



## Socio-economic profile and profitability of faecal sludge emptying companies

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### ABSTRACT

Given the rapid demographic growth, developing countries are increasingly facing difficulties in meeting the sanitation needs of their populations. Various strategies, such as on-site sanitation, have therefore been developed to improve and facilitate access of urban dwellers to effective liquid waste management mechanisms. These sanitation facilities used by about one-third of the world population are increasingly seen as the alternative towards achieving the Millennium Development Goals. However, this type of sanitation generates huge quantities of faecal sludge to be extracted and treated or conveyed to appropriate disposal sites. These important tasks are carried out by private operators whose organisational and operational structures are not always well understood. Due to their important link to on-site sanitation, the profile and profitability of these companies need to be defined to keep on-site sanitation costs under control. The case study conducted in the city of Dakar, Senegal – a typical example of a large city in developing countries – reveals that companies involved in domestic faecal sludge emptying can evolve both within a formal and informal framework. In most cases (68%), as these companies only own one vacuum tanker, they can hardly make a profit if their services merely offer domestic faecal sludge emptying. Investments in other market opportunities, such as cleaning of sewerage networks or industrial emptying, have allowed these companies to reach a rate of return upwards of 20% with the use of one or several trucks. This diversification could lead to a 32% drop in emptying fees and to a 19% rate of return, which can be improved by optimising the emptying equipment and enhancing the organisational structure of the faecal sludge management system.

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### 1. Introduction

Developing countries are characterised by a rapid growth of their populations mainly centred in cities where the economic activity is far more dynamic than in rural areas. In Senegal for instance, the city of Dakar, covering only 0.3% of the national territory, hosts 22% of the total population (DPS, 2004). This demographic situation explains why the authorities find it difficult to satisfy the different basic service needs of their populations, particularly in the sanitation sector (United Nations, 2007). This lack of service also leads to an insufficient collection of generated waste and its inappropriate disposal on streets and open land (Medina, 2000). To offset this deficiency, the populations have resorted to various survival strategies. In sanitation, several individual solu-

tions have been developed (latrines, septic tanks, flush toilets, etc.). These facilities are used by about one-third of the world population or nearly 2.6 billion urban dwellers in developing countries (Koné, 2010). In Dakar, 90% of the population is serviced by on-site sanitation infrastructure (Toukara, 2007).

Moreover, mainly on account of the settlement structure and due to economic constraints, conventional sewerage systems are unlikely to spread as an option of choice in these countries. In these poor areas, on-site sanitation is regarded as the best solution to reach the Millennium Development Goals in sanitation, which aim at reducing by half the number of people without any access to decent sanitation facilities by 2015 (United Nations, 2007). On-site sanitation is characterised, however, by the daily production of huge quantities of faecal sludge to be extracted from sanitation facilities and disposed of adequately to safeguard human health and the environment. In the city of Dakar alone about 1500 m<sup>3</sup> of sludge is collected every day from on-site sanitation systems (Toukara, 2007). This waste is sometimes discharged directly into the natural environment, i.e. in suburban areas, in watercourses and in rivers. In the case of the district of Dioukhop (a Dakar suburb), 74% of the sludge is dumped on streets and 7% in household compounds (Kassa M'Voubou, 2004). According to World Health Organisation, lack of safe water and proper sanitation in combination with poor

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hygiene may cause as much as 90% of all childhood diarrhoea in low-and-middle-income countries (WHO, 2005).

It must be emphasised that faecal sludge management in developing countries is conducted by private entities and small-size companies working independently from the public sector. Where public services are not always provided, these manual or mechanical emptying operators, responsible for sludge emptying and transport to disposal sites (faecal sludge treatment plants or unused land), play a key role in on-site sanitation systems (Jeuland and Koné, 2004). In Senegal, mechanical operators are often organised as incorporated companies offering safer working conditions than manual operators whose working methods expose them and the populations to faecal sludge risks.

Though their importance as key players in sanitation service providers is recognised, very little is known about the working conditions of faecal sludge emptiers and factors influencing their survival and business profitability. As key players in urban sanitation, stakeholders as well as national and local authorities need to develop a sound policy and regulatory framework to sustain and improve faecal sludge emptying services. The best way to help the poor is to encourage more small-time entrepreneurs to enter the market and to compete (Solo, 1999).

This paper analyses a representative case study based on experience acquired in Dakar, Senegal, the first country in Sub-Saharan Africa, if not in the world, to have implemented a city-wide faecal sludge emptying and treatment system with reuse of biosolids.

## 2. Materials and methods

### 2.1. Framework of the study

This study was conducted in Dakar, the capital of Senegal, a country located at the western tip of Africa with a surface area of 196 722 km<sup>2</sup> and a population of approximately 11 million inhabitants. Dakar and its suburbs with over two million inhabitants cover 0.3% of the national territory but numbers 22% of the total population.

