collection service coverage					**321,300**
Revenue at the current service coverage of 34%					**109,200**

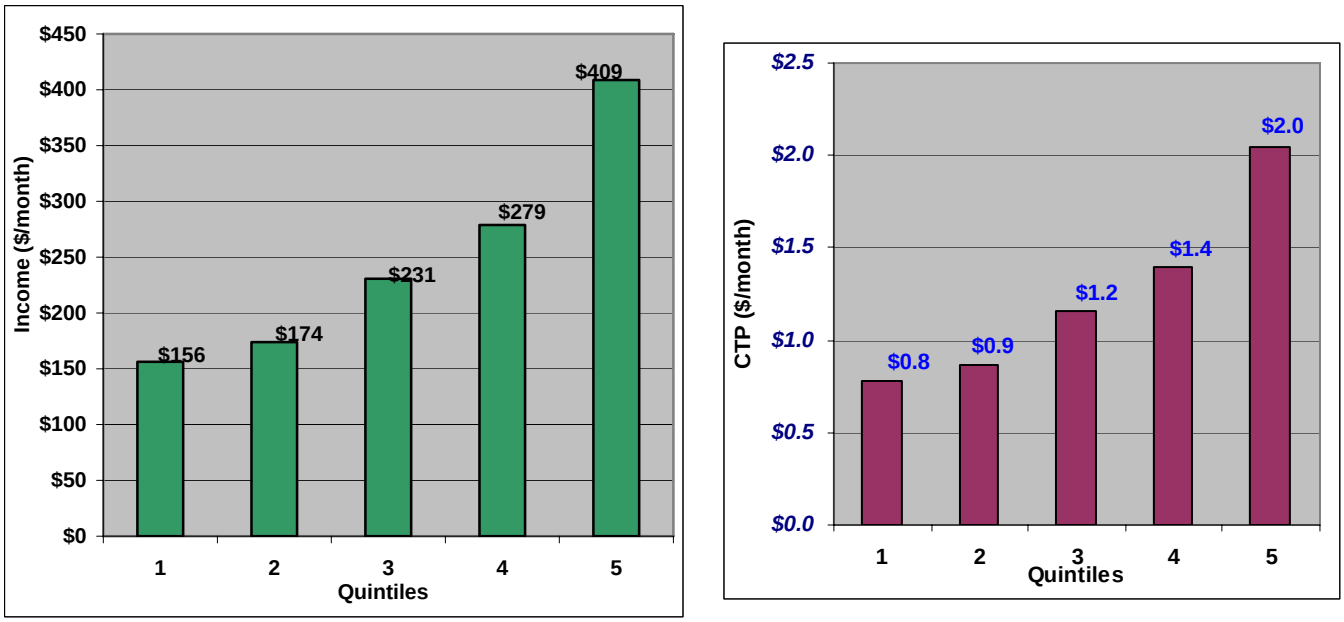


Figure 9-4: Average monthly income and CTP of households grouped by quintiles

Annex-4 Results of sensitivity analysis

	Total HH revenue	109,200																			
	Total compost sale	18,000																			
% of CTP																					
100%	143%	144%	145%	147%	148%	149%	150%	151%	153%	154%	155%	156%	157%	158%	160%	161%	162%	163%	164%	166%	167%
95%	136%	137%	138%	140%	141%	142%	143%	144%	145%	147%	148%	149%	150%	151%	152%	154%	155%	156%	157%	158%	160%
90%	129%	130%	131%	132%	134%	135%	136%	137%	138%	139%	141%	142%	143%	144%	145%	147%	148%	149%	150%	151%	152%
85%	122%	123%	124%	125%	126%	128%	129%	130%	131%	132%	133%	135%	136%	137%	138%	139%	141%	142%	143%	144%	145%
80%	114%	116%	117%	118%	119%	120%	122%	123%	124%	125%	126%	127%	129%	130%	131%	132%	133%	135%	136%	137%	138%
75%	107%	109%	110%	111%	112%	113%	114%	116%	117%	118%	119%	120%	121%	123%	124%	125%	126%	127%	129%	130%	131%
70%	100%	101%	103%	104%	105%	106%	107%	108%	110%	111%	112%	113%	114%	116%	117%	118%	119%	120%	121%	123%	124%
65%	93%	94%	95%	97%	98%	99%	100%	101%	102%	104%	105%	106%	107%	108%	110%	111%	112%	113%	114%	115%	117%
60%	86%	87%	88%	89%	91%	92%	93%	94%	95%	96%	98%	99%	100%	101%	102%	104%	105%	106%	107%	108%	109%
