BILL & MELINDA GATES foundation

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

Final report

Team members

Denis ZOUNGRANA
Christian BERE
Lydie YIOUGO
Halidou KOANDA

September 2011

Table of contents

Table list of tables

List of figures

Summary

The management of faecal sludge of on-site sanitation facilities is a big issue in Burkina Faso urban areas. This study outlines the sanitation services delivery in three (3) cities of Burkina Faso, namely Ouagadougou, Bobo-Dioulasso and Fada N'Gourma. It aims at discuss current faecal sludge management approaches and the way forward.

According to the national survey on household's access to domestic sanitation (2010) and national standards the urban sanitation coverage is critical (9%). With the current approach and investment, Burkina Faso has gained only 1 point in percentage per year in urban sanitation coverage. The widespread sanitation facility is still the simple pit latrine called « traditional latrine ». Meanwhile faecal sludge is extracted from on-site sanitation facilities and dumped directly in the environment with negative impacts on public health.

Burkina Faso has adopted since the nineties decentralized waste management and strategic sanitation planning approach for urban sanitation. Local governments are in charge of sanitation planning with the support of national Water supply and sanitation utility (ONEA). Unfortunately faecal sludge management is not explicitly included in plans.

The findings of the study shows that Burkina Faso has clear institutional framework to tackle sanitation services delivery but the institutions and individuals do not have capacity to take over. Private sector got the initiative to manage the faecal sludge at their risks. The market reaches 80% of faecal sludge produced. Finance mobilized could be estimated at least equal to 2/3 of sanitation tax collected per annum. The system is already market-driven in big and medium cities. But it is not sustainable regarding financing and the environment. Urban planners should integrate faecal sludge management in strategic sanitation plan as a strong component of sanitation service delivery. The private operators could be involved in faecal sludge management through extraction and transportation of faecal sludge, faecal sludge treatment plants and disposal sites operation and maintenance. At the current situation, households payment will be enough to finance a market-driven primary extraction and transportation from their facilities. But public finance is needed for secondary transportation to the treatment plants and disposal sites. Otherwise the faecal sludge emptiers business won't be sustainable for short and mid-term. Sanitation tax attached to water bills could be an opportunity to use for the implementation of the new strategic planning.

Four (4) strong recommendations evolve from the study. To achieve sustainable sanitation service delivery, financial and technical partners in sanitation should pay attention to invest in upgrading the traditional latrines up to the national standards, construction of local transfer holding pits, design and construction of faecal sludge treatment plants or low-cost dumping sites, and coach mechanical operators. As a pre-requisite condition, national and local governments should set up strong regulation for faecal sludge management.

1 Introduction

Burkina Faso is a landlocked country located in the heart of West Africa in the Sudanese-Sahelian region. It has an area of 274 000 km^2. Climate change and human pressure participate in the accelerated degradation of its already limited natural resources. Regarding water resources, the country is facing a downward trend in rainfall. It has one rainy season (June to September) and the rainfall ranges from 300 in the north to 1200 mm in the south and an average of 800 mm. Burkina Faso had 15 731 000 inhabitants and a population growth rate of 3% (INSD, 2007). The main activity is agro-pastoralism of which 85% of the population derives its income. The proportion of the population living below the poverty line is 44%. The urbanization is 23% and still increasing. Urban sanitation coverage is very critical (9%) for overall urban areas. It rates at 21.49% for the cities covered by the national water and sanitation utility. Water and sanitation has a very small place in the structure of household expenditures.

2 Methodology

In Burkina Faso, households use exclusively on-site sanitation for excreta management according to the national policies for sanitation either in urban or rural areas. The big and mid-size cities have Strategic Sanitation Plans. These policies contribute to increase the number of on-site facilities. Consequently fecal sludge management becomes an issue in the cities. This study gives an overview of how people are dealing with extraction, transportation, treatment and discharge of fecal sludge and the involvement of private sector in fecal sludge business.

The method used to conduct the study is based on:

- deep literature review
- survey among the population,
- Interview with key stakeholders involved in fecal sludge management,
- Field observation
- Workshops.

2.1Literature review

The aim of literature review is to collect existing data in sanitation (excreta, wastewater and fecal sludge management) in the selected cities. The mains documents that have been consulted are:

- Report of the last national census of 2006 (INSD, 2007)
- The Strategic Sanitation Plans of Ouagadougou, Bobo Dioulasso and Fada N'Gourma (ONEA, 2006);
- The national survey on household access to on-site sanitation facility of 2010 (DGAEUE, 2011);

2.2Survey design

2.2.1 Household survey

The Data of current fecal sludge management are collected among households by surveys in the three the cities. The surveys have addressed the following issues (i) the socio economical situation of household; (ii) the water and sanitation coverage ; (iii) the type of on-site sanitation facilities; (iv) the quantity of fecal sludge produced per year; (v) the way of fecal sludge extraction, transportation and treatment/discharge; (vi) the frequency and the cost of fecal sludge extraction and transportation; (vii) the main challenges faced by households; (viii) the willingness to pay for improving the current situation.

For the survey in the three cities, the sampling of households has been done in two steps. The first one was the sample size estimate. The second one was random sampling in each city for the choice the household who will be interviewed.

Step 1: Determining the size of the sample of households for the survey in each city

The determination of the sample size of households for the survey in each city is based on the calculation of probabilities of selection of households according to three criteria:

- The geographical location of households in the city,
- The standing of household housing,
- The type of household excreta management facilities.

Table 1 shows the distribution the number of households to investigate per city.

Table 1 : **Sampling for households survey in the chosen cities of Burkina Faso**

N°	City	Population	Nb of households	Sample	Error margin (95%)
1	Ouagadougou	1 339 458	277 988	625	4%
2	Bobo Dioulasso	489 967	94 947	315	6%
3	Fada N'Gourma	41 785	8 440	150	8%

In each city, the survey was concern the entire cities. Big cities like Ouagadougou and Bobo are divided in districts and districts are divided in areas. Fada, mid-size city is considered as one district divided into areas. The number of households per district is proportional to the total households.

Step 2: Random sampling
Random sampling has been used to select a sufficient number of subjects from each district. In each district, the first household has been chosen by random.
A questionnaire is elaborated and adapted to each city. A team of interviewers per city were trained and equipped for conducting the households' survey. The teams were supervised by a junior expert with the backstopping of a socio-economist.

2.2.2 Interviews of key stakeholders

Interview was conducted based on guidance and check list of issues to be discussed with the relevant stakeholders as listed:

- Extraction and transportation operators ;
- Municipal authorities ;
- National water and sanitation utility ;
- Environment protection agencies ;
- Universities and research institute ;
- Fecal sludge reusers.

The purpose of the interviews with extraction and transportation operators, is to collect data about (i) the volume of fecal sludge collected from the city per day/month/year; (ii) the way fecal sludge is removed ; (iii) equipment used for pit emptying and fecal sludge transportation; (iv) the structure or the organization's statutes; (V) the cost and tariffs of the service (vi) the type of customers (households, commercial, industrial, government); (vii) the activity constraints (policies, legal requirements, relationship with municipal and governmental agencies); and (viii) the financial flow. The interviews are addressed to a sample of extraction operators in each zone. The data collected is completed by focus group organized with each category (mechanical, manual). An income statement of each mechanical emptying operator is established by using the information collected.

The interviews with other stakeholders (Municipal authorities, national water and sanitation utility, environment protection agencies, universities and research institute) were to collect information about (i) their role and responsibilities in fecal sludge management; (ii) their technical and financial capacity and (iv) their relationships. In appendix, details on sampling methodology are provided. Table2 shows the number of interviewed persons per city.

Table 2 : Data collected in the cities of Burkina Faso

Data collected	Fada N'Gourma	Bobo-Dioulasso	Ouagadougou
Interviews of Mechanical operators	1	4	15
Interviews of Manual operators	6	6	-
Re-users	7	-	-
Municipal authority	1	2	
National Utility agency	-	1	1
Environment and Health protection agency		1	1
University and research institute		1	

2.2.3 Field observations

The field observations aims to (i) characterize pit latrine (size and filling frequency); (ii) identify the intermediate and final destinations of fecal sludge after extraction and transportation; (iii) follow the itinerary of the truck (time of extraction – transportation – dumping, the number of pits to empty for filling the truck and the truck volume; (iv) identify the quantity of fecal sludge removed per day in each city; (v) analyze the impacts on environment of discharged sludge.

2.2.4 Workshops with stakeholders

A restitution workshop of the study preliminary report will be organized with all stakeholders in each selected city. During these workshops, stakeholders will have the opportunity to validate the collected data and to give their opinion on the situational analysis of fecal sludge management system.

2.3 Data analysis

2.3.1 Statistical analysis

Survey data are captured and processed by Excel and XLSTAT software. Statistical analysis is mainly descriptive. Average, sum, mode, variance and standard deviation are calculated for household's practices in sanitation (sanitation coverage, types of latrines, frequency of extraction, tariffs, etc.), their socio-economical conditions and perceptions (revenue, activities, socio profile, willingness to improve, to pay, etc.).

2.3.2 Institutional analysis/stakeholders analysis

Institutional analysis underlines the role of each stakeholder (the water/sanitation agency, local government, municipality, health department, environmental agency, mechanic and manual operator), their actual contribution in fecal sludge management and their relationships. At the end of this analysis, role and responsibilities of each stakeholder has been emphasized. A platform for multi actors' dialogue has been designed to support the institutional arrangements.

2.3.3 Financial/market analysis

The financial analysis consists in (i) evaluating the service cost (extraction, transportation, treatment, discharge and reuse), (ii) establishing the financial flow of fecal sludge management and (ii) proposing sustainable scenarios (tariffs setting, incentive measures, regulation).

The main purpose is to evaluate the current and potential market for small private enterprises to invest in fecal sludge management and make business. A simulation of enterprise activities, revenues and expenses will show the conditions of setting up small business units (tariffs, incentives, investments, equipments, supports from banks and other financial institutions, etc.). The opportunities for reusing treatment products is explored and integrated in the analysis framework.

2.3.4 SWOT analysis

An overview of fecal sludge management system, the issues and challenges come out by using SWOT analysis. The strengths and weaknesses of the institutional and financial aspects has been be highlighted. The opportunities for improving fecal sludge management and the threats have been emphasized. In this way, strong solution comes out from the study findings in order to improve the fecal sludge management in selected cities.

3 Situational analysis

3.1Landscape analysis

3.1.1 Demograhic aspects

Ouagadougou is the capital of Burkina Faso and is located in the centre of the country (See map below).
With 1 339 4581 inhabitants, Ouagadougou is the biggest city with high demographic growth rate due to in-country migration. The 2nd city is Bobo-Dioulasso, located in the western part with a population of 489 960 inhabitants. It is the economic capital of Burkina Faso. Fada N'Gourma is a small town located in the eastern part of the country. It is a semi-urban city of 41 785 inhabitants. In Ouagadougou and Bobo-Dioulasso, the revenue of households comes from informal and small business while in Fada N'Gourma farming and livestock are predominant.

Figure 1: Location of the 3 cities in the map of Burkina Faso

3.1.2 Institutional and legal framework

Sanitation policy

In Burkina Faso, there is a national sanitation policy established since 1997 which aims to protect and improve health. The main purpose is to eradicate fecal drama by taking actions to provide local governments with plans and tools. For the entire country, government is implementing a national programme for MDGs achievement in order to reduce by half the number of people without access to drinking water and improved sanitation. The urban component of this programme is led by the National Water and Sanitation Utility (ONEA) which elaborate strategic sanitation plans for 60% of urban cities (28/47). These strategic sanitation plans are based on demand-driven approach combining capacity to pay and subsidies for the poorest households (Wright, 1997). They promote at large scale on-site sanitation but for big cities, small wastewater networks and treatment plants are planned to cover industrial zones and business centres.

At national and local level, there is no FSM policy or strategy. Some strategic sanitation plans (Ouagadougou, Fada N'Gourma and Bobo-Dioulasso) mentioned FSM and aims to construct FS treatment plants.

Stakeholders' analysis

The main stakeholders involved in Faucal Sludge Management in Burkina Faso are: the Central and Local Governments, The National Water and Sanitation Utility, the extraction and transportation operators, the re-users, research centers and financial partners.

- **The Local Governments**: According to the Local Government General Code (December 2004), Local Governments are in charge of organizing and providing improved sanitation services to the citizens. The FS

management in Ouagadougou and Bobo by the municipalities comes down to emptying low income household pits. **The National Water and Sanitation Utility (ONEA)**: ONEA is the main urban sanitation operator. ONEA has signed a MoU with the local governments to develop the sanitation service. Strategic Sanitation Planning is the main approach used by ONEA for promoting improved urban sanitation services. This Strategic Sanitation Plan is being implemented in the 3 cities subject of this study (mainly **onsite sanitation facilities). ONEA is technica**lly and financially supported by many development agencies and institutions (e.g. French Agency, German cooperation agency, Danish cooperation, World Bank, etc.).
FSM is not integrated properly in the plans. For the case of Ouagadougou and Bobo-Dioulasso, ONEA has planned to construct a FS treatment plants without any clear idea on how these plants will operate. For the small towns such as Fada N'Gourma, FSM is mentioned in their strategic sanitation plans but not as an entire component.