Senegal is one of the least developed countries and, according to UNDP's Human Development Index, ranks 156 out of 177 countries (UNDP, 2007). This is an indication of the extreme poverty that characterises its population of which about 30% live below the poverty line (with less than 2 dollars/day). The per capita gross domestic product was estimated at US\$ 1700 in 2007. Senegal is therefore a typical example of a developing country facing important difficulties related to water and sanitation access.

In Senegal, faecal sludge management is conducted by several stakeholders, i.e. state-owned companies, the population and private sector. The government intervenes mainly as a regulatory entity of the sector and implements and manages faecal sludge treatment facilities. The private sector plays the role of service provider at the faecal sludge emptying level. It stands in direct contact with the populations who are its basic customers and sometimes with the government, which subcontracts part of the collective sewerage network or entrusts the private sector with exceptional operational tasks of pit emptying in religious cities on the eve of national ceremonies. The government authorities also provide emptying operators with the disposal service at the level of existing faecal sludge treatment units by paying US\$ 0.4 per m<sup>3</sup> tanker. The three faecal sludge treatment plants (Cambérène, Yarakh and Rufisque) receive between 300 and 500 m<sup>3</sup> of sludge daily and are operated five days a week from 9 a.m. to 4 p.m.

### 2.2. Definition of the emptying operator's profile

Definition of the emptying company's profile was preceded by an inventory of the main stakeholders involved in the emptying sec-

tor. It was based on a survey of the telephone directory, the register of members of Senegal's emptier association and also on timekeeping work in the faecal sludge treatment plant of Cambérène, the rallying point of most emptiers.

The profile of the emptying company was then defined on the basis of interviews and review of official documents related to the emptying companies. Free and/or semi-structured interviews were conducted with 23 heads of the 52 companies identified in Dakar. Of these 52 private emptying operators, 40 work informally and only 12 are incorporated companies. Informal companies are entities not subject to the rules and regulations of private companies and without a legal status or declared revenue.

The activities conducted in this study had a general and specific character. Indeed, the general issues pertaining to the organisation, operation and resources were, on the one hand, discussed with all the companies visited and, on the other, studied thoroughly with the emptying company used as reference basis for our study. This work was conducted over a period of one month, from 28 December 2006 to 30 January 2007.

### 2.3. Operating account of the surveyed emptying company

This activity, which lasted three months (from February to April 2007), was carried out in the form of participatory observations and visits to the three faecal sludge treatment plants of Dakar (Cambérène, Yarakh and Rufisque), to the garage and to the Association of Manual and Mechanical Emptiers, to the emptying company surveyed, as well as to other private companies. These visits aimed at identifying the different expenditure of the companies during faecal sludge emptying and haulage to faecal sludge treatment plants, evaluating the amount of fees paid at the faecal sludge treatment plants and becoming acquainted with the operation of the studied emptying company.

Observations made over a fortnight (March 2007) also took the form of daily routings of a tanker of the monitored emptying company. In the course of these two weeks, we witnessed not only domestic pits emptying (for eight days), but also industrial emptying (emptying of a ship in the Port of Dakar, operations at petrol stations and industries). Routing consisted in a daily monitoring of the tanker, where especially participatory observations allowed to gain the confidence of the emptiers, obtain confidential information and also confirm certain financial information derived from discussions with the emptiers (applied prices, municipal tax, discharge fees, etc.).

The FS emptying company was surveyed for two months to monitor and understand its management structure, operating and accounting system, various other formal or informal activities, and the profile of the staff other than those working directly with the emptying trucks. Monitoring of this company's accounting system allowed to identify two types of turnover: a formal turnover (C.A.<sub>f</sub>) and an informal turnover (C.A.<sub>i</sub>). Only the formal turnover is controlled by tax authorities as it is subject to regular pricing verified by the invoices. The informal turnover corresponds to the undeclared revenue from domestic pits emptying.

A questionnaire was also developed to obtain the opinion of the populations on the faecal sludge management system. The main issues addressed in this questionnaire concerned the type of faecal sludge management system used at household level, financial aspects, willingness to pay and households' satisfaction with the service provided. However, this paper only focuses on the financial aspects of the survey, particularly on the fees paid for the emptying service. The stratification criteria of this sociological survey were based on "houses" as survey units. They were chosen because they group several households generally sharing the same sanitary facility. According to the quota sampling method applied, about 100 houses were visited from 15 to 30 April 2007.

Emptying revenue evaluation is based on an average number of four trips per day for 312 days (six working days per week), thus amounting to totally 1248 trips/truck/year.