55%	79%	80%	81%	82%	83%	85%	86%	87%	88%	89%	91%	92%	93%	94%	95%	96%	98%	99%	100%	101%	102%
50%	72%	73%	74%	75%	76%	77%	79%	80%	81%	82%	83%	85%	86%	87%	88%	89%	90%	92%	93%	94%	95%
45%	64%	66%	67%	68%	69%	70%	71%	73%	74%	75%	76%	77%	79%	80%	81%	82%	83%	84%	86%	87%	88%
40%	57%	58%	60%	61%	62%	63%	64%	66%	67%	68%	69%	70%	71%	73%	74%	75%	76%	77%	78%	80%	81%
35%	50%	51%	52%	54%	55%	56%	57%	58%	60%	61%	62%	63%	64%	65%	67%	68%	69%	70%	71%	73%	74%
30%	43%	44%	45%	46%	48%	49%	50%	51%	52%	54%	55%	56%	57%	58%	59%	61%	62%	63%	64%	65%	67%
25%	36%	37%	38%	39%	40%	42%	43%	44%	45%	46%	48%	49%	50%	51%	52%	53%	55%	56%	57%	58%	59%
20%	29%	30%	31%	32%	33%	35%	36%	37%	38%	39%	40%	42%	43%	44%	45%	46%	47%	49%	50%	51%	52%
15%	21%	23%	24%	25%	26%	27%	29%	30%	31%	32%	33%	34%	36%	37%	38%	39%	40%	42%	43%	44%	45%
10%	14%	15%	17%	18%	19%	20%	21%	23%	24%	25%	26%	27%	28%	30%	31%	32%	33%	34%	36%	37%	38%
5%	7%	8%	10%	11%	12%	13%	14%	15%	17%	18%	19%	20%	21%	22%	24%	25%	26%	27%	28%	30%	31%
0%	0%	1%	2%	4%	5%	6%	7%	8%	9%	11%	12%	13%	14%	15%	17%	18%	19%	20%	21%	22%	24%
	0%	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%

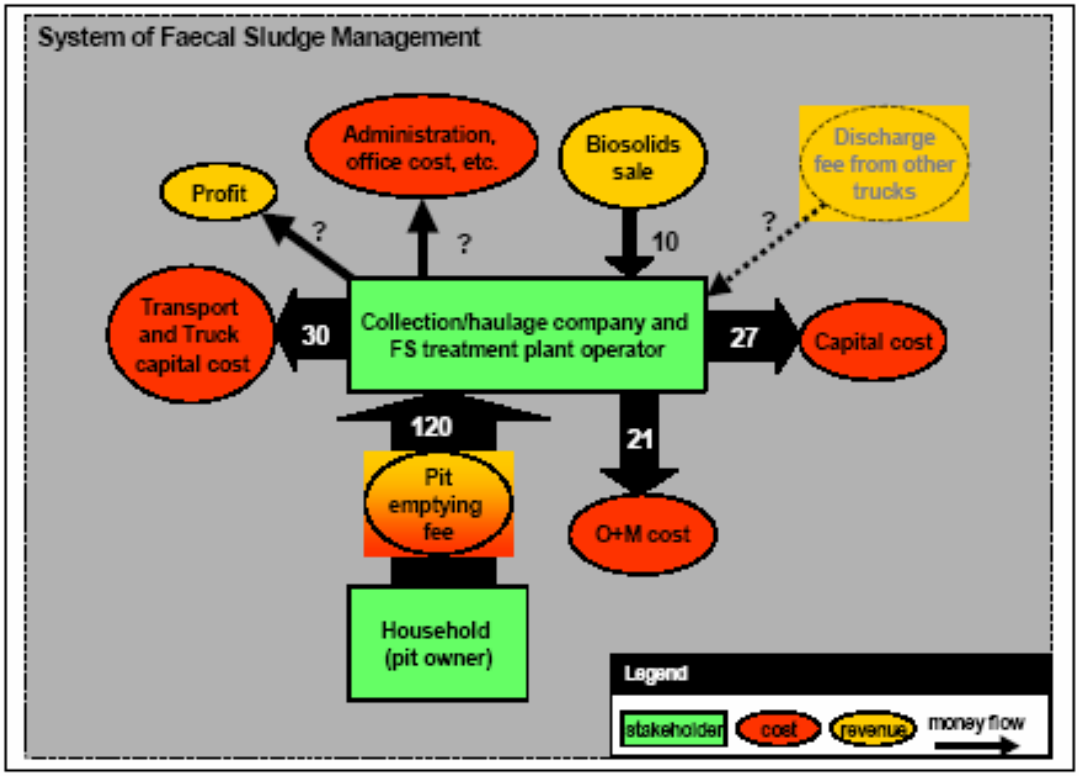
Annex-5 Sandec scenarios (source: Steiner *et al.* (2003))

SCENARIO No 1	Same operator providing the collection and treatment service without Government intervention.