- The National Water and Sanitation Utility is implementing a project which aims to develop a FS Management model for Ouagadougou and Bobo-Dioulasso with the financial support from French Development Agency. This project has three (3) main components: (i) institutional arrangement between stakeholders – capacity building, roles and responsibilities, (ii) regulation of FSM in the city by municipal authorities, (iii) construction of 3 FS treatment plants. Private sector is involved in the implementation of the project (participating to define treatment sites, model of regulation, requirements for FS extraction and transportation, dumping fees, etc. There is a need for capacity building for an effective FS management at local level.

- **The Central Government**: the central government is supposed to elaborate policies for organizing, controlling and monitoring sanitation project/activities. It is represented at local level by Technical Services from several ministries (Health, Environment, and Water). No specific FSM policy has been developed so far. They need also capacity development to really contribute for establishing an FSM policy in the country.

- **Research and training centers**: The most significant are University Of Ouagadougou, International Institute for Water and Environment (2iE) and the Regional Centre for Water and Sanitation (CREPA). Many studies have been conducted on FSM issues.

- **Donors**: Many donors are supporting sanitation sector in Burkina Faso but few of them are interested in FS management. ONEA is implementing In Ouagadougou and Bobo-Dioulasso a FSM project financed by French Development Agency and World Bank. German Development agency and Bill and Melinda Gates Foundation are potential partners for improving FSM in the country. The current study will provide ONEA and other stakeholders with ideas on how to strengthen and involve private sector in the FSM planning.

- **The Extraction and Transportation Operators:** There are 2 main types of operators, the manual and the mechanical operators. Many individual and small enterprises are operating in FSM sector in Burkina Faso. The mechanical operators are operating with second hand trucks in 5 main cities including Ouagadougou, Bobo-Dioulasso and Fada N'Gourma. They are not equipped to transport the sludge out from the surrounding of the pit. The mechanical operators are from private sector but some public institutions are owners of trucks (National Police, Army, Municipality of Ouagadougou, and Prison of Ouagadougou). In the city of Ouagadougou, they are organized as an association to raise their social profile and better promote their rights and profession. The one from Ouagadougou is part of stakeholders involved in the implementation of the project cited above. These associations also play the role of interface between operators and local governments. The main challenge for both manual and mechanical operators is the lack of Treatment plants or official dumping sites for fecal sludge. Spare parts of vacuum trucks are also an issue.

- **Re-users of FS:** During our investigations, some cases of reusing FS (treated or not) in agriculture have been mentioned by operators and households. That is an informal activity.

- **Households**: They are the main producers of fecal sludge. They request for disludging the pits when full. In rural context, there is no service of disludging and the households are used to close the pit and build a new latrine.

The figure below shows the relationship between stakeholders in the context of Burkina Faso. The various relationships between the stakeholders of sanitation at local level in Fada N'Gourma can be summarized as stated in Figure 1. Institutional framework matches the situation of FSM in Burkina Faso. However the institutions and individuals don't have capacity to implement their mandate. Setting regulatory framework is the main task to fulfil in order to create and strengthen relationships between the stakeholders.

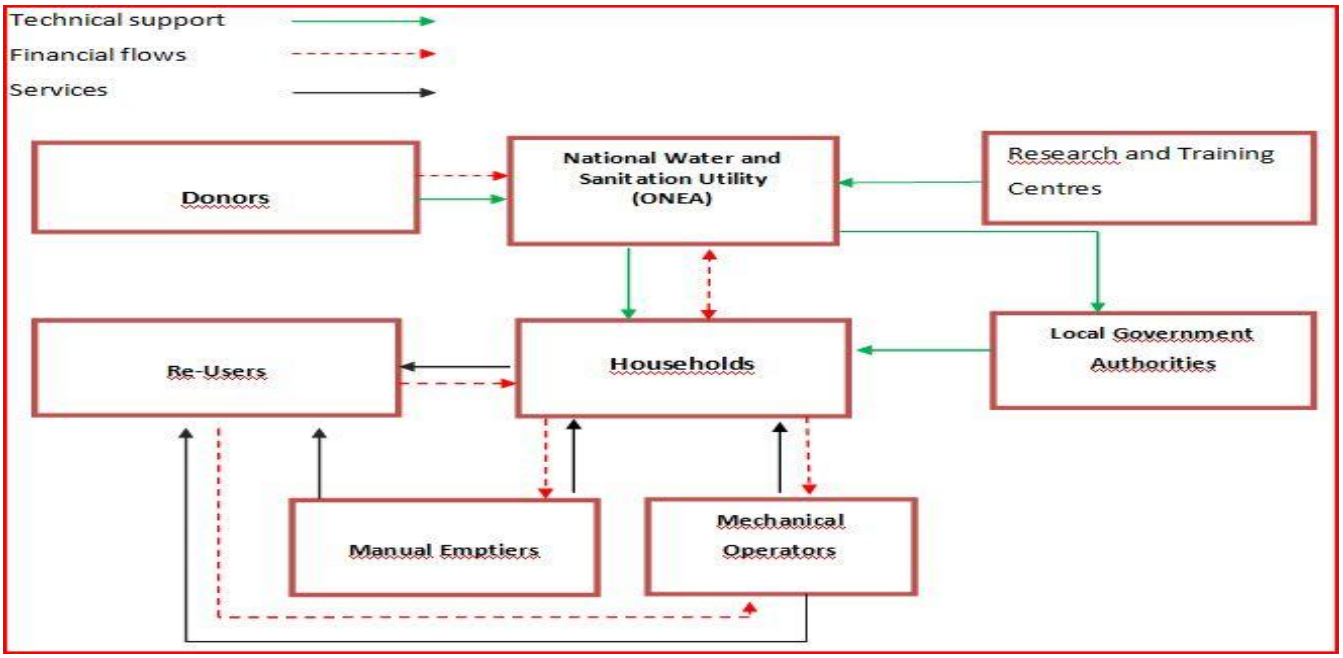


Figure 2 : Model of Relationships between Stakeholders in Burkina Faso

3.2 Financing

In Burkina Faso, central and local governments are mainly promoting on-site sanitation. In urban areas, ONEA with the supports of partners is implementing strategic sanitation plans by subsidizing on-site sanitation facilities construction. The subsidy depends on technology and amount of fund raised by ONEA. In the framework of the National Program for Water and Sanitation, ONEA receives funds from central government. However, ONEA raises fund by submitting projects to partners such as World Bank, French Development Agency, German cooperation, Danish cooperation, etc. Some local governments started raising fund for sanitation via decentralized cooperation.
Since 1985, ONEA is collecting sanitation tax defined by government to promote hygiene and sanitation. This tax is collected monthly based on the drinking water consumption and annexed to the water bill (see table 3 below). Actually, an average of 2 millions USD is collected per annum. ONEA uses this tax to cover the cost of operation and maintenance of sewerage networks and waste water treatment plants of Ouagadougou and Bobo-Dioulasso, to develop the demand for sanitation and subsidize households engaged in improving their on-site sanitation facilities.

Table 3 : profile of tax collected monthly annexed to water bill

Type of access to services	Tax (USD/m^3)
Water public tap service	0.021
Household with Water connection & on-site sanitation facility	0.045
household with Water connection & sewerage connection	0.129
Industries and business centres	0.193

The fecal sludge extraction and transportation is entirely financed by households through payment to mechanical and manual operators. The amount raised per year can be estimated at USD 1.56 millions for Ouagadougou, USD 103 000 for Bobo. In other words, households are subsidizing the sewerage operation and maintenance and still have to disludge their own facility. Something has to be done for equitable cross-subsidy between consumers.

3.3 Access to services

3.3.1 Drinking Water supply and sanitation coverage

The water supply coverage for the entire country is about 60% with 56% in rural areas and 70% in urban ones (Revue conjointe PN-AEPA 2011). With a supplement effort, Burkina Faso could reach the MDG target for water supply by 2015. Ouagadougou is more covered, followed by Bobo-Dioulasso and Fada N'Gourma. The majority of households having access to safe water are connected to water network in Ouagadougou and covered by standpipe in Fada N'Gourma. Covering the peri-urban areas is a remained challenge for the national and local authorities.

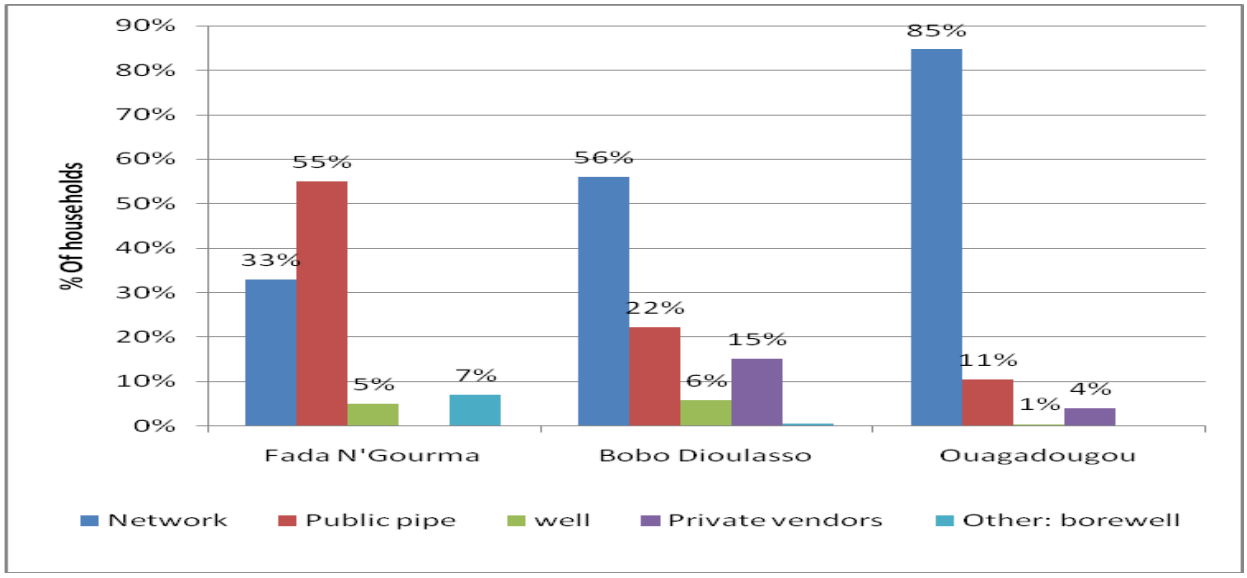


Figure 3 : Drinking Water Access in 3 cities

According to the national water utility standards, access to sanitation means having within the household either an improved latrine and a cesspool, simple poor flush system and cesspool, septic tank system or a connection to sewerage network. But sanitation coverage is measured only by having an excreta collection facility.

All the 3 cities have an ongoing strategic sanitation plan being implemented by ONEA in collaboration with municipal authorities. The main challenge is how best to address households living in the informal settlements or in the periphery of the cities. According to the last national sanitation survey (DGAEUE, 2011), the sanitation coverage at national level is very critical (9%) specifically in rural areas (less than 1%). Our survey reveals that households are mainly equipped with simple pits latrines: 63% for Fada N'Gourma, 94% for Bobo-Dioulasso and 61% for Ouagadougou (figure3). One should remember that simple pit latrine is not considered as a sanitation facility according to Burkina Faso standards.

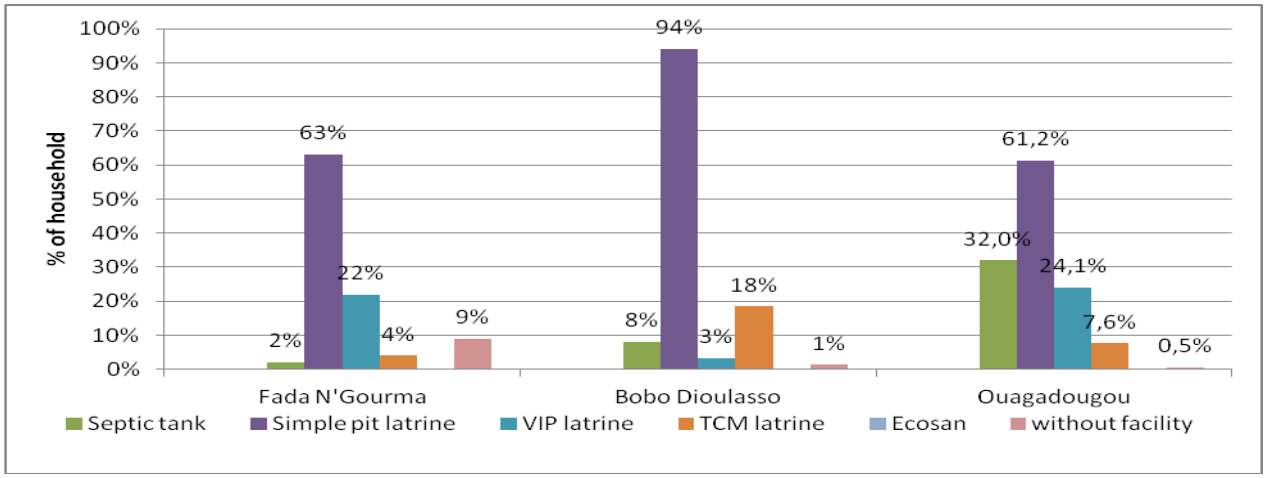


Figure 4 : On site sanitation facilities in three cities of Burkina Faso

The households' survey reveals that some of them have more than 1 sanitation facility. Most of the time, those having septic tanks have also another facility such as simple pit latrine, VIP or pour flush latrine (TCM) for visitors and guests. The overall water supply and sanitation coverage in the three cities are above the national coverage for urban areas (see table 4 below).