#### 2.4. Calculation of the emptying fee

The results obtained allowed to calculate the standard emptying fee. This calculation can be performed on the basis of the company's rate of return. Mention should be made that the very notion of profitability is a concept that varies depending on the approach chosen. It is often useful to calculate several ratios to determine as accurately as possible profitability of the studied company. Overall profitability, economic viability, financial profitability, and commercial viability can then be calculated. However, the commercial viability or company margin rate allowing to evaluate the company's future performance as a function of the fluctuation of its business volume measured by the turnover, is the only one directly linked to the company's turnover, thus allowing to establish a correlation to the emptying fee.

The rate of return is calculated as follows (Batsch, 2003):

$$Re = \frac{R}{C.A.} \quad (1)$$

where  $Re$  = profitability,  $R$  = result, and  $C.A.$  = turnover.

Hence:

$$Re = \frac{C.A. - C.T.}{C.A.} \quad (2)$$

where  $C.T.$  = total costs.

Consequently,

$$Re = 1 - \frac{C.T.}{C.A.} \quad (3)$$

Since the formal emptying activity is cyclical and not controlled by operators, we assumed fixed revenues.

The aforementioned return formula can therefore be expressed as:

$$Re = 1 - \frac{C.T.}{C.A.f + C.A.i} \quad (4)$$

where  $C.A.f$  = formal turnover and  $C.A.i$  = informal turnover.

$$C.A.i = P \times N \quad (5)$$

where  $P$  = emptying fee and  $N$  = number of trips (estimated at 1248 trips/year).

### 3. Results and discussion

#### 3.1. Profile of Dakar's emptying companies

##### 3.1.1. Overview

The private stakeholders involved in mechanical emptying are divided into two categories: incorporated companies and individual operators.

As illustrated in Fig. 1, most companies (67.3%) only own one truck. Generally, these companies are managed by private entities operating their own truck in an informal way. Starting the business with one truck is a common strategy to acquire experience in the sector and learn the management survival rules. Successful operators will subsequently invest in additional trucks. Therefore, companies owning more than two trucks have a long experience in the field and often turn formal to stabilise some activities and generate revenue. In this latter category, the number of companies with two to five trucks is nearly equal to the distribution rate of the total number of trucks belonging to either private or legal emptying entities. Most operators in the emptying sector own only one truck

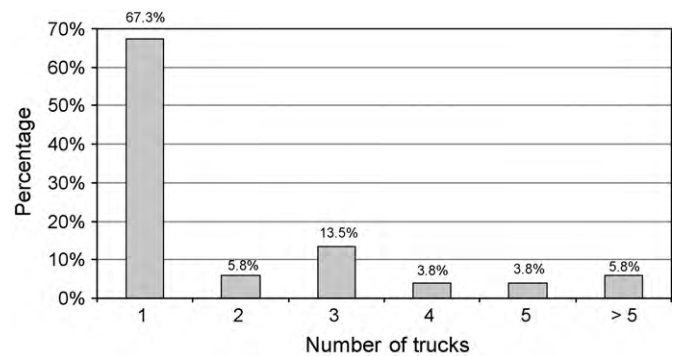


Fig. 1. Number of emptying trucks per company. Supplies include consumption of fuel, electricity, water, office running cost purchase and repair of computers, purchase of uniforms as well as small equipment and tools. External services A comprise rental and leasing charges, maintenance and repair of vehicles, vehicle insurance and communication costs (phone and fax). External services B comprise bank charges, fees and meal allowances for the staff.

(67.3%) and are mainly private operators. Large operators holding only 6% of the park are the best equipped with a fleet of 15 trucks.

The incorporated emptying companies are either Limited Liability Companies (LLC) or Economic Interest Groups (GIE). They own at least one truck, a head office and employ staff they manage in a more or less formal way.

The Limited Liability Company comprises at least two associates, which may be natural or legal persons. It is headed by a manager appointed by the associates. In the case of the emptying companies surveyed, the associates are members of one family who have inherited their parents' business.

GIE is a cooperation of existing companies aiming at facilitating or developing the economic activity of its members, improving or increasing the results of their activities whose purpose is not to make a profit for themselves but for their members (Pougoué et al., 1998). Emptiers are grouped in GIE out of a need to service diverse customers. Indeed, to secure some procurement contracts whose size exceeds the means of private emptiers, this framework was created to allow a consolidation and thus an increase in means. In Senegal for example, the government responsible for emptying pits in religious cities on the eve of ceremonies often calls the emptiers affiliated to GIE.

Emptying companies, GIE and LLC are often organised as associations. They are legally recognised and act as an interface between the associations and government entities. Their role is to acknowledge the emptiers' work, formalise the sector (issuing emptying licenses), regulate and limit the number of trucks but, above all, ensure transparency in public tenders.