Main description:

- A sanitation company owns vacuum trucks and conducted the refuse collection as well as the treatment plant operation;
- The role of the authority will depend on the type of the public private partnership arrangement for the plant operation, from a concession contract with a simple ownership to service contract.
- If other company deliver the waste to plant, he has to pay a fee or be remunerated according to the situation.

Chart:



Benefit:

- The collection fee can finance the FS treatment and then FSM can be financially sustainable;
- No longer indiscriminate dumping by the sanitation company as he use the waste to produce saleable biosolids.

Drawbacks :

- The emptying fee may not be affordable for households with the private company, which will would like to recovered all its O&M cost and capital expenditures and make profit.
- By raising the emptying fee the company will not be competitive with other companies which only provide the collection service.

Main issue:

High operation and maintenance cost and capital expenditures of faecal sludge treatment, and difficulties in commercialising biosolids at an appropriate price will hinder private sector involvement.

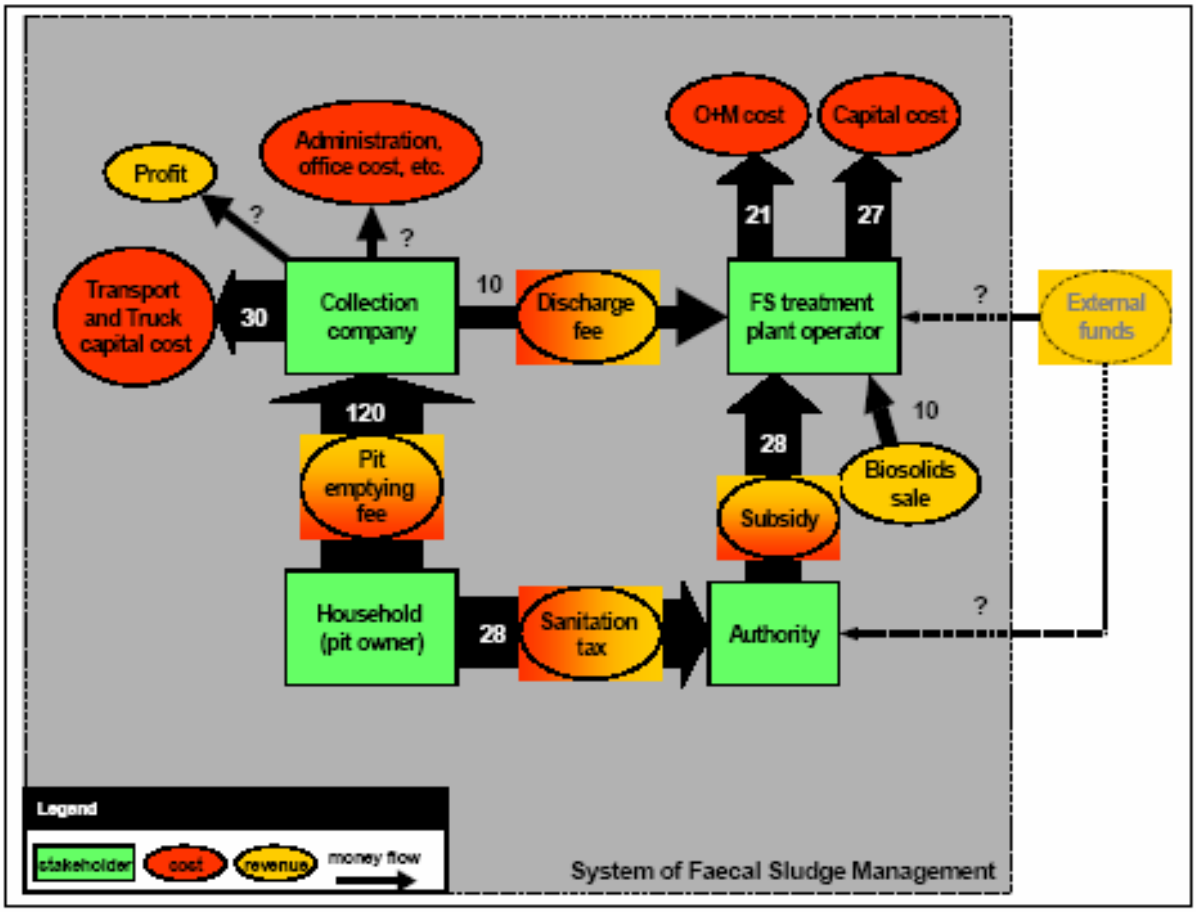
SCENARIO No 2	Separate operators for the collection and treatment with Government subsidy for the FS treatment by sanitation tax and discharge fee.