Table 4 : Water and sanitation coverage for three 3 cities in Burkina Faso.

	Fada N'Gourma	Bobo-Dioulasso	Ouagadougou
Water supply coverage (%)	88	93	99
Sanitation coverage (%)	28	29	64

Source: Households' survey

3.3.2 Faecal sludge production

Table 5 below shows the fecal sludge production based on the method1 (survey and characteristics of the facilities) and method2 (quantity per person per day).

Table 5 : Quantity of faecal sludge in Fada N'Gourma, Bobo-Dioulasso and Ouagadougou

Calculation method	Fada N'Gourma	Bobo-Dioulasso	Ouagadougou
Method1 – Survey (m^3/year)	4 045	59 361	439 122
Method2 theoritical (m^3/year)	4 331	62 593	255 451

Source: Households' survey

Calculation assumptions for theoretical method:

- improved latrines are considered as simple pit latrine in terms of sludge production;
- The specific production is 0.3 l/day / capita for simple pit latrines and 1l/day/capita for septic tanks (Koanda, 2006);
- The TCM latrines are considered as septic tank in terms of faecal sludge production.

Table xxx shows that the 2 methods used for calculating FS production are robust for Bobo-Dioulasso and Fada N'Gourma (much closed results). But, for Ouagadougou there is a high difference between the results that could be explained by: (i) high frequencies of pits and septic tank emptying, (ii) depth of latrines.

Greywater is mainly dumped in streets and open spaces. Cesspools are not yet good promoted and adopted by households in all the cities as shown in figure 5.

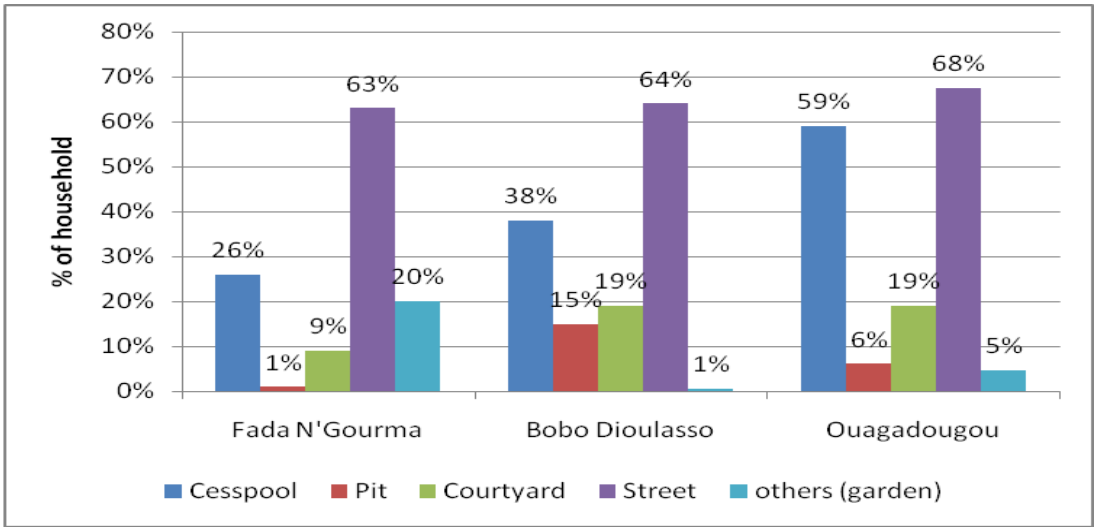


Figure 5 *: greywater management by households in 3 cities*

In Ouagadougou and Bobo-Dioulasso, wastewater from city business centre and industrial zones are collected through sewerage network and treated for disposal in wastewater treatment plant. These systems are managed by ONEA.

3.3.3 Fécal sludge management

Average frequencies of pits emptying depend on the facility design and its use. According to survey respectively 44%, 39% of pits have never been emptied in the cities of Fada N'Gourma and Bobo-Dioulasso. This rate is only 7% for the city of Ouagadougou. In Fada, the period of desludging varies between 5 to 10 years for 26% of the pits, while it is 2 years for 15% of the pits in Bobo. In Ouagadougou, the average emptying period seems to be too high (2 years for 34% of the pits from that can be observed

4 Extraction and transportation Market analysis

4.1Supply of fecal sludge market

4.1.1 Current situation/Technologies and efficiencies

Two types of operators work in fecal sludge extraction and transportation businesses: mechanical **enterprises and manual operators. Desludging capacity is captured by the survey among the operators** themselves and the households. As far as mechanical emptying operators are concerned, there are:

- A single mechanical operator is recently established in Fada N'Gourma in 2011. For the past time the mechanical extraction service is provided by a small enterprise located in another town 100 kilometers far from;
- Six (6) companies, among which two public trucks in the city of Bobo-Dioulasso;
- Thirty nine (39) companies in the city of Ouagadougou included three (3) public utilities.

The table below shows their intervention capacities. It is well known that some of the trucks are too old and broke very often.

Table 6: Mechanical Faecal sludge extraction and transportation capacity in three cities of Burkina Faso

City	Number of operators	Number of vacuum trucks
Ouagadougou	39	59
Bobo-Dioulasso	6	6
Fada N'Gourma	1	1

Source: survey data

The average tank volume is 8 m^3 for Ouagadougou and Bob-Dioulasso and 12 m^3 for Fada N'Gourma. It is important to notice that a small but an increasing part of fecal sludge is collected through sewerage network in the city of Ouagadougou and Bobo-Dioulasso. The networks and the wastewater treatment plants cover the need of commercial zone (hotels, restaurants…) and industries. They were part of the survey.

The number of manual operators is difficult to determine because they operate informally earlier in the morning or in the middle of the night. They don't have addresses. Their activities are captured across the households declarations about extraction of their on-site sanitation facilities. Among households that have emptied their facility in Ouagadougou, 22% have used manual operators. This rate increases to 55% in Bob-Dioulasso and 57% for the city of Fada N'Gourma. This situation can be explained by the predominance of simple pits latrines difficult to be emptied in the last two cities.

How do they operate?

- **Mechanical extraction and transportation**

In Burkina Faso, mechanical extraction service is well established in big cities such as Ouagadougou and Bobo-Dioulasso. In general, they pump the liquid fraction of the sludge. The emptying process is as follows. The truck is parked as close to the pit. After removal of the slab, emptying pipe is introduced into the pit by the dustman. Once the pipe system is installed, the emptying begins with the start of the compressor

suction pump. The mechanical emptying is done by a team of 2 persons: the driver and the dustman. The FS extracted mechanically are dumped in open spaces due to lack of official dumping sites or FS treatment plants. Sometimes, farmers request to dump the sludge on their fields for small flat fees.

- **Manual extraction**

Manual emptiers desludge very often simple pits, VIP latrines, and sometimes septic tanks. The equipment used are buckets, shovels, picks crowbars, wheelbarrows, carts and rarely scarves, gloves and boots. They also rent pumps from gardeners in case of septic tanks emptying. Generally, manual emptiers work by team of 2 or 3 persons. After removing the slabs of latrine, they put hail and oil into the sludge for 24 hours in other to reduce the bad smelling. The first part of sludge is removed with a shovel and the rest, one of the emptier have to go down into the pit, filled a bucket and the second emptier pull the bucket with a rope and pours the contents outside. The fecal sludge is sometimes put on the floor in front of the house or is dumped in a new pit and closed by sand. The manual emptying team completes the work by cleaning the immediate vicinity.

For instance the sludge extracted manually is discharged in the streets in Bobo-Dioulasso (66%), Fada N'Gourma (69%) or in open spaces for Ouagadougou (92%). In some cases, households request for burying the sludge in another pit digged next to the emptied pit. The manual emptiers don't have means for transporting the sludge out of the cities. In the case of Fada N'Gourma, the dried sludge (31%) is sold or offered for free by households to farmers (picture 1).

Picture 1: Stock of dried FS in a farm of Fada N'Gourma

- **Health link to fecal sludge management**
  - Emptying operators: Emptier does not use protective equipment (gloves, scarves, and boots) for the fecal sludge extraction process. Then they are in contact with the sludge and are exposed to infections. Manual operators also are sometimes victims of landslides from the walls of the pits;
  - Households: the surveys state that the sludge drained manually, were discharged behind the house on the street or buried in a pit. These places are usually the ideal sitting for children's play (unprotected). These places are major risks of contamination by pathogens in the sludge drained ;
  - Reusers: The use of untreated fecal sludge by farmers exposed them to health risk

Uncontrolled dumping of fecal sludge in nature creates visual and olfactory pollution for people and presents health risks by contaminated vegetables, surface and groundwater.
The way of pits emptying and the untreated fecal sludge discharged involve risks among emptying operators Household mainly children and re-users.

4.1.2 Mechanical companies

4.1.2.1 Profile of mechanical operators

The surveys in the three cities show that all of the mechanical are multi-activities companies and the common profile of the operators is:

Education

- Several have a low level of scholar education
- managers are without any special qualification in the field of management
- No knowledge of the regulations for the sludge management
- Underestimation of risks to workers
- Business conducted in an informal manner.

Evolution

- Business conducted in an informal manner
- No formal relationship with the city council, ONEA and Environmental Services. But, in Ouagadougou there are some meeting between ONEA and the some of the operator
- No authorization is required to implement the activity

Company Structure

- Staff composed of the boss and the workers. The workers are 2 or 3 per truck
- No special provisions for health protection of workers
- Pas de local propre à l'entreprise : à la maison ou abritée dans les locaux pris pour une activité principale
- No head office
- Equipment consisting of truck, older than 20 years, a capacity from 4 to 16 m3. Bought used locally or imported, without major modifications.
- Specific equipment working for workers: gloves, boots and coats

Features of business

- Bank loans for the purchase of their truck and reimbursement
- Service opened 5-6 days a week, but in reality they worked fully 2 or 3 days per week
- Faecal sludge extraction and transportation are is not the main business of the operator
- Average number of households served per day: 4 /Number of trips per day: 4
- Average distance per trip : in Bobo-Dioulasso is about 15 to 35 km and in Ouagadougou is about 15 to 45 km
- Socio-economic profiles of customers: All Categories
- No specific strategies to get customers

4.1.2.2 Mechanical companies profitability

There is no bookkeeping and no separate financial statements related to the fecal sludge extraction and transportation business. The financial analysis is generated from the use of the data collected directly with the managers who supplied them without any written evidence.

- **Level of business activity**

As shown in table 7 the number of households deserved per day varies from 4 to 16 depending of the number of trucks during of the high season of July to September.

Table 7: Number of trips per day for mechanical operators

Customers	Bobo Dioulasso : Mechanical operator	Ouagadougou : Mechanical operators with			
	01 truck	01 truck	2 trucks	3 trucks	4 trucks
Total number of customers per day	4	4	7	11	16

- **Expenditure**

The different categories of firms have the same structure of costs.

- operation (fuel expenses) and maintenance cost;
- tyres, pipes, insurance, equipment of protection and the technical visit and unforeseen expenses ;
- personal fees;

- Administrative expenses.

The quasi-totality of companies has no provision to rent an office, and trucks are parked along ways. Also, they do not make any depreciation allowances.
The average cost of a complete trip for extraction transportation and dumping, taxes excluded, are presented in table 8 below. For the same city like Ouagadougou cost per empting operation is going down with the number of trucks per company.

Table 8: cost per trip (empting operation)

	Bobo Dioulasso : Mechanical operator with	Ouagadougou : Mechanical operators with			
	01 truck	01 truck	2 trucks	3 trucks	4 trucks
Cost per trip (USD)	21.7	28.5	26.4	25.9	24.7

The table 9 below gives the importance of operating costs of mechanical emptying business in the cost per trip in the city of Bob-Dioulasso and Ouagadougou

Table 9 : Importance of operating expenses in the costs per trip

Enterprises operating in	% average of different operating costs								
	Fuel	Operations and maintenance	Tyres replacement	Pipes	Personal	Business administration	Insurance	Equipment for personal	miscellaneous*
Ouagadougou	51,4%	10,5%	13,7%	2,6%	10,5%	3,0%	1,4%	1,6%	5,3%
Bob-Dioulasso	52,6%	16,3%	7,7%	1,9%	10,4%	4,5%	1,2%	1,4%	4,1%

(*) Police harassment

The highest running cost per trip is fuel (more than 50%), followed by maintenance, tyres replacement and the personnel. On the whole, running cost of the truck represents 78% of the total business running cost in the city of Ouagadougou and Bob-Dioulasso as well.

- **Revenue**

Operator's revenues come solely from collection or extraction, transportation and dumping bills. They set indicative tariffs, but billing is a bargaining process depending on two factors:

- Pit volume and fullness: the customer pays full fee if the sludge quantity is large than the half of truck tank.
- Household standard of living: for the same volume extracted, fee can be higher than the average tariffs set the wealthy household or less if the household is poor.