Moreover, it is important to note the wide range of activities conducted by the emptying companies. They do not work only in emptying and haulage of domestic faecal sludge but are active in the disposal of wastewater and stormwater, in industrial emptying as well as in maintenance of the sewerage network.

However, in other respects, emptying companies seem limited in their development due to financial reasons (Koné et al., 2007) such as:

- an infrastructure often paid off (amortised) with no renewal (replacement): no investment capital, lack of locally available equipment and spare parts, etc.,
- no access to investment capital, often for lack of legal status and credibility (Solo, 1999),
- poor capacity building with limited knowledge in business management.

### 3.1.2. Human resources

The emptying companies have two categories of staff: permanent employees and day-labourers. The number of employees in an emptying company varies according to its size, number of trucks and nature of its business. Furthermore, the emptying companies visited are composed of teams with at least one director who coordinates all the activities, one marketing specialist, one secretary–accountant, one mechanic who ensures truck maintenance, drivers, and labourers—a typical organisational structure in West Africa (Blunier, 2004; Collignon and Vézina, 2000).

With the company surveyed, the team is composed of twenty-three persons, five of which are permanent employees and eighteen day-labourers. Permanent employees include a director, two marketing specialists, a secretary–accountant, and an administrator. The organisation of the company is generally structured around the truck. Each truck requires a team of three persons:

- One driver: He is responsible for the truck and is in charge of managing all mechanical parts, i.e. the truck engine and suction pump. He has to ensure proper functioning of the equipment before, during and after emptying or of any other services requiring use of the truck.
- Two labourers: They provide technical assistance during emptying operations (opening of pits, joining of pipes, closing and cleaning of pits).

### 3.1.3. Material resources

The mechanical emptying activities in the city of Dakar require an important vehicle fleet of about 130 trucks, most of which are rundown. None of the identified trucks are less than 10 years old. If the number of trucks was divided by the number of households benefiting from an on-site sanitation system, the ratio would be one truck for about 11 538 people or one truck for 1154 households serviced by on-site sanitation.

The survey results reveal that the trucks are mostly imported second-hand vehicles from Europe, mainly from France, Belgium and Holland. Rapid renewal of this fleet is difficult as a law prohibits the import to Senegal of trucks older 10 years. To remain in the emptying sector and secure survival, truck owners are forced to extend almost indefinitely the life of their vehicles. Yet, in Senegal, import of such specific utility vehicles seems less costly than elsewhere, primarily due to the existence of tax incentives on imports of emptying vehicles. Among other preferential terms we can cite:

- Tax exemption,
- Customs duties of 5% compared to 30% for other types of vehicles,
- 50% insurance exemption,
- 100% tax sticker exemption, thus cost-free.

According to the operators, this a priori quite interesting model of incentives has so far not facilitated fleet renewal, as the import prices for second-hand tankers remain very high. They currently vary between US\$ 25 000 and 45 000 depending on whether it is a pumping or a hydrocuring vehicle. This price also varies according to truck origin and make. This is also why faecal sludge emptying operators prefer to buy locally available old trucks at very affordable prices and renew them. Another quite important aspect to be underlined is that emptiers in Senegal mainly favour two makes of vehicles: Renault and Mercedes. Renault is chosen because spare parts are available. As regards Mercedes, emptiers argue that its strength and longevity are terms of productivity and profitability.

The emptying company surveyed has a fleet of 10 tankers but only three were operational at the time of the study. The potential of available operational trucks is reduced by frequent breakdowns

of vehicles requiring spare parts unavailable locally. The percentage of trucks frequently inoperational affects the emptying costs as it impacts inevitably the demand–supply ratio. With a downtime rate of about 50%, the number of tankers per household amounts to one truck for 2308 households or one truck for 230 latrines, assuming an average household size of 10 persons. This explains the frequent demand for manual emptying, an extremely harmful activity to human health and the environment.

Currently, among the hundred available trucks in Dakar, only 3% are hydrocuring, the remaining vehicles are pumping trucks and slurry tankers. This creates a problem in mobilising the full sludge capacity at pit level. Thus, after emptying, an important part of the settled sludge remains in the pit and only the supernatant is disposed of at the faecal sludge treatment plant. Aside from technical problems caused by this situation at the treatment plants, social problems are created between emptying service provider and the population, who considers the service unsatisfactory due to the rapid filling of pits after emptying.

The interviews reveal that the operators agree unanimously on the rundown condition of the vehicles, however, their limited resources limit renewal of the truck fleet. Donors and public entities should therefore intervene and impose regulations on types and service life of trucks operating in sludge emptying, create incentives for vehicle renewal and propose a blueprint for access to credits for this type of business.