Main description:

The situation look like the current situation but in which:

- the authorities collect sanitation tax from households to subsidy the FS treatment;
- the biosolids sale is considered to be an input for the FS treatment revenue.

Chart:



Benefit:

- Possibility to finance FS treatment by sanitation tax and biosolids sale, instead of external funds.

Drawbacks :

- The emptying fee remain high, and sanitation tax make too much the households financial contribution against the high profit made the emptying companies;
- The discharge fee will still encourage illegal dumping of untreated faecal sludge.

Main issue:

A type of sanitation tax (indirect taxes or regular users tax) and its actual collection and allocation to FS treatment budget is a big issue.

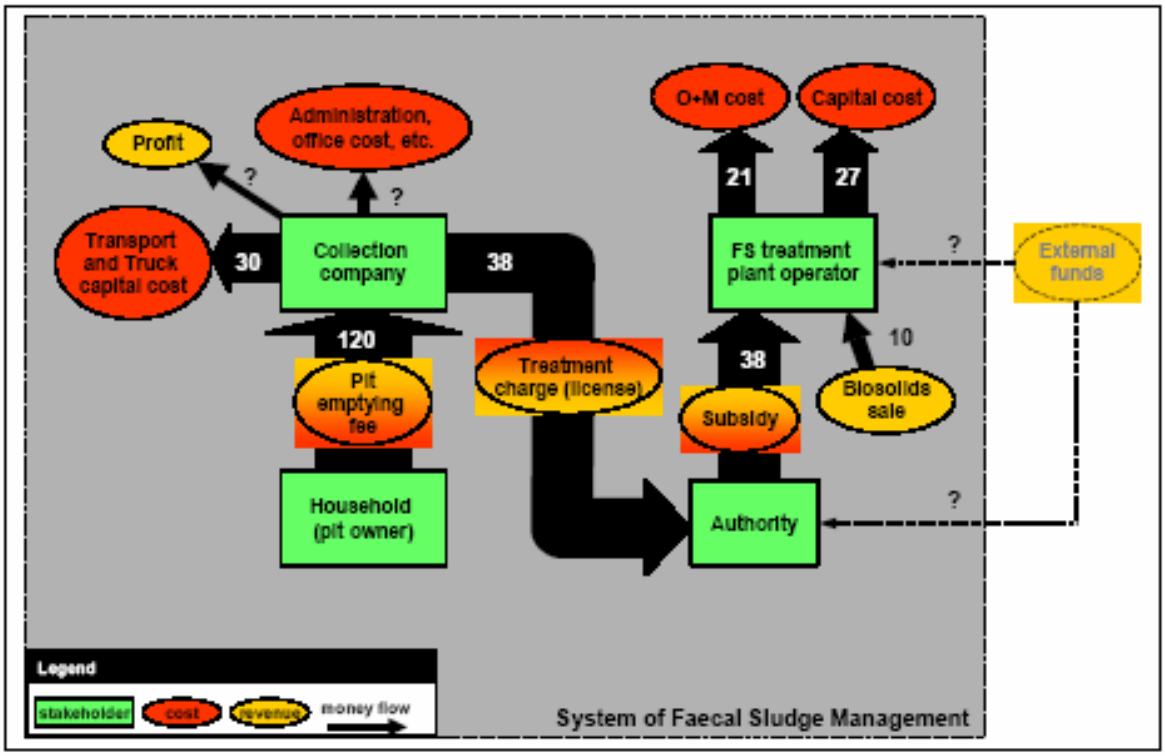
SCENARIO No 3	Separate operators for the collection and treatment with Authority subsidy for the FS treatment by licence fee from registered companies.

Main description:

In this situation:

- Registered companies pay a monthly or annual licence (treatment fee), which authorise them to convey cost-free the collected FS to the treatment plant ;
- The treatment plant revenue are based on subsidy from the authority with licence fee, and biosolids sale.