That is why the fee paid by households ranges from USD 17 to USD 45. At the end average desludging can be estimated at USD 63 in Ouagadougou and USD 32 in Bobo-Dioualasso,

The extraction service fee varies from 27 USD to 34.4 USD per emptying operation. In Ouagadougou, 74% of households report having paid between USD 32.25 and USD 53.76; in Bobo Dioulasso, 72% of households report having paid between USD 21.5 and USD 43. We consider the average bill paid by households in Ouagadougou and Bobo Dioulasso are respectively USD 43 and USD 32.25.

- **Net revenue per year**

Theoretically all classes of the mechanical operators foresee a benefit from their businesses, and an increasing with the number of trucks. See table 10 below.

Table 10: Net revenue calculation in USD

	Bobo Dioulasso : Mechanical operator with	Ouagadougou : Mechanical operators with			
	01 truck	01 truck	02 trucks	03 trucks	04 trucks
Gross Revenue	30 968	33 118	75 355	113 548	165 161
Running cost	25 322	23 371	47 502	68 345	94 749
Revenue	5 646	9 747	27 853	45 203	70 412
Net revenue	3 952	6 823	19 497	31 642	49 288

USD 1 = XOF 465

The average purchase price of used trucks is around USD 43011. A depreciation over 10 years would be about USD 4301 per year per truck. On this basis, in Bobo Dioulasso, companies equipped with a single truck would not be profitable. In Ouagadougou they would be almost 70% less profitable.

- **Cash-flow**

Most companies say they do not practice trucks amortization. In this case, cash flow can be summed up in the net operating income minus dividends taken by shareholders, including the remuneration of the promoter in the case of sole ownership. To do this, we can assume the 2 / 3 of net income are spent on salaries and dividends, the third self-financing. On this basis, we see, as shown in Table 11 below, that it is possible to all classes of business get a cash flow.

Table 11: Cash flow of mechanical operators (USD)

	Bobo Dioulasso : Mechanical operator with	Ouagadougou : Mechanical operators with			
	01 truck	01 truck	01 truck	01 truck	01 truck
Cash flow	1 317	2 274	6 499	10 547	16 429

- **Breakeven analysis**

The breakeven point is much lower than the turnover number of different types of business. This would mean that all categories of businesses are in a comfortable situation. The security index is very high for each category, or about 0.8 for companies based in Bobo Dioulasso and 0.9 for categories of companies in **Ouagadougou**. This implies that all types of enterprises can quickly reach the critical turnover.

Table 12: breakeven of mechanical operators (USD)

	Bobo Dioulasso : Mechanical operator with	Ouagadougou : Mechanical operators with			
	01 truck	01 truck	02 trucks	03 trucks	04 trucks
a- Turnover (excluding taxes)	30 968	30 968	72 258	113 548	165 161
b- Total variable costs (excluding taxes)	9 217	9 775	17 546	23 873	31 406
c- Contribution margin (a-b)	21 751	21 193	54 712	89 675	133 755
d- Ratio margin (c/a)	71%	68%	76%	79%	81%
e- Total fixed charges[1] (excluding taxes)	3 297	2 824	5 865	8 988	11 730
f- Breakeven (e/d)	**4 694**	**4 127**	**7 746**	**11 381**	**14 484**

[1] Staff costs, Trucks insurance, Technical inspection of trucks,

4.1.2.3 Mechanical companies' sensitivity and risk analysis

The table xxx determines the profitability of companies. The benefits of a company equipped with 4 trucks are 7 times more profitable than those with only 1 truck.

The sensitivity of desludging activity in Ouagadougou and Bob-Dioulasso depend on fuel consumption, maintenance of truck (operation and reparations), tyres replacement cost, police harassment cost, age of the truck, average tariff and the distance for 1 trip. Rationale of hypothesis is:

- - 5% of distance for rationale management of routing
- - 5% of fuel cost for good maintenance of the motor ;
- - 30% of maintenance cost by respecting disludging period and purchasing good quality repair parts ;
- - 50% of new pneumatic cost refunded after 2 years.
- -50% of harassment cost due to administrative requirements during controls
- Purchasing new trucks assume that fuel cost decrease (20%), maintenance decrease (70%) and pneumatic decrease (50%) during the 2 first years.

The table 13 below shows the effects on benefits of a variation of factors.

- **Age of the trucks:** All operators purchased 2nd hand truck at least 15 years old. There are 2 risks linked to trucks' age: clash of motor which could occur at any time and the availability of repair parts. This could generate standby for long time of the truck. The analysis is done assuming that the truck is purchased new.

- **Tariff paid by customers:** It would have been relevant to measure the sensitivity of demand on price and conclude on the effect of increasing the price on annual benefits of the enterprise. The data collected don't allow such analysis. Considering that portfolio of clients is the same, we assume 10% of emptying price will increase for 10% due to service improvement.

Table 13: Sensitivy study of companies benefit

Factor	Hypothesis of variation*	Variation rate on benefit of the enterprise equipped with				Average
		1 truck	2 trucks	3 trucks	4 trucks	
Tariff	+10%	32%	26%	25%	23%	27%
Distance for 1 trip	-5%	11%	8,5%	8%	7,5%	9%
Fuel cost	-5%	6%	4%	4%	4%	4%
Maintenance cost	-30%	7%	5%	3%	4%	5%
Cost of pneumatics	-50%	17%	12%	11%	9%	12%
Cost of miscellaneous	- 50%	10%	5%	2%	2%	5%
Age of truck	New	66%	46%	40%	36%	47%

The data collected don't allow a sensitivity analysis based on « capacity of trucks » which though determines the operational capacity of mechanical operators.

- **Dumping fee :** Considering that fecal sludge treatment plant exist, the sensitivity of mechanical operators activities to pay a dumping tax has been analyzed

Table 14: The sensitivity of mechanical operators activities to pay a dumping tax

Tariff	Variation rate on benefit of the enterprise equipped with				
	Bobo Dioulasso	In Ouagadougou			
	1 truck	1 truck	2 trucks	3 trucks	4 trucks
USD 0.22/m3	-35%	-14%	-11%	-10%	-12%
USD 0.43/m3	-71%	-27%	-21%	-20%	-23%
USD 1.08 /m3		-68%	-53%	-50%	-59%

All the enterprises cannot stand dumping tax more than USD 0.43 per m^3.

4.1.2.4 Sustainability of mechanical companies

The sustainability of mechanical companies depends on several factors.

- **Equipment management**

All operators working with used trucks, aged from 15 to 20 years. There are two major risks associated with outdated trucks, namely: (i) the engine breakdown can occur at any time. This can be fatal for a young company, and (ii) the inability to quickly find some replacement parts which may result in the immobilization of the truck for long periods.

This is an important factor implies that the manager has a business concern in the regular maintenance and repair trucks. This requires not only the existence of permanent cash but more importantly the will of the operator to make a good maintenance logistics. The interviews show that the bankruptcy of many companies due to the greatly extended outage trucks.

- **Administrative and financial management**

The analysis of profitability and the sensitivity of the mechanical companies reveal that there are factors those managers must incorporate into their daily management not to erode their profits. These include the control of expenses related to emptying, namely fuel, tires and the cost of police checks. Some companies to avoid long journeys have decided to operate in a specific area of the city. In Ouagadougou, in the case of the company whose Ikuzo range of about 5km around his head or companies like CLAUVIS vidange and GUESWEND vidange and which operate only the scale of a few sectors.

It should also be noted that companies do not provide for depreciation. This significantly reduces their ability to develop a strong cash flow, to renew their trucks and the better to increase the number. Companies are very vulnerable.

In addition, the purchase price of the trucks are very high, approximately USD 43,000. This requires that companies have access to bank loans for periods of at least 5 years. Managers must be able to effectively manage long-term loans.

- **Personnel management**

Effective personnel management is a condition of mechanicals companies' viability. They determine: (i) the quality of services, which affects the portfolio of clients, (ii) the good functioning of trucks and expenses relating thereto, and (iii) the benefit of enterprises if they do not travel well or are not honest. Managers need to know to select skilled and conscientious workers (drivers), motivate and secure and strengthen their capacity to use well equipment, to communicate well with customers and to work according to quality standards

4.1.3 Manual operators

4.1.3.1 Profile of manual operators

The profile of manual operators is as followed:

Education

- Education: mostly illiterate
- managers are without any special qualification in the field of management
- No knowledge of the regulations for fecal sludge management
- Underestimation of risks for manual emptying
- Business entirely within the informal sector

Evolution

- Business conducted in an informal manner

- No formal relationship with the city council, ONEA and Environmental Services
- No authorization is required to implement the activity

Organization structure

- Company formed by co-option of up to 2 or 3 people, working as teammates, but with a team leader
- No special provision to protect their health
- Pas d'adresse au non de l'entreprise. Ils sont ambulants
- Equipment consisting of buckets from 10 to 20 liters, strings 6 to 10 meters, the daba, shovels, picks and wheelbarrows or.
- Use of products such as oil, sleet to mitigate odors and to catalyze the consolidation of the top layer of sludge; soap for bathing after operation
- No use of specific equipment such as gloves, gowns, masks and boots. The strong suffocating heat in the pit does not allow the wearing of such equipment

Features of business

- No loans
- The activity is carried out continuously throughout the year Number of working days per week from 1 to 6 days a week.
- Most of the time, they have small additional business (mason, security guards, running shops, etc.)
- One (1) pit emptied daily
- No charge of transportation for the disposal of sludge, where the majority of cases they are buried on the plot or in the public domain (the street behind the wall of the housing).
- Socio-economic profiles of customers: all categories, the vast majority of poor households equipped with pits that cannot be emptied mechanically.
- No specific strategies to get customers, but some informations are gathered from mechanical operators.

Most of them run others activities during the day time

4.1.3.2 Manual operators profitability

The billing system is flexible and based on the risks in the process of disludging and the volume of the pit. In average, households pay USD 27.8, 24.4 and 25.5 per emptying operation respectively in Fada N'Gourma, Bobo-Dioulasso and Ouagadougou.

Overall, operating expenses for manual emptiers are indexed to each operation. They boil down to the rental of small equipment (wheelbarrows, shovels or buckets). The amount of these fees varies between USD 3 and USD 5. The emptiers operate on average time of 180 working days per year. On this basis and the household survey data, the following table 15 shows the income statement of manual operators.

Table 15 : the income statement of manual operators

	Fada N'Gourma	Bobo Dioulasso	Ouagadougou
Num of working days per year (a)	180	180	180
Num of emptied pit per year (b)	1	1	1
Average bill **per** pit (c)	28	24	26
Average expenses per pit (d)	4	5	5
Net operating revenue (USD)	4 230	3 424	3 622

Manual removal companies consist of 3 persons and the daily gain is distributed evenly at the end of operation. So the average monthly income per person is USD 117, 95, 101 respectively in Fada N'Gourma, Bobo-Dioulasso and Ouagadougou.

4.2 Demand analysis

4.2.1 Fecal Sludge extraction and transportation market

The fecal sludge produced per year base on survey data or theoretically is more important than FS that have been collected by mechanical and manual operators. According to the survey the market of fecal

sludge extraction and transportation is 76% of the production for Bobo-Dioulasso and 60% for Ouagadougou (Table 16 below).

Table 16: Produced and collected FS in Fada N'Gourma, Bobo and Ouagadougou

Calculation method	Fada N'Gourma	Bobo-Dioulasso	Ouagadougou
Method1 – Survey (m^3/year)	4 045	59 361	439 122
Method2 theoritical (m^3/year)	4 331	62 593	255 451
FS collected (m^3/year)	-	44 811	238 673

4.2.2 Type and evolution of demand

- The households constitute 80 % of the the mechanical emptiers customers and almost 100 % for the manual emptiers. In the cities of Bobo-Dioulasso and Ouagadougou the industries, the hotels and the administration constitute a significant category of demand for the sewage disposal businesses. However, they are progressively losing these customers the sewerage system has been established in these towns.

- The FS emptying demand fluctuates strongly during the year. All the managers of mechanical companies confirm that during the rainy season (July to september) the demand triples, while in the dry period (October to June) it is largely reduced in particular during February in May. This phenomenon explains by the rise of the groundwater table and the clogging of pits by rainwater.

- Changes in service demand by households are function of population growth. The rate of population growth is 4.3% for the city of Bobo-Dioulasso, 7.59% for Ouagadougou and 3.63% for Fada N'Gourma. It is also a function of changes in standards of living.

- The tendency of urban households is the construction of habitat type with modern sanitation facilities. But the experience of the implementation of the PSA by ONEA shows that the evolution of the choice of sanitation facilities by the population is rather slow. In the cities of Ouagadougou and Bobo Dioulasso, where the promotion of VIP latrines is made since 1992 and 2000 respectively. They represent less than 10% of wastewater in Ouagadougou and less than 5% in Bobo Dioulasso.

- The shift towards dry pits (VIP promoted by ONEA) or wet pits (septic tanks) is very slow due to the high incidence of poverty and the influx of rural people in cities who reproduce the rural way of life. However, surveys show that there hadn't been the financial constraints and characteristics of their on-site facilities that imply manual extraction, households prefer mechanical emptying. Demand for mechanical emptying services will be still go rising but at a slow pace.