## 3.2. Economic assessment of the emptying company

### 3.2.1. Emptying company revenue and expenditure

**3.2.1.1. Revenues.** The revenues of the emptying companies can be classified in two categories: revenues derived from informal and formal activity.

The revenues from an informal activity are primarily earned through emptying domestic septic tanks. They are considered informal because they are not declared and not listed in the official accounts of the company. This is common practice in developing countries in order to pay the least possible taxes. With an average emptying fee of US\$ 50 and average number of four trips per day, the informal activity of a tanker generates 200 US\$/day.

Revenues from a formal activity of mechanical emptying companies can be summarised as follows:

- Public contracts for maintaining sewerage networks and related facilities,
- Contracts with petrol stations (hydrocarbon emptying), industries and other companies,
- Annual domestic pit emptying in religious cities during religious events.

The tariffs applied vary according to the different activities. As regards contracts with the national sanitation utility or the religious cities, trucks and crew are rented for an 8-h working day at US\$ 600 each. Regarding the other contracts, the prices range from US\$ 100–160 per trip. Otherwise, the tariffs vary both technically and financially depending on the company submitting the tender.

**3.2.1.2. Expenditure.** The expenditure for the emptying company surveyed varies, however, it can be grouped as follows: depreciation allowances, personnel costs, purchase of materials and supplies, transport costs, external services A and B, taxes and duties, revenue tax.

**3.2.1.2.1. Investment and renewal costs or depreciation allowances.** The investment and renewal costs of emptying companies comprise not only the operational material but also all the assets of the company. Mainly emptying tankers, other transport material (tyres, suction or flexible hoses), office equip-

**Table 1**  
Expenses and revenues of a selected company operating only in domestic faecal sludge emptying.

Items	Unit	Annual amount per truck	Monthly amount per truck	Amount per trip	Percentage/charges
Purchase of materials and supplies	US\$	63 552	5296	50.68	51.9%
Water	US\$	41	3	0.03	0.03%
Electricity	US\$	301	25	0.24	0.2%
Fuel	US\$	48 928	4077	39.20	40.1%
Maintenance supplies	US\$	5754	480	4.61	4.7%
Office supplies and computer	US\$	2627	219	2.11	2.2%
Small equipment and tools	US\$	2667	222	1.90	1.9%
Studies and service provision	US\$	1093	91	0.88	0.9%
Purchase of records, materials and equipment	US\$	2141	178	1.72	1.8%
Transport	US\$	8148	679	6.53	6.7%
Transport of personnel	US\$	728	61	0.58	0.6%
Transport of parcels	US\$	100	8	0.08	0.1%
Travel and transfers	US\$	7320	610	5.87	6.0%
External services A	US\$	25 928	2161	20.77	21.3%
Material renting	US\$	7000	583	5.61	5.7%
Rental and leasing charges	US\$	120	10	0.10	0.1%
Maintenance and repairs of movables	US\$	13 747	1146	11.02	11.3%
Insurance of transport material	US\$	2097	175	1.68	1.7%
Documentation	US\$	191	16	0.15	0.2%
Phone and fax costs	US\$	2583	215	2.07	2.1%
Other telecom costs	US\$	190	16	0.15	0.2%
External services B	US\$	2714	226	2.17	2.2%
Banking	US\$	237	20	0.19	0.2%
Fees	US\$	500	42	0.40	0.4%
Accommodation and meal allowance	US\$	1977	165	1.58	1.6%
Taxes and duties	US\$	530	44	0.42	0.4%
Patents and related taxes	US\$	304	25	0.24	0.2%
Direct tax on wages	US\$	82	7	0.07	0.1%
Stamp duty	US\$	143	12	0.11	0.1%
Personnel costs	US\$	17 867	1489	14.32	14.6%
Wages	US\$	16 848	1404	13.50	13.8%
Social contributions	US\$	442	37	0.35	0.4%
Medical expenses	US\$	577	48	0.46	0.5%
Financial costs	US\$	1825	152	1.46	1.5%
Depreciation allowance	US\$	1711	143	1.37	3.7%
Total expenses	US\$	122 274	10 189	97.73	100%
Revenue	US\$	62 400	5200	50.00	51.2%
Revenue before tax	US\$	−59 874	−4989	−47.73	−48.8%
MTR	US\$	1000	83	0.80	0.8%
Net revenue	US\$	−60 874	−5073	−48.54	−49.7%

ment, and furniture are among the other investments subject to depreciation in an emptying company.

**3.2.1.2.2. Personnel costs.** The personnel costs include wages, social contributions and medical expenses. In these wage costs, the drivers responsible for the truck and thus for the emptying activity, are the best paid with a monthly wage of US\$ 160 (at least twice the minimum wage in Senegal), including a premium of 5% per trip. With four trips per day, the driver can get paid a premium amounting to three times his monthly wage (US\$ 200). Thus, the net salary of a tanker driver is US\$ 360. The two other crew members of the truck (labourers) receive each US\$ 50 in addition to a daily allowance for meals of US\$ 2.