Chart:



Benefit:

- Highest possible FS delivery by companies because it is already paid and they will not want to loose their licence;
- Incentive for collaboration of the emptying companies with the authorities and the FSTP operators.

Drawbacks :

- The illegal dumping is still not excluded because of the haulage cost saving;
- Licence price must be higher to cover FS treatment cost resulting in high emptying cost;
- Difficulty in the licence cost setting on the basis that it should rise with the amount of collected faecal sludge.

Main issue:

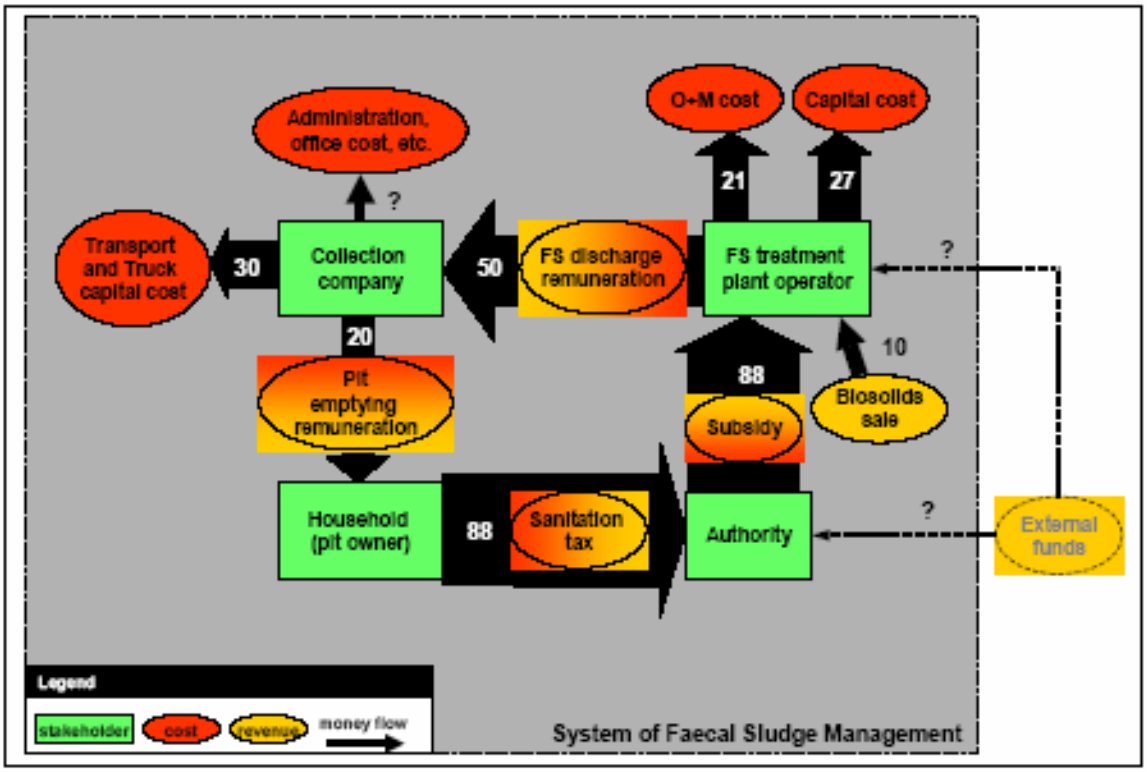
The control of emptying companies and licensing procedure require considerable political will and enforcement capacity.

SCENARIO No 4	Separate operators for the collection and treatment with Government subsidy for the FS treatment by sanitation tax, BUT the FS is considered to be commercial good.

Main description:

- Households are remunerated for the pit emptying instead of paying for the service, in other word they are selling the waste;
- The collection companies as well are remunerated for the FS discharge to the treatment plant;
- Sanitation tax are collected from households to subsidy the FS treatment plant.

Chart:



Benefit:

The model appear to be an ideal approach to enhance ecologically sustainable FSM, since:

- it allow mechanical and safe emptying of all pit holders irrespective of their financial situation;
- and allows the FS to be discharged appropriately by emptying company, resulting in no more indiscriminate dumping, because of the remuneration for FS sludge delivery to the FSTP.

Drawbacks :

The model is too incentive oriented and may rather be prone to abuses such as:

- the pit owners demand emptying before the pits and vaults have reached their designed storage capacity;
- the emptying companies fill up their trucks using river or drainage water before dumping the content in the FS treatment plant;
- the companies refuse to remunerate the pit owners after collecting the sludge.