- Fecal sludge reuse

Reuse of excreta sludge is a demand variable but it is not direct. The demand for re-use of sludge is a factor that can stimulate both households and enterprises drain. However, it depends on the conditions appropriate mobilized for reuse of sludge and the purchase price offered to re-users.

For now, surveys show that most of households don't agree to reuse the dried fecal sludge (97% for Ouagadougou and 88% for Bobo-Dioulasso). However, in Fada N'Gourma, 43% of households agree to reuse dried sludge in agriculture probably because farming is their secondary business (73%). The demand is there and will be growing, but currently it is difficult to estimate its volume. Sludge treatment is not yet effective. Projects of treatment plant construction are underway. Farmers recycle the sludge as it is, without any prior treatment. INERA, the main center of scientific research in Burkina Faso, working on the impact of sludge dumped in the wild or in the fields, not on conditions of reuse.

4.2.3 Willingness and capacity to pay

The willingness and ability to pay are important for the growing demand. They depend on several factors including the perception that users (households) have the quality of the service drain sludge which is currently provided, the improvement can be made and the price change it will follow.

With regard to the services currently delivered to the household surveys show that hhouseholds are happy with the emptying fees in Ouagadougou (87%) and Fada N'Gourma (80%). In adverse most of the households (53%) complain for the fees in Bobo-Dioulasso.

Satisfaction for service delivery rates at 45% in Fada N'Gourma, 44% in Bobo-Dioulasso and 75% in Ouagadougou. The improvement of service delivery i.e. complete removal of sludge, sludge disposal out of homes and easy access to business mechanical operators will not lead the an increasing of willingness to pay in any city. Even though willingness to pay remains less than the current tariffs. It is very low in Bobo-DioulassoUSD 14 and high in Ouagadougou USD34.5 and Fada N'Gourma USD 34.2.

4.3 Fecal sludge extraction and transportation market development

Apart from ongoing project of faecal sludge treatment plants construction and institutional reorganization leads by ONEA for the cities of Ouagadougou and Bob-Dioulasso, the management of sludge has not been subject to action.

4.3.1 Access to finance by mechanical companies

Access to finance by enterprises remains a major challenge for companies in Burkina Faso. The major obstacles lie in the inability of applicants for funding to install files in the standards and provide the guarantees required. He also is accused banks to have very long procedures without any flexible arrangements to support companies that are sometimes faced with difficult situations beyond their control. The interest rates are very high, around 17%, for three (3) years.

To overcome these difficulties, it was established the Interbank Guarantee Finance Corporation (SOFIGIB), which aims to provide access to financing for businesses through the Guarantee Fund mechanism. It is positioned as an intermediary between financial institutions granting credit and the institution by establishing a guarantee fund in favor of a given target group. The role of SOFIGIB relates the operationalization of sustainable mechanism of guarantee funds. It ensures in particular to secure the guarantee fund by ensuring that banks and borrowers do not abuse the guarantee fund set up by an institution.

It is an alternative that could allow access to financing by private companies working in the fecal sludge management business. A guarantee fund could be established by contracting with SOFIGIB. On the one hand, the SOFIGIB support businesses to set up good records of credit applications and support their request to the banks. On the other hand, once the credit, not only does it ensure that the borrower manages professionally, but it will force the bank to deploy its proceedings to recover the credit position, without yielding to the temptation to automatically activate the guarantee fund to cover the share of credit deemed uncollectible.

For SOFIGIB, the minimum amount of the loan must be a minimum of three million FCFA (USD 6452) and a maximum of 25 million FCFA (USD 53 763). The guarantee supplied by the SOFOGIB covers 50 % of the amount of the wanted credit. The credit should be payed back between 2 to 7 years period.

Also, note the setting up of funds by the government to support entrepreneurship, namely the Support Fund for the informal sector (FASI), the Fund for Support of Enterprise Promotion (FAPE) and the Fund to support the Youth Initiatives (Faija). These funds, under certain conditions (age, area of work, length of credit etc...) offer funding opportunities, but access is an individual process.

4.3.2 Opportunities for capacity building in fecal sludge management.

Capacity-building has become a major concern in Burkina Faso. To this end, efforts have been made to establish institutions of non-financial technical support. Apart from ad hoc structures of the various ministries, the option of the Government seems to focus on the establishment of independent institutions run by the private sector. So in addition to the Chamber of Commerce, Industry and Crafts, the state has supported the creation of the House of the enterprises and proceeded to the creation of Chambers of Trade focused on the business of the crafts.

Given the configuration of support institutions to the private sector, the House of the company seems to offer standard service that could be used to build the capacity of stakeholders in the management chain of sludge, particularly those of mechanical operators. The home of the company often provides standard services to support business promoters. Moreover, under a memorandum of understanding it can develop services targeted to a specific category of companies.

4.3.3 Role of public sector in business sustainability

The role of the state today is characterized by its disengagement from industrial activities and service delivery. Its primary role is to build an enhancing environment for the private sector in all sectors of economic and social development. The implementation of this environment is based on the adoption of national policies and strategies, an attractive tax framework and the creation of supporting institutions.

In terms of policies and strategies, in addition to making great options for the management of water resources, the state adopted in 2006 the National Water Supply and Sanitation (PN-AEPA) for the horizon 2015. Significantly, in the sanitation sector in recent years is the subject of more attention. A policy document and strategy was adopted, a document of operational policy for the management of wastewater and excreta also developed and a branch was built in the Ministry in charge. This is significant breakthroughs in promoting sanitation. However, the problem of sludge management is completely absent from the various issues addressed and is not subject to a particular action on the part of the state or its decentralized departments.

As part of the PN-AEPA, the principle of the grant is retained but only for the construction of latrines to households. Actions developed, including social marketing intended to promote the acquisition of wastewater. Sensitization of households to ensure an adequate extraction and disposal of sludge is not made. The national water supply and sanitation has no activities to generate demand and supply service drain.

The local authorities seem not to include the extraction and sludge disposal of excreta and wastewater in their priorities. Emptying companies face a lack of dumping sites and do not benefit from special measures to enable them to contribute to cleaner cities unimpeded

4.4 Constraints and barriers

Fecal sludge management stakeholders face barriers and constraints regarding implementation of their activities. They are institutional, professional technological and from market development.

Institutional constraints: there are no strategy and regulatory framework of FSM.

The main Professional constraints are the low capacity of managers, professional risks for the extractors either manual or mechanical (solid and dangerous materials in the pits, intoxication by inside gas of the pits, collapsed pit).

Technological constraints are mechanical emptying related to this consolidated faecal sludge and solid materials, Pumping system for trucks is not suitable for thick sludge extraction, the lack of skilled craftsmen for the repair of vacuum pumps; No official sites and unloading facility for the sludge;

Financial constraints is the low access to bank financing related to high interest rates, guarantees and documents (financial statements) required, and monthly payments.

Market constraints are the Frequent and often prolonged failures related to dilapidated trucks and lack of spare parts, Low household capacity to pay and Unfair competition from public enterprises (Hall and military engineers) due to low prices charged by public enterprises;

5 Service delivery models

5.1 Overview of service delivery models

The current fecal sludge management models in the cities of Ouagadougou, Bobo-Dioualasso do not help cities managers to achieve fecal risk management which is the first step of sanitation. The fecal sludge is disposed of in the environment with negative impacts on public health.

The overall picture presented in the table below indicates three options for extraction, transportation and disposal of FS and greywater: mechanical extraction and transportation, manual extraction and dumping in the street, manual extraction and transportation by means of donkey carts or vehicle to reuse site. Most of the respondents who have already emptied their pits or tanks have used the service of mechanical operators; this is the case of septic tanks. The overall sludge emptied by manual operators, is dumped in the street, sometimes let to dry on-site and transported to the field for reuse. Moreover 9% of households in Ouagadougou, 54% in Bobo-Dioulasso and 72% In Fada N'Gourma are dumping the greywater in the streets.

Table 17: Current faecal sludge extraction and transportation in three cities of Burkina Faso (%)

City	Mechanical extraction and transportation	Manual extraction and street dumping	Manual extraction and transportation
Ouagadougou	78	20	2
Bobo-Dioulasso	55	30	15
Fada N'Gourma	43	39	18

Source: Households' survey

The situation of FSM can be summarized in the ongoing FSM model. This model can be explained by splitting the activities into three files as shown in figure7.

In file F1, the sludge or greywater is extracted from septic tanks, cesspools and traditional latrines and transported by trucks directly to the discharge points or to reuse. This solution is implemented by mechanical operators who collect the FS and greywater from households, business centres and industries.

For the second file F2, fecal sludge and greywater are extracted and deposited in the street by manual operators or householders overnight. They are transported through drainage channels to the fields.

The third file F3 is the handling of sludge accumulated in dry pits (VIP), TCM and traditional latrines. Fecal sludge is extracted by manual operators, let to dry on-site and then transported by donkey carts or vehicles to the field for reuse.

There is no fecal sludge treatment plant in Ouagadougou, nor in Bobo-Dioulasso or Fada N'Gourma. In the current situation, each local government has designated some informal sites out of the cities to dispose of the fecal sludge.

Two main issues are coming across FSM in these cities. Most of the traditional latrines which represent 61% of the on-site sanitation facilities in Ouagadougou, 94 % in Bobo-Dioulasso and 62% in Fada cannot be emptied easily by most of the existing vacuum trucks. The cesspools which are normally designed to infiltrate the greywater have to be emptied: greywater is flushed in the street overnight or sometimes extracted and transported by mechanical operators.

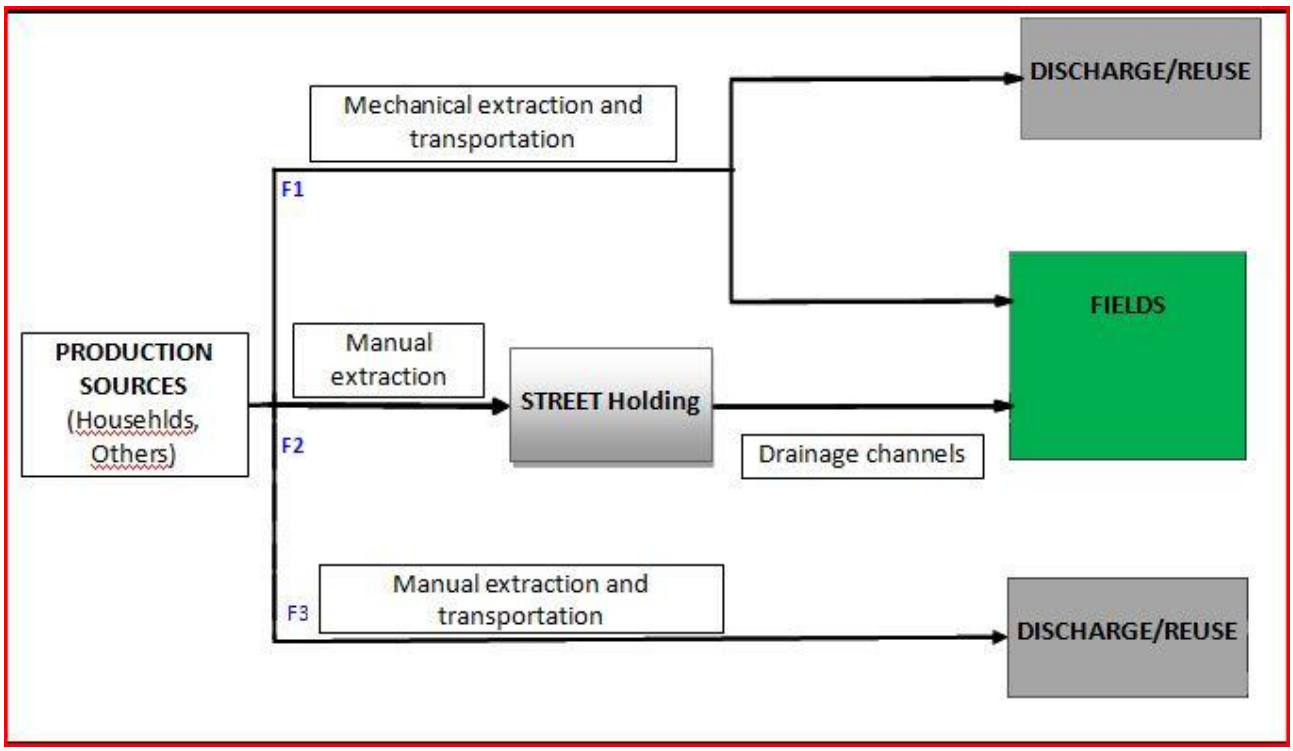


Figure 6**: Current fecal sludge management in three cities of Burkina Faso**

5.2 Comparison with solid waste service management models

There are some commonalities between fecal sludge management system and solid waste management system. In Burkina Faso, both sectors are operated mainly by informal/small entrepreneurs without any support from local or central government. These operators organized themselves to develop the offer for meeting the demand of households. Table below shows that from production to final destination FSM system can take benefit of good practices coming from solid waste management system.