The monthly wages of the other employees are the following: US\$ 100 for the secretary, US\$ 120 for the accountant, US\$ 300 for the engineer, US\$ 80 for the security guard, and US\$ 240 for the director.

Social contributions are paid only for permanent staff. They comprise contributions to the pension fund (US\$ 190 for three months) and to social security (US\$ 440/three months).

Medical expenses account for the remaining personnel costs.

**3.2.1.2.3. Purchase of materials and supplies.** This item is the highest of all expenses as it represents the operating costs of the

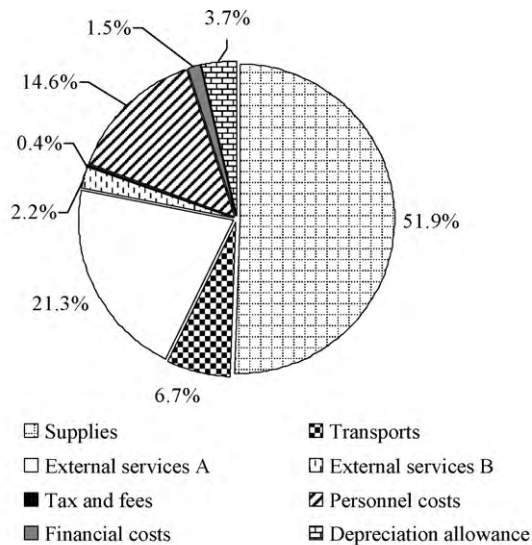
emptying company, which include consumption of fuel, electricity, water, supplies (maintenance, office and computer), purchase of uniforms as well as small equipment and tools.

**3.2.1.2.4. Transport costs.** They consist mainly of two elements: transport of personnel, travel and transfers. Transport costs of marketing specialists who canvass daily for new customers are listed under this item. Trips to Europe to purchase new trucks or other material, such as spare parts, are also included.

**3.2.1.2.5. External services “A”.** External services “A” comprise rental and leasing charges, maintenance and repair of vehicles, vehicle insurance and communication costs (phone and fax). Since communication with customers and other employees is of key importance, all the staff has been equipped with mobile phones. A telephone ensures smooth coordination of activities within the shortest possible time but at a rather high price.

**3.2.1.2.6. External services “B”.** External services “B” include bank charges, fees and meal allowances for the staff as determined by the company. Indeed, all the administrative staff and at least one marketing specialist spend their day at the office. Their meals are covered by the company.

**3.2.1.2.7. Taxes and duties.** They comprise all the taxes and duties paid by the company: direct tax on wages, stamp duty,



*Supplies include consumption of fuel, electricity, water, office running cost purchase and repair of computers, purchase of uniforms as well as small equipment and tools*  
*External services A comprise rental and leasing charges, maintenance and repair of vehicles, vehicle insurance and communication costs (phone and fax)*  
*External services B comprise bank charges, fees and meal allowances for the staff*

**Fig. 2.** Distribution of annual costs of a selected faecal sludge emptying company operating in Dakar in 2008.

related taxes (informal tax paid as “baksheesh” to traffic policemen). The tipping fee paid at the faecal sludge treatment plants is included in this column.

**3.2.1.2.8. Revenue tax.** It is the minimum taxable revenue (MTR) estimated at US\$ 1000 in Senegal and paid even in case of operating deficit. The importance of the informal activity in the sector of sludge emptying, and the fact that this activity is not officially declared explain why the revenue tax of emptying companies rarely exceeds the minimum taxable revenue. In fact, it could exceed this threshold should the government succeed to control all the activities of the emptying company.

### 3.2.2. Economic analysis of the emptying company operating only in domestic sludge emptying

Table 1 and Fig. 2 show the distribution of the operating costs per truck and trip of an emptying company whose main operating costs is fuel consumption that accounts for about 40% of the expenses and for almost 77% of the item “Purchase of materials and supplies”. The conducted survey has shown that a trip requires on average 101 of diesel oil. This fuel volume is used for haulage of sludge and starting the pump. Hence, profitability of emptying companies remains largely dependent on fuel consumption and market price.

External services “A” also represent an important operational part of the emptying companies and account for about 22% of the expenses; slightly more than half of this budget is reserved for maintenance and repair of equipment. If the expenses of the emptying company are to be reduced, this item should be given particular attention because a simple renewal of the equipment will cost the company far less as fewer spare parts will have to be purchased and fewer engines repaired. This relates to the item “Transport” (8.16% of expenses), of which 90% of the budget is reserved for international trips to acquire spare parts. Personnel costs are relatively high and amount to approximately 15% of the turnover; thus an indication of the quality of wages paid by emptying companies. The law on minimum wages is therefore complied with in a context where adherence to the Minimum Wage Act generally applies only to a small part of the formal sector (Saget, 2008).