Main issue:

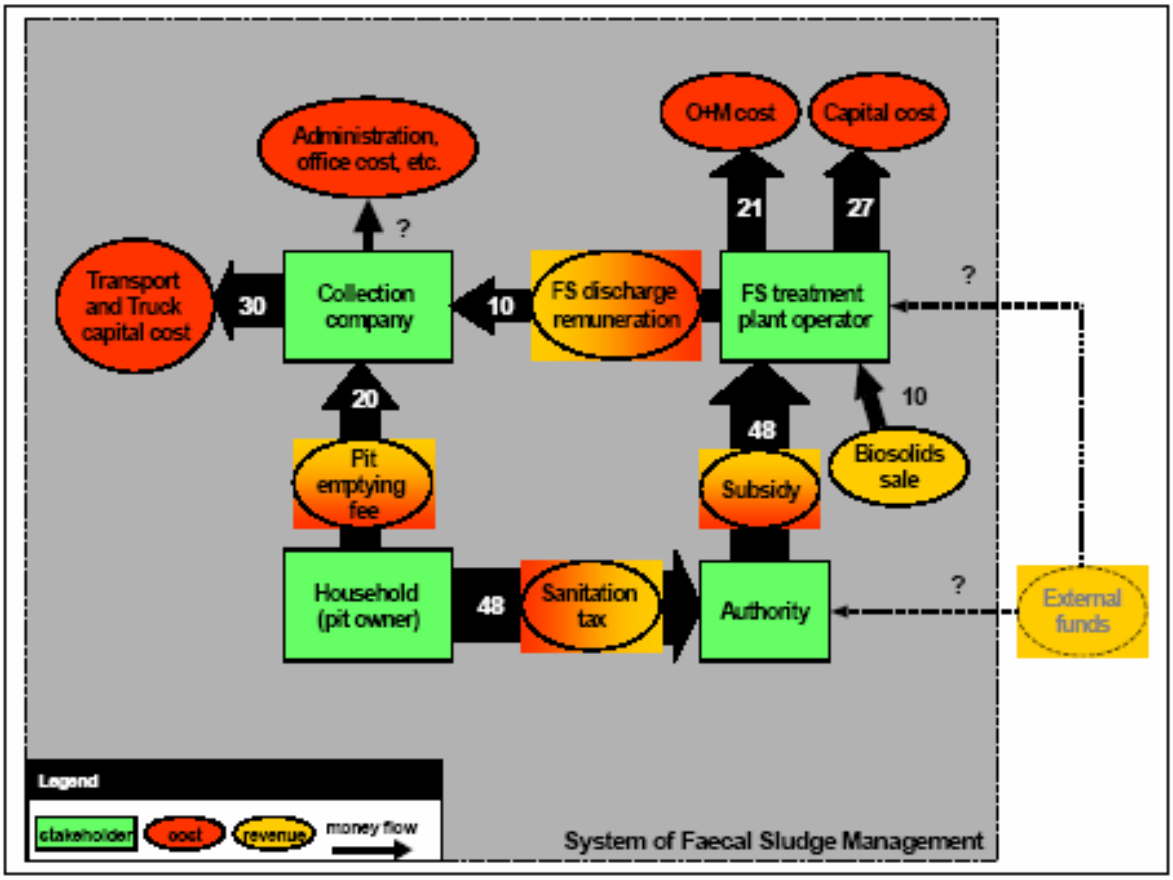
This incentive oriented model is likely to be prone to abuses and may not function correctly.

SCENARIO No 5	Separate operators for the collection and treatment with Government subsidy for the FS treatment by sanitation tax, BUT the collection company is remunerated for the FS dumping.

Main description:

- Households pay less (affordable) fee for the emptying service;
- The collection companies are remunerated for the FS discharge to the treatment plant;
- Sanitation tax are collected from households to subsidy the FS treatment plant.

Chart:



Benefit:

- The model is appropriate for a sustainable FSM, as the collection companies are forced to deliver to the FS at the treatment plant to get remunerated, this will result in no more illegal dumping;
- More households will afford the emptying service

Drawbacks :

- A higher FS dumping remuneration would encourage abuses like filling the truck with the river water.

Main issue:

The main challenge is the setting of a fair FS discharge remuneration to allow the collection company to cover its cost. The importance of compromise between an appropriate Fs dumping remuneration and affordable pit emptying fee is also an issue.