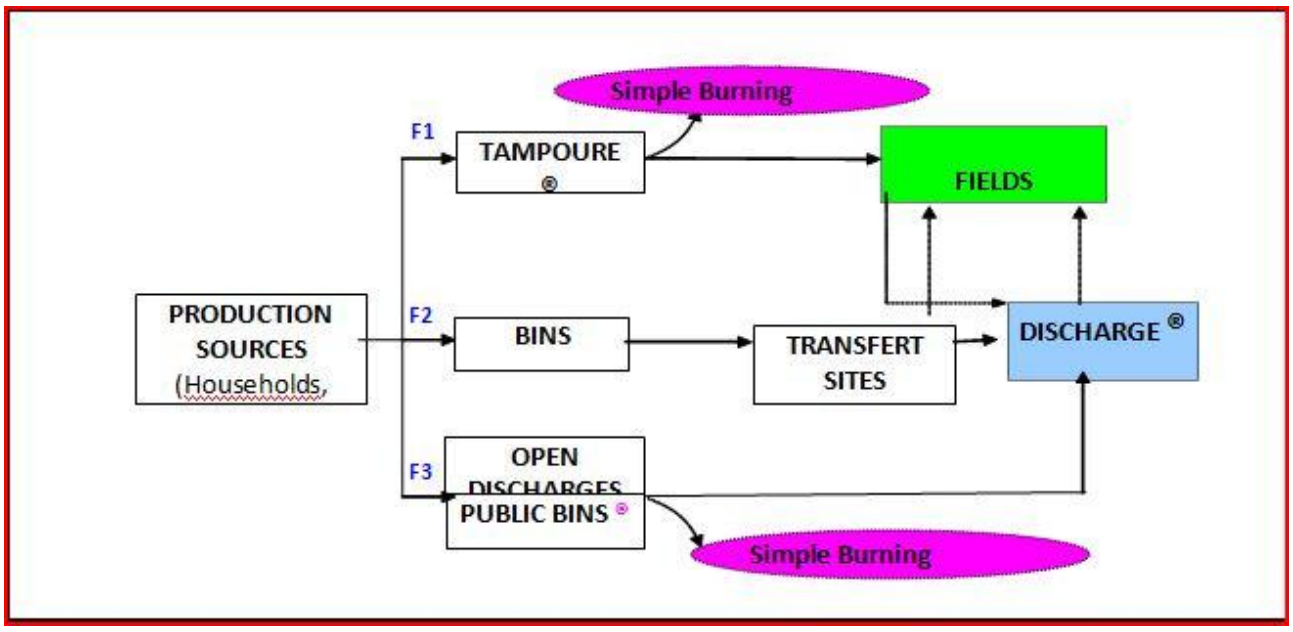


Figure 7 : Solid waste service management model

Table 18 : Comparison FSM vs solid waste service management models

	Fecal Sludge Management System	Solid Waste Management System
Processus	• 1 product • Production : households • Manual/mechanical emptying • Dumping on street and open spaces • Recycling	• Many products • Production : households • Door-to-door collection • Dumping on street and open spaces • Discharge/treatment • Recycling
Stakeholders	• Municipality • Small operators for emptying • Farmers • Households • Private and public services	• Municipality • Farmers and reusers • Households • Small entreprises • Civil society organisations for pre-collection
Institutionnal and Legal arrangements	• National strategy for sanitation • Code of environment	• National strategy • Code of environment • Municipal policies
Economy and Finance	• Small scale business • Investment for trucks • Heavy investment for treatment plants	• Small scale business for pre-collection • Small enterprises for collection • Heavy investment for discharge and treatment
Strenghts	• Private sector is interested to invest • Good quality of the service • Initiatives developed for combining FS extraction/transportation with other small business • ONEA is the leader on sanitation in the country and is implementing a project for improving FSM • Association of emptiers exit in some cities : Fada, Ouagadougou and Ouahigouya	• Treatments plans exist in some cities (Ouagadougou, Bobo) • Many recycling operators (plastic, seal, organic matter for composting) • Municipal strategies for solid waste management • Investment of medium enterprises (collection part)
Weaknesses	• No treatment plants or official discharge • No technology for transportation of sludge extracted manually • No legal framework and institutional arrangements • No support or incentives from municipalities and central government • No recognition of operators specifically the manual emptiers	• No formal platform of concertation for operators • Very low profit for operators
Market	• Growing market for manual emptiers with national program for water and sanitation 2015 and the strategic sanitation plans promoted by ONEA • Distortion of the market by public agencies	• Growing market for collection, • Market for sorting and reusing

Solid waste management in the cities of Burkina Faso is a partnership between the local governments, informal sector and small enterprises. This management model brings the monthly pre-collection fee for the household to a level the majority of the households can afford (USD 1). The system is not market-driven. The profit is very low for the operators. Anyway the model is working.

5.3 Proposed technical model for FSM in Burkina Faso cities

On the basis of survey and discussion with the stakeholders, three files illustrated in figure 8 are designed to handle faecal sludge management in Burkina Faso towns. Called shared market model, it's designed for FSM of the 20 coming years. The objective is to create sustainable and cost-effective fecal sludge extraction and transportation for the stakeholders, included the growing private sector.

File 1: The direct mechanical holding: the sludge is extracted from septic tank, emptyable cesspools and traditional latrines, transported directly to the FSTP by mechanical operators with vacuum trucks. This file is widely used in Ouagadougou and Bobo-Dioulasso. It is relatively expensive for the urban poor; average price amounts XOF 15 000 to 20 000 (USD 33 to 44). The tankers volume varies from 3 to 12 m^3. Very often, they need to complete the emptying by manual operators for the mineralized thick sludge.

File 2: the transfer station file: the fecal sludge is extracted and transported primarily from household to an intermediate holding pit by manual or semi-mechanical operators. The secondary transport is done by vacuum trucks from the holding pit to the fecal sludge treatment plant located nearby or official dumping sites. The land for building the intermediate holding pits is provided by the local government. The transfer station site for solid waste could be used for that purpose. The holding pit which simply an underground tank is managed by the semi-mechanical operators. As discussed with a semi-mechanical truck designer, the fee for primary extraction and transportation will be less than XOF 10 000 (USD 22). The design of semi-mechanical truck is not yet completed.

File 3: mineralized sludge file: this file is designed to carry out the fecal sludge accumulated in VIP and TCM (simple pour flush toilet). The fecal sludge is extracted and transported by manual operators and transported by handcarts or vehicles to disposal or reuse sites. This file is not yet in operation but its market will increase very soon because the number of VIP is increasing.

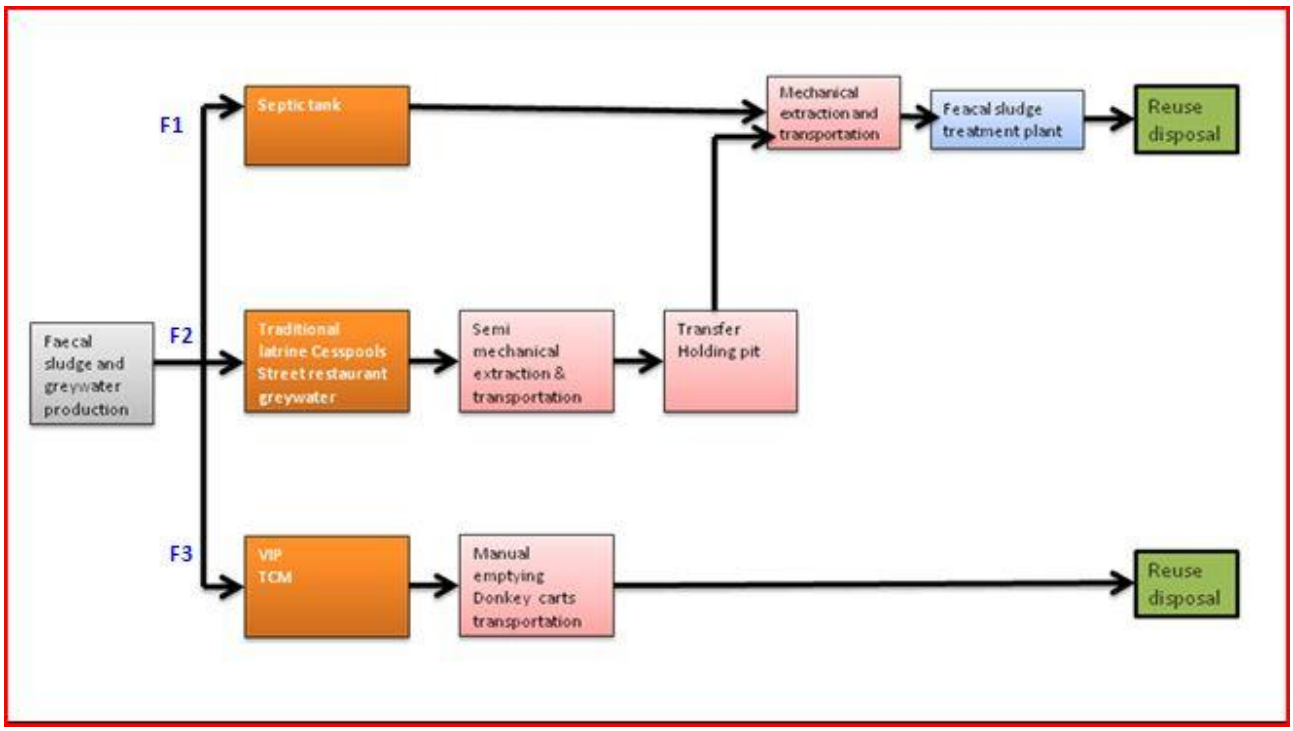


Figure 8: Proposed faecal sludge and wastewater management model for Burkina Faso cities

5.4 Model characteristics

How do we justify this model? Burkina Faso has adopted decentralized urban wastewater and fecal sludge management. Two wastewater treatment plants are in operation in the towns of Ouagadougou and Bobo-Dioulasso. Two (3) fecal sludge treatment plants are underway of construction in Ouagadougou and one (1) projected in Bobo-Dioulasso.

It is surprising that after more than 20 years of implementation of strategic sanitation plan the urban households continue to build traditional latrines. The reason is that the amount household has to pay for VIP or TCM building is still too high for the middle and poor income households. It means that the traditional latrine will continue to be the on-site facility for most of urban households: it has to be taken into account.

The model is trying to achieve a global management of fecal sludge, value chain of sanitation, and cope with the demand diversity and the participation in poverty reduction. The rationale behind the model is to integrate fecal sludge management in the strategic sanitation plans of the cities, reinforce a win-win relationship between the stakeholders and the environmental sustainability of sanitation.

5.4.1 Technical aspects

The distance for fecal sludge transportation can be optimized by doing the collection at household level by low-cost transport systems (small or semi-mechanical trucks, donkey cart and manual emptying) and organizing secondary transportation to fecal sludge treatment plants by big trucks. It is expected that for every trip, the tank of truck is full. The use of transfer holding pits will cut down the surge between the collection and the big trucks transportation. Distance for big trucks transportation will be reduced and the volume transported will be optimized.

5.4.2 Economical and financial aspects

The service delivery tariff fit the financial conditions of the households. Financially households are able to pay a small tariff for FS collection at household level. This tariff cannot be higher than the present willingness to pay. The proposed model allows the increasing of mechanical extraction and transportation market. Progressively the shared cost secondary transportation will be charged in water bills. The system is sooner or later market-driven and integrated in its economical and financial environment. Investment in transfer holding pits is the main barrier to the development of mechanical emptying business.

5.5 Sustainable faecal sludge management models for different categories of cities

The implementation of FSM model in the three (3) cities requires the construction of fecal sludge treatment plants and transfer holding pits. The economical size of holding pit covering areas is not yet established. Low-cost technologies transportation means (UN-Habitat vacuum truck, semi-mechanical truck (see photo in appendix XXX), manual extraction and transportation) will be used for primary extraction and transportation to the holding pits. From the survey, the average volume of tanks is 8 m^3. The working load is 4 trips/ day and 130 days/ year. We assume 80% of fecal sludge produced has to be extracted and transported. Under these conditions the number of trucks needed for each town is tabulated below in table 19.

Table 19 : Number of trucks needed per city

City	Fecal sludge production (m^3/year)	theoretical Number of trucks	Number of trucks	Number of small enterprises
Ouagadougou	395 000	76	76	25
Bobo-Dioulasso	68 127	13	13	4
Fada N'Gourma	5 363	1	1	1

The gaps between numbers of trucks needed are 16 for the city of Ouagadougou, 5 for the city of Bobo-Dioulasso.

5.5.1 Implementation of FSM model in mid-size cities (Fada N'Gourma)

The implementation of FSM in mid-size cities or semi-urban areas like Fada N'Gourma is a Public private partnership process: Faecal sludge management in Fada faces several challenges. The types of technologies proposed in the strategic sanitation plan, are generally dry pits for faeces therefore they can't be emptied mechanically. The discharge of solid materials in the pits including broken bottles, boxes is risky for manual emptying and mechanical as well.

The frequency of pit emptying is too slow (more than 10 years to 24% of pits) and does not guarantee a continuity of business service. Based on operation expenses and emptying fee rates of the mechanical operator in Fada N'Gourma, the balance (without taking account equipment amortization) can be achieved only if he empties 120 households per year (2.5 households/ per week) and 11 administrative structures per year. Under these conditions, the mechanical operation may be viable if the service includes both the mechanical and the manual operations and serves households and administrative structures of the surrounding towns. However, the demand for reuse of faecal sludge is increasing. Farmers and gardeners already pay for untreated sludge. The conclusion is that the demand for faecal extraction and transportation is greater than the supply which is not yet structured. The implementation of a sludge treatment and marketing could help to strengthen the faecal sludge management business.