From a financial viewpoint, these costs account for a total annual amount of US\$ 122 214 per operated tanker. Concerning the revenues, they are assessed around US\$ 62 400 for four trips per day and a six-day working week at an average emptying fee (one trip) of US\$ 50.

Consequently, the emptying activity itself is not profitable; the loss would amount to 95% of the turnover. For a sustainable activity and promotion of a safe emptying service provision capable of safeguarding human health and the environment, it is necessary to define the operating conditions of emptying companies able to run at a profit. Policy-makers could therefore act on the emptying fees, the discharge fees at the faecal sludge treatment plant or influence diversification of the activities of the emptying company.

Since the sludge discharge fee (fixed at US\$ 0.4/m<sup>3</sup> per tanker) at the faecal sludge treatment plant does not allow a balanced operation of the faecal sludge treatment plant (Gning, 2008), lowering of this fee cannot be contemplated.

Moreover, an increase in the emptying fee could make up for the loss experienced by the emptying companies. A 96% increase or a fee of US\$ 98 per trip could contribute to a strictly balanced operation. However, such a measure would conflict with the poor living standards of 30% of the population earning less than 2 dollars a day.

### 3.2.3. Economic analysis of the emptying company responsible for domestic emptying and other activities

With due regard to the so-called formal activities contracted with government or private entities (collective pit emptying in religious cities, flushing of collective sewerage networks, drying of flood areas, and industrial flushing) and to the informal activities (domestic pits emptying), analysis of the operating account of the surveyed company reveals a positive and high net income, 28% of the revenue (Table 2). It must be noted that the operating account has been established on the basis of a fleet of three operational tankers of the company surveyed.

It should also be underlined that revenue tax is based on a minimum of US\$ 1000 since its calculation does not take into account the revenues from domestic emptying, which remain undeclared as no invoice is issued to the households after service provision. The revenues officially declared are not high enough to exceed the minimum tax. Yet, the income generated by the informal activity is significant, i.e. it contributes on average up to 31% of the total revenue or US\$ 156 000. As the expenses remain unchanged, the company makes a clear net profit of US\$ 139 576. Yet, if the taxable income were calculated on the whole business, the net income would be much lower and would amount to about US\$ 42 173, which corresponds to 8.4% of the turnover (the tax corresponds to 30% of the net income).

Improvement of the profitability of emptying companies also presupposes a reduction in their operating costs; a factor of key importance for a smooth operation of the company as illustrated in Fig. 3.

As aforementioned, the items “Fuel”, “Transport” and “Repairs” can be revised downwards following a renewal of the emptying material. This old material requires additional expenditure to ensure smooth operation of the company.

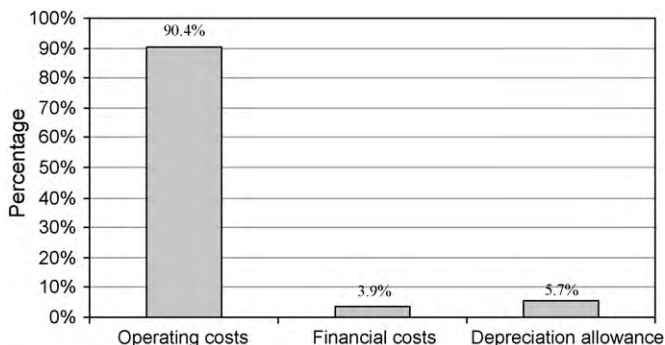
Moreover, emptying companies can diversify their activities by investing in other sectors they have not intervened yet. By using multi-purpose trucks capable of carrying various materials like sand, water, gravel, as practised in Sokodé (UNDP and GEF, 2007), the profitability of emptying companies can certainly be improved.

### 3.3. Towards new fees for domestic emptying services

A fixed revenue derived from formal emptying activity and an equal or at least 20% profitability level is assumed to be achieved

**Table 2**  
Expenses and revenues of a selected company operating as a multi-service provider.

Items	Amount (US\$)	Expense ratios (%)	Revenues ratios (%)
Purchase of materials and supplies	190 656	52.6%	37.9%
Water	124	0.03%	
Electricity	903	0.25%	
Fuel	146 783	40.53%	
Maintenance supplies	17 262	4.77%	
Office supplies and computer	7882	2.18%	
Small equipment and tools	8000	2.21%	
Studies and provision of services	3280	0.91%	
Purchase of records, materials and equipment	6422	1.77%	
Transport	24 444	6.7%	4.9%
Transport of personnel	2184	0.6%	
Transport of parcels	299	0.1%	
Travel and transfers	21 961	6.1%	
External services A	77 783	21.5%	15.5%
Material renting	21 000	5.8%	
Rental and leasing charges	360	0.1%	
Maintenance and repairs of movables	41 241	11.4%	
Insurance of transport material	6291	1.7%	
Documentation	572	0.2%	
Phone and fax costs	7748	2.1%	
Other telecom costs	571	0.2%	
External services B	8141	2.2%	1.6%
Banking	710	0.2%	
Fees	1500	0.4%	
Accommodation and meal allowance	5931	1.6%	
Taxes and duties	1589	0.4%	0.3%
Patents and related taxes	913	0.3%	
Direct tax on wages	246	0.1%	
Stamp duty	430	0.1%	
Personnel costs	33 440	9.2%	6.7%
Wages	30 384	8.4%	
Social contributions	1326	0.4%	
Medical expenses	1731	0.5%	
Depreciation allowance	20 671	5.7%	4.1%
Downtime allowance	120	0.03%	
Tangible assets allowance	20 551	5.67%	
Financial costs	5476	3.9%	547.6%
Total expenses	362 201	100%	72.0%
Total revenue	502 777	147.9%	
Revenue from formal activity	346 777	–	–
Revenue from informal activity	156 000	–	–
Revenue before tax	140 576	–	–
MTR	1000	–	–
Net revenue	139 576	47.6%	27.8%



**Fig. 3.** Distribution faecal sludge emptying company's expenditures per year.

by the emptying company. Based on the profitability formula, the following equations are formed:

$$1 - 0.20 = \frac{C.T.}{C.A._f + P \times N}$$

with CT=total costs, C.A.<sub>f</sub>=formal turnover, C.A.<sub>i</sub>=informal turnover, P=emptying fee, and N=number of trips (estimated at 3120/year) calculated on the basis of the surveyed company register data.

Accordingly:

$$P = \frac{C.T. - 0.8 \times C.A._f}{0.8 \times N}$$

Numeric application:

$$P = \frac{362\,201 - 0.8 \times 346\,777}{0.8 \times 3120}$$

$$P = \text{US\$ } 34$$

In view of this result, the company surveyed is capable of sustaining a decrease in its current fees (on average US\$ 50 per trip). The emptying fee could thus decrease 32% (about US\$ 34) while keeping a rate of return of about 20% of the turnover. This decrease is possible because emptying companies in Dakar are involved besides domestic emptying also in other activities, such as flushing of sewerage networks and industrial emptying. A 20% service increase is proposed given the volatility of these activities, the price fluctuations of an oil barrel and to ensure a sustainable emptying service. This would amount to an emptying fee of about US\$ 41.

Profitability assessment of emptying companies with only one truck (68% of the private operators) has shown that diversification still seems to be the solution to render these economic entities viable. Indeed, by recouping the revenues generated by the formal activity of the one-truck company surveyed and reducing them by 30% (taking into account the volatility of this type of activity), one-truck companies will yield a return level of 19% of their turnover, assuming that the trip fee is still US\$ 50. The proposed drop in emptying fees to US\$ 41 would bring the rate of return of this type of company back to 13%.

Moreover, profitability of the emptying companies can be improved by introducing fuel-efficient emptying tankers, both at engine and suction pump level. By extending also the closing hours of the faecal sludge treatment plants beyond the normal office hours (for instance 8 p.m. instead of currently 4 p.m.), the average number of trips per day could be increased by the improved mobility of tankers less handicapped by the huge traffic jams in cities of developing countries. Also, when competition is present between companies, the service may be less costly (Bel and Warner, 2008).

#### 4. Conclusion

- Domestic faecal sludge emptying in developing countries is mainly ensured by incorporated companies facing various difficulties to guarantee their balanced operation.
- A formal company dealing only in sludge management in Dakar cannot cover all its running costs. It would sustain important losses and would go bankrupt. Consequently, faecal sludge emptying in Dakar is not a profitable activity. However, if tankers are used for additional activities, such as rainwater drainage, hydrocarbon emptying, the gap created by the domestic emptying activity could be filled. Accordingly, diversifying activities seem to be the solution to raise the revenues of emptying companies while maintaining their emptying service. It also seems a solution to the drop in emptying fees of on-site sanitation facilities.
- Renewal of the emptiers' truck fleet has become vital not only to sustain the emptying service but also to reduce fees and thus the costs of emptying companies. However, this renewal is only possible with the introduction of incentive measures facilitating the import of emptying tankers. As in the case of Senegal, tax abatement on imported emptying tankers, could form part of this objective.

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