What kind of business model could be promoted to enhance FSM for small towns in Burkina Faso?

- The **local government should own the FSM and delegate the operational functions to one or two small private enterprises**: the ownership means service development planning, purchasing the equipment, setting up the local policies and requirements for service delivery. A private entrepreneur could deliver the service base on a leasing contract of the equipment and an agreement.
- For this enterprise to be viable, it should development other business activities e.g. solid waste collection and purchase new trucks to increase its capacity to cover the surroundings cities.

This public private partnership model can be implemented in almost 40 cities in Burkina Faso.

5.5.2 Implementation of FSM model in medium cities (Bobo-Dioulasso)

In the case of Bob-Dioulasso, the survey shows that 82% of the Households who got their pits or tanks full have already desludged them mechanically. In addition 75% of the households are willing to request for mechanical emptying. The results show that the potential market for fecal sludge extraction and transportation is attractive for private sector if the price increases to USD 43.

A market driven model for fecal sludge extraction and transportation could be applied. A multi-service enterprise with 3 to 5 trucks can be viable. Local government should establish an enabling environment and limit the number or enterprises to ensure a fair competition in order to avoid monopoly and market distortion.

5.5.3 Implementation of FSM model in big cities (Ouagadougou)

The system of FSM in Ouagadougou is market-driven: In the city of Ouagadougou 39 enterprises are delivering the service in fecal sludge extraction and transportation. Big enterprises who own 3 to 5 trucks with high management skills level should be promoted. The demand for mechanical emptying is very high. This current model has to be optimized by organizing the primary collection of fecal sludge at household level.

6 The way forward

6.1 SWOT analysis

6.1.1 Successes and weaknesses

As shown in Table 20, Faecal Sludge Management has an emerging story in Burkina Faso. The most important part of this story is due to small privates who decided to invest in FS extraction and transportation. Without any support from national and local authorities, they deliver the service to households based on business approach. A deep analysis of FSM in the country will contribute to have a clear picture of the market (demand and offer).

There is a need for taking actions to tackle the weaknesses. The main constraint raised by extraction and transportation operators is the lack of official dumping sites. People started complaining about dumping the FS into open spaces inside or in the peripheries of the cities.

Table 20: Successes and weaknesses of FSM in Burkina Faso

	SUCCESS	WEAKNESSES
Policy and regulation	• General policies on health, environment, sanitation and hygiene • Decentralized management system • FSM is mentioned in some Strategic Sanitation Plans • National programme for water and sanitation 2015	• No national specific policy on FSM • No local government has established a local legal framework on FSM
Institutional and Organisational	• Involvement of private sector (mainly small entrepreneurs) • Some communes and specific public administration have their own truck for delivering the service • Competition between enterprises • Emptiers are organized as association in some cities • A project is being implemented by ONEA in Ouagadougou and Bobo-Dioulasso to define a strategy for strengthening private sector	• No national or local institutional framework • All entrepreneurs are informal • Luck of capacity of all categories of stakeholders
Technical	• Some small entrepreneurs combine mechanical and manual extraction services • Initiatives of developing technologies to collect FS emptied manually • A national expertise on FSM • A project is being implemented by ONEA in Ouagadougou and Bobo-Dioulasso with the aim to construct FS treatment plants	• No official dumping site for FS collected by emptiers • No treatment plant in any city in the country • Promotion of “non FS extractible” technologies of latrines • No technology for extracting solid or high viscosity FS • Trucks are purchased 2nd hand without technical requirements
Economical and social	• Demand for FS extraction and transportation (from households and public building owners) • Social tariff for very poor households (from public operators)	• Low social profile of emptying operators (specifically the manuals) • No fiscal incentives for entrepreneurs • No sanctions for illegal or open dumping of FS

6.1.2 Opportunities and threats

Nowadays, FSM profile has been raised due to impacts on public health and thanks to some actors who started reflecting on how best to organize an improved FSM in cities. The major threat (see Table 21 below) is about the availability of fund for constructing treatment plants in the cities.

Table 21: Opportunities and threats for an improved FSM in Burkina Faso

	OPPORTUNITIES	THREATS
Policy and regulation	• People and local authorities are more aware of open dumping of FS • People leaving around current dumping sites complain • On-going projects for improving FSM (AfD, Bill and Melinda Gates Foundation) • National survey on sanitation status	• No means to put in place all components of improved FSM (for example treatment plants) to enforce policies or regulations
Institutional and Organisational	• Awareness of extraction and transportation operators for setting up associations	• Most of the enterprises are informal
Technical	• A national expertise on FSM • A project is being implemented by ONEA in Ouagadougou and Bobo-Dioulasso with the aim to construct FS treatment plants • Research on extraction and transportation technologies (launched by Bill and Melinda Gates Foundation)	• No staff with good FSM skills in local governments • New technologies are very expensive and unaffordable to local enterprises
Economic and social	• Private sector is interested to invest in FSM in the country • Farmers request for FS as organic matter to enhance the soil and consequently the crops • A project is being implemented by ONEA in Ouagadougou and Bobo-Dioulasso to define a strategy for strengthening private sector • Demand for FS extraction and transportation (from households and public building owners)	• Low social profile of emptying operators (specifically the manuals)

6.2 Recommendations

The FS market analysis in the 3 cities shows that it is possible to develop a sustainable FS extraction and transportation service. The market-driven option is the most suitable for Burkina Faso. To booster the market in short term, 3 levers of action plan could be used:

1. **Lever1: Developing demand for mechanical emptying by**
   - Increasing the number of "disludgeable" pits by normalizing the simple pits latrines: the potential is large in the Ouagadougou as the survey shows that 80% of households are equipped with this type of latrine
   - Reinventing the latrines: moving from dried pits to watered pits

2. **Lever2: Professionalizing the operators by**
   - Coaching operators on management skills and business plans
   - Developing new and suitable technology for dislodging dried pits (VIP, simple pits)
   - Structuring a Union of operators for common activities or investments (insurance of trucks, purchasing trucks, etc.)

3. **Lever3: Developing policies and regulating the value chain of sanitation**

- Elaborating a national strategy of FS management
- Establishing a license and requirements for mechanical operators
- Constructing fecal sludge treatment plants

In all cases, setting up a dumping fee will affect strongly the revenue of extraction and transportation operators. Our suggestion is that ONEA should discuss with local governments and FS operators based on deep financial analysis of FSM system in each city. ONEA could support the money flow by using a part of sanitation tax to cover the operation and maintenance cost of FS treatment plants.

6.3 Perspectives

The National Water and Sanitation Utility – ONEA is in the process of reviewing the strategic sanitation plans for the main cities of the country. This is an opportunity to introduce a component on Fecal Sludge Management. An improved FSM includes a treatment plant in the system. Before regulating and asking operators to pay for dumping FS at the plants, there is a need to avoid the operators to pass on the dumping fee on households. This could be achieved if a multi-dialog platform is in place and gives voice to all stakeholders (ONEA, local authorities, health and environmental protection agencies, operators, reusers, researchers, etc.).

The next step of the study is organizing a national workshop to present the results and the suggestions for improved FSM in Burkina Faso. Further initiatives could combine field actions and research on (i) technology of latrine and treatment and (ii) technology of FS extraction. A pilot scale project on intermediate holding pits is necessary to better understand their added-value in transportation optimization.

There are several opportunities that ONEA and local governments should take profit to raise fund for FSM improvement in Burkina Faso: (i) Bill and Melinda Gates Foundation Programme, (ii) African Sanitation Facility launched by African Development Bank, (iii) National budget for sanitation and (iv) Water and Sanitation Programme of World Bank.

7 Conclusion

The landscape analysis and business model assessment in fecal sludge management in the cities of Ouagadougou, Bobo-Dioulasso and Fada N'Gourma gives an overview of FSM practices in the urban areas of Burkina Faso. It gives enough information for the coordination of investment by local government and international donors. Burkina Faso has adopted during the past 20 years in its policy decentralized sanitation management through strategic sanitation plans for each city. The implementations of SSP are more oriented towards the construction of on-site facilities for all than service delivering. Fecal sludge management is not specifically included in these SSP as a component. This gap has to be looked at by national government and local urban planners in order to achieve sustainable urban sanitation.

The market for fecal sludge extraction and transportation exists already in the city of Ouagadougou and Bobo-Dioulasso as well in some extend. But, in the mid-size like Fada N'Gourma, market has to be built by local governments. On the basis of ongoing practices and financial analysis of mechanical operators businesses, there are some opportunities for private sector involvement.

The proposed technical model for FSM in urban areas includes two stages by integrating the practices and paying more attention to the service affordability. The system of primary extraction and transportation at the first stage is market-driven for the big urban cities. It is a public-private partnership process in the mid-size or semi-urban cities. The public intervention is needed for second stage for sharing the cost of final transportation and fecal sludge treatment for either mid-size, medium or big cities. Transport optimization, construction and management of holding pits, fecal sludge treatment plants or low-cost sludge disposal sites are the main issues for upgrading the FSM in Burkina Faso urban areas. Two practical issues can be raised.

One key point is related to the technological choice and the design of on-site facilities. Upgrading traditional latrines according to Burkina Faso standards (lining of pits, providing new slab, and ventilation pipe) will improve the living conditions of the urban pours who are the owners and increase drastically sanitation coverage and accelerate the reach of MDG in sanitation.

In the context of Burkina Faso, the second issue to take into account is the others activities done by the mechanical operators in order to get a sustainable enterprise. The affordability for the urban poor is a concern as we expect a global fecal sludge management in order to protect the environment and the human health. Looking at the operators businesses, there a room for improvements and cost optimization. A concept note for project led by the national water supply and sanitation utility (ONEA) in the three cities is proposed to experiment the finding of the study and accelerate the reaching of the millennium development goal in sanitation sector.

It is recommended to reinforce regulatory framework to facilitate private sector involvement. Tax collected through water bills should be used progressively to cover sewerage management, operation and maintenance of secondary collection and treatment of fecal sludge as well.

The way forward is the implantation of a project that takes into account the design of adapted semi-mechanical truck, the design of transfer holding tank and the optimization of a mechanical truck tank and financial model of FSM for each city.

8 Appendix

8.1 Incomes statements for the mechanical operators

8.1.1 Income statement for companies with 1 truck in Bubo Doulas'

Désignation	Unité	Montant unitaire	Quantité	Montant total
Charges d'exploitation				
Frais de personnel				
Chauffeur	FCFA/ (homme mois)	50 000	12	600 000
Manœuvre	FCFA/ (homme mois)	23 750	24	570 000
Démarcheur	FCFA/ (homme mois)	7 500	12	90 000
Cotisation CNSS	% salaire brut	13 413	12	160 950
Entretien et réparations	FCFA/an	1 920 000	1	1 920 000
Petit matériel de protection	FCFA/mois	14 000	12	168 000
Carburant: *Trajets et pompage*	FCFA/km	177	28 800	5 097 600
Charges administratives	FCFA/an	540 000	1	540 000
Assurance du véhicule	FCFA/an	148 000	1	148 000
Visite technique	FCFA/an	54 000	1	54 000
Frais de route	FCFA/An	495 000	1	495 000
Pneus	FCFA/ (camion an)	928 000	1	928 000
Tuyauterie	FCFA/ (camion an)	235 000	1	235 000
Frais de dépotage / traitement	FCFA/rotation	800	960	768 000
Amortissement camion vidangeur	FCFA/ (camion an)	0	1	0
Total charges				***11 774 550***
Recettes				
Vidange (ménages) ht	FCFA/voyage	15 000	960	14 400 000
Vidange (établissement à forte fréq.) ht	FCFA/voyage	0	0	0
Total recettes				***14 400 000***
Bénéfice avant impôt				**2 625 450**
Impôt	**% /an**	30		***787 635***
Bénéfice après impôt				**1 837 815**

Source: Data from surveys among the mechanical operator. Juin 2011.

8.1.2 Income statement for companies with 1 truck in Ouagadougou

Désignation	Unité	Montant unitaire	Quantité	Montant total
Charges d'exploitation				
Frais de personnel				
Chauffeur	FCFA/ (homme mois)	40 000	12	480 000
Manœuvre	FCFA/ (homme mois)	20 000	24	480 000
Démarcheur	FCFA/ (homme mois)		0	0
Cotisation CNSS	% salaire brut	12 600	12	151 200
Entretien et réparations du camion	FCFA/an	1 100 000	1	1 100 000
Petit matériel de protection	FCFA/mois	15 000	12	180 000
Carburant : *Trajets et pompage*	FCFA/km	152	33 065	5 009 280
Charges administratives	FCFA/an	540 000	1	540 000
Assurance du véhicule	FCFA/an	148 000	1	148 000
Pneus	FCFA/ (camion an)	1 507 200	1	1 507 200
Tuyauterie	FCFA/ (camion an)	282 000	1	282 000
Visite technique	FCFA/an	54 000	1	54 000
Frais de route	FCFA/An	936 000	1	936 000
Frais de dépotage / traitement	FCFA/rotation	0	768	0
Amortissement camion vidangeur	FCFA/ (camion an)		1	0
Total charges d'exploitation				***10 867 680***
Recettes				
Vidange (ménages) ht	FCFA/voyage	20 000	720	14 400 000
Vidange (établissement à forte fréq) ht	FCFA/voyage	20 833	48	999 984
Total recettes				***15 399 984***
Bénéfice avant impôt				**4 532 304**
Impôt	**% /an**	30		***1 359 691***
Bénéfice après impôt				**3 172 613**

8.1.3 Income statement for companies with 2 trucks in Ouagadougou

Désignation	Unité	Montant unitaire	Quantité	Montant total
Charges d'exploitation				
Frais de personnel				
Chauffeur	FCFA/ (homme mois)	40 000	24	960 000
Manœuvre	FCFA/ (homme mois)	20 000	48	960 000
Démarcheur	FCFA/ (homme mois)		0	0
Cotisation CNSS	% salaire brut	33 600	12	403 200
Entretien et réparations du camion	FCFA/an	2 150 000	1	2 150 000
Petit matériel de protection	FCFA/mois	30 000	12	360 000
Carburant : *Trajets et pompage*	FCFA/km	152	73 941	11 202 000
Charges administratives	FCFA/an	648 000	1	648 000
Assurance du véhicule	FCFA/an	148 000	2	296 000
Pneus	FCFA/ (camion an)	1 507 200	2	3 014 400
Tuyauterie	FCFA/ (camion an)	282 000	2	564 000
Visite technique	FCFA/an	54 000	2	108 000
Frais de route	FCFA/An	1 422 720	1	1 422 720
Frais de dépotage / traitement	FCFA/rotation	0	1728	0
Amortissement camion vidangeur	FCFA/ (camion an)		2	0
Total charges d'exploitation				***22 088 320***
Recettes				
Vidange (ménages) ht	FCFA/voyage	20 000	1 680	33 600 000
Vidange (établissement à forte fréq) ht	FCFA/voyage	30 000	48	1 440 000
Total recettes				***35 040 000***
Bénéfice avant impôt				**12 951 680**
Impôt	**% /an**	30		***3 885 504***
Bénéfice après impôt				**9 066 176**

Source: Data from surveys among the mechanical operator. Août 2011.augustcome statement for companies with 3 trucks in Ouagadougou

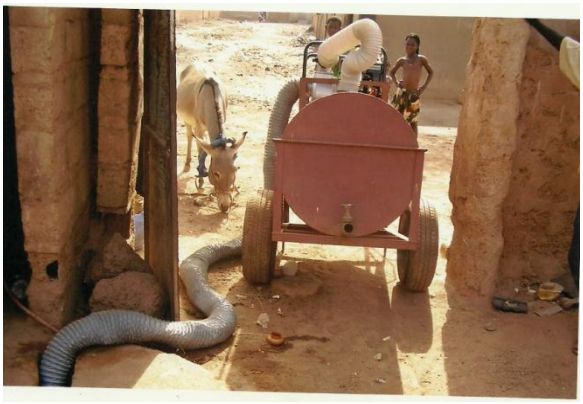
Désignation	Unité	Montant unitaire	Quantité	Montant total
Charges d'exploitation				
Frais de personnel				
Chauffeur	FCFA/(homme mois)	40 000	36	1 440 000
Manœuvre	FCFA/(homme mois)	20 000	72	1 440 000
Démarcheur	FCFA/ (homme mois)		0	0
Cotisation CNSS	% salaire brut	50 400	12	604 800
Entretien et réparations du camion	FCFA/an	3 335 786	1	3 335 786
Petit matériel de protection	FCFA/mois	45 000	12	540 000
Carburant : *Trajets et pompage*	FCFA/km	152	108 911	16 500 000
Charges administratives	FCFA/an	777 600	1	777 600
Assurance du véhicule	FCFA/an	177 600	3	532 800
Pneus	FCFA/ (camion an)	1 507 200	3	4 521 600
Tuyauterie	FCFA/ (camion an)	282 000	3	846 000
Visite technique	FCFA/an	54 000	3	162 000
Frais de route	FCFA/An	1 080 000	1	1 080 000
Frais de dépotage / traitement	FCFA/rotation	0	2640	0
Amortissement camion vidangeur	FCFA/ (camion an)		3	0
Total charges d'exploitation				***31 780 586***
Recettes				
Vidange (ménages) ht	FCFA/voyage	20 000	2 640	52 800 000
Vidange (établissement à forte fréq) ht	FCFA/voyage		0	0
Total recettes				***52 800 000***
Bénéfice avant impôt				**21 019 414**
Impôt	**% /an**	30		***6 305 824***
Bénéfice après impôt				**14 713 590**

8.1.4 Income statement for companies with 4 trucks in Ouagadougou

Désignation	Unité	Montant unitaire	Quantité	Montant total
Charges d'exploitation				
Frais de personnel				
Chauffeur	FCFA/ (homme mois)	40 000	48	1 920 000
Manœuvre	FCFA/ (homme mois)	20 000	96	1 920 000
Démarcheur	FCFA/ (homme mois)		0	0
Cotisation CNSS	% salaire brut	67 200	12	806 400
Entretien et réparations du camion	FCFA/an	4 500 000	1	4 500 000
Petit matériel de protection	FCFA/mois	60 000	12	720 000
Carburant : *Trajets et pompage*	FCFA/km	152	158 416	24 000
Charges administratives	FCFA/an	907 200	1	907 200
Assurance du véhicule	FCFA/an	148 000	4	592 000
Pneus	FCFA/ (camion an)	1 507 200	4	6 028 800
Tuyauterie	FCFA/ (camion an)	282 000	4	1 128 000
Visite technique	FCFA/an	54 000	4	216 000
Frais de route	FCFA/An	330 000	4	1 320 000
Frais de dépotage / traitement	FCFA/rotation	0	3840	0
Amortissement camion vidangeur	FCFA/ (camion an)		4	0
Total charges d'exploitation				***44 058 400***
Recettes				
Vidange (ménages) ht	FCFA/voyage	20 000	3 840	76 800 000
Vidange (établissement à forte fréq) ht	FCFA/voyage		0	0
Total recettes				***76 800 000***
Bénéfice avant impôt				**32 741 600**
Impôt	**% /an**	30		***9 822 480***
Bénéfice après impôt				**22 919 120**

Source: Data from surveys among the mechanical operator. Août 2011.

8.2 Photos of semi-mechanical faecal sludge truck



8.3 Average dimensions of on-site sanitation facilities

City	Installation	Length (m)	width (m)	depth (m)	Volume (m^3)	Volume for emptying period (m^3)
Ouagadougou	Septic tank	3	1	2	3.6	4
	VIP	2.5	1.3	1.6	5..2	2.5
	TCM	Dia 1.0*2	-	1.6	1.25*2	1.25
	Puisard	Dia 1.0*2	-	1.6	1.25*2	1.25
Bobo-Dioulasso	Septic tank	3	1	2	3.6	4
	VIP	1.90	1.3	1.6	3.95*2	2
	TCM	Dia 1.0*2	-	1.6	1.25*2	1.25
	Puisard	Dia 1.0*2	-	1.6	1.25*2	1.25

8.4 Country data master sheet –Burkina Faso

Source: From LITERATURE REVIEW DATA:			
	Fada N'Gourma	Bobo Dioulasso	Ouagadougou
1. Population	41785	489967	1339458
Number of HH in city	8440	94947	277988
Number of HHs with septic tanks	422		
Number of HH with pits	6583,2		
Number of HH with holding tank/cesspools			
Source for all rest: YOUR SURVEY DATA			
Consultant HH survey data:			
HH survey sample size	150	315	625
What number of HH is the city does this sample represent?	1,78	0,33	0,22
2. Access to Drinking water	Fada N'Gourma	Bobo Dioulasso	Ouagadougou
% HH with Piped systems to household	33%	56%	85%
% HH using Piped systems to public taps	55%	22%	11%
% HH using Wells	5%	6%	1%
% HH using Private vendors	0%	15%	4%
% using Other sources- Borehole	7%	0,64%	0%
3. Types of Sanitation facilities :	Fada N'Gourma	Bobo Dioulasso	Ouagadougou
% HH with no sanitation	9%	1,29%	0,50%
% HH with direct connection to sewer network	0%	0%	0%
% HH with Septic Tank	2%	8%	32%
% HH with holding tank/cesspools	26%	38%	59%
% HH with pit latrines	63%	94%	61,20%
% HH with VIP	22%	3,20%	24,10%
% HH w septic tanks to sewer network	0	0	0
% HH w pits to sewer network	0	0	0
% HH with Other (TCM)	4%	18%	7,60%
3b. Usage of the sanitation facility from survey			
Number of people per HH	8,8	14,6	8,9
average users per toilet	8,8	14,6	8,9
% Pits/tanks that receive grey water	1%	15,0%	6%
4. Emptying Frequency	Fada N'Gourma	Bobo Dioulasso	Ouagadougou
% HH that have Emptied at least once	56%	61%	80%
% Never emptied	44%	39%	20%
% that do not know	0%	0%	0,32%
2-3 times / year	0%	6%	12%
Once per year	2%	8%	16%
Once every 2 years	4%	15%	21%
Once every 3 years	4%	8%	5%
Once every 4 years	8%	5%	2%
Between 5 - 10 years	26%	14%	19%
Over 10 years	12%	5%	5%
Other (please specify)			
Method of emptying per survey	Fada N'Gourma	Bobo Dioulasso	Ouagadougou
% HH that use manual emptiers	57%	63%	22%
% HH that use mechanical emptiers	43%	37%	78%
other (what is "other"?)			
5. HH Survey Data : HH expenses	Fada N'Gourma	Bobo Dioulasso	Ouagadougou
HH Income/month			
Average income (USD/HH/month)			
Cost of other services			
average water bill (USD/month)	8,79	16,69	16,11
average phone bill (USD/month)	11,29	9,80	13,06
average electricity bill (USD/month)	20,29	30,64	37,25
average solids waste collection bill (USD/month)	1,08	1,08	1,08
Cost of emptying*			
Avg ANNUAL manual emptying cost per household	3,61	7,31	18,16
Avg. ANNUAL mechanical emptying cost per household per	4,53	8,18	18,72

service			
** Even if they do not empty each year, you can calculate what it comes to per year (eg. If they empty every 2 years and it costs them $30 for it, means, it is an annual cost of $15)*			
6. FS Production Rate - based on the calculation	Fada N'Gourma	Bobo Dioulasso	Ouagadougou
PRODUCTION per YEAR			
Based on survey data = **P1**	4045	59361	439122
Theoretical calc = **P2** *(state assumptions used)*	4331	62593	255451
FS Collected per year =C			
What % is dumped in open	100%	100%	100%
Where is it dumped	informal sites	informal sites	informal sites
what % is sold to users? And price received per m3	None	None	None
7. Mechanical emptying business information	Fada N'Gourma	Bobo Dioulasso	Ouagadougou
# of private mechanical businesses in the city	1	6	38
# of trucks run by private businesses	1	4	62
# of trucks owned by utilities	0	2	3
Are Utility trucks used for HH emptying?	Yes	Yes	Yes
What is typical HH emptying fee (manual)? USD	27,96	21,86	25,81
What is typical HH emptying fee (mechanical)? USD	37,63	26,88	53,65
What is the fee per m3 for mechanical emptying?	6,99	3,23	6,71
# of private businesses that are small (1 truck)	1	4	26
# of private businesses that are medium size (2-5 trucks)	-	-	12
# of private businesses that are large (>5 trucks)	-	-	0
What is the range of capacities of private trucks (m3)		8 to 20	3 to 16
What is most common capacity of private truck m3?	9	8	8
Most common truck capacity for utility (m3)		8	10
Price for NEW truck (mention for what m3 capacity)	Not applicable		Not applicable
Price for 2nd-hand truck (mention for what m3 capacity)	32 258 for 8 m3		
Are most trucks 2nd hand or new at time of purchase	2nd hand		
Typical age of trucks in city?	15 years		
What is typical number of trips per day for the trucks?	Not applicable	4	5,1
Avg distance per trip in km	15	25	30
Avg time per trip	1,5	2	2
Cost of fuel for truck? (USD/liter)	1,31	1,27	1,30
8. Financial access for private owners			**COUNTRY**
Who is the Owner? (self employed, Civil servant? Venture?)			Self employed
What % of the private truck owners take loans?			100%
What are bank interest rate and years for repayment?			12% for 3 years
Are the rest self-financing?			Yes (about 20%)
Do they run any other business from which they get this self finance money?			Yes
What % of the FS emptying owners do this as their main business ?			0%
What are the other sources of funding for these operators besides bank and personal money?			Family
9Treatment/dumping site	Fada N'Gourma	Bobo Dioulasso	Ouagadougou
What is the official dumping site for city? (WWTP, FSTP, wetlands, landfill, official site, or open??	Open	Official open site	Official open site
Who operates the treatment plant?	-		
What is the m3 capacity of this treatment facility?			
Where is it located? (center of city, edge of city, outside city..?)	Outside	Outside	Outside
Where should the treatment site be located? How many sites are best?			
What is the dumping fee truckers have to pay?			
Is this payment per trip or per month or m3			
What % of emptying trucks in city actually do to official dumping site?			

8.5 Ouagadougou Fecal Sludge management map: Two (2) fecal sludge treatment plants (POYRY)