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

Final Report

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Contents

Abbreviations

ADB	Asian Development Bank
BMGF	Bill and Melinda Gates Foundation
BOD	Biochemical Oxygen Demand
Co.	Company
COD	Chemical Oxygen Demand
DWWM	Decentralized wastewater management
DO	Dissolved Oxygen
EPA	Environmental Protection Agency
FS	Fecal sludge
FSM	Fecal sludge management
FSTP	Fecal sludge treatment plant
GDP	Gross Domestic Product
GSO	General Statistical Office
HCMC	Ho Chi Minh City
HH	Household
HN	Hanoi city
HP	Hai Phong city
IESE	Institute of Environmental Science and Engineering
Ltd.	Limited
MARD	Ministry of Agriculture & Rural Development
MoC	Ministry of Construction
MoF	Ministry of Finance
MoIT	Ministry of Industry and Trade
MoH	Ministry of Health
MONRE	Ministry of Natural Resources and Environment
VEA	Vietnam Environment Administration
NGO	Non-governmental Organization
ODA	Official Development Assistance
SADCO	Sewerage and Drainage Company
SoE	State-owned Enterprises
STP	Sewage treatment plant
SWM	Solid Waste Management
URENCO	Urban Environment Company
VND	Vietnamese Dong
WB	World Bank
WSC (WSCO)	Water Supply Companies
WHO	World Health Organization
WWTP	Wastewater treatment plant

Table of Figure

List of Tables

1. Introduction

The Bill & Melinda Gates Foundation

Guided by the belief that every life has equal value, the Bill & Melinda Gates Foundation works to help all people lead healthy, productive lives. In developing countries, it focuses on improving people's health and giving them the chance to lift themselves out of hunger and extreme poverty. In the United States, it seeks to ensure that all people—especially those with the fewest resources—have access to the opportunities they need to succeed in school and life. We concentrate on areas with the potential for high-impact—sustainable solutions that can reach millions of people. We work closely with our partners to support innovative approaches and expand existing ones so they reach the people who need them most. We also support policy and advocacy efforts to accelerate progress against the world's most acute poverty.

Global Development

Nearly 2.5 billion people live on less than $2 a day. For one person in eight, hunger is a constant, potentially deadly companion. The vast majority of the poor also lack access to the most basic financial services, and only a tiny minority have access to the Internet. The foundation's Global Development Program is working with motivated partners to create opportunities for people to lift themselves out of poverty and hunger. Our strategy is focused. Because most of the world's poorest people rely directly on agriculture, we support efforts to help small farmers improve crop production and market access. Because loans, insurance, and savings can help people weather setbacks and build assets, we facilitate access to financial services for the poor. In addition, information can change lives, we support free public access to computers connected to the Internet. The newest Global Development program area —Water, Sanitation & Hygiene—focuses on sanitation that works for the poor.

The challenges of latrines emptying and fecal sludge (FS) transportation

The WHO-UNICEF Joint Monitoring Programme online database shows that in Developing Countries, both in rural and urban areas, a total of 2.8 billion people use non-piped sanitation infrastructure. Of that population, at least 40% of urban dwellers (i.e. more than 1.1 billion people) currently use non-piped sanitation installations, which are unsustainably operated and maintained in most of the cases. The majority of cities in these countries, which can be categorised as "latrine-based cities", rely on such infrastructure for excreta disposal. Ongoing latrine provision programmes, aiming at achieving the MGDs sanitation target, still lack, service provision arrangement for the collection/emptying, haulage, safe disposal, reuse or treatment of faecal sludge produced by onsite sanitation infrastructures. This is considered as an issue of immediate attention, as the sanitation coverage is increasing, especially in urban areas with high population density.

Literature data shows that when full, latrines are emptied either mechanically by emptying trucks, or manually. While mechanically emptied sludge can be transported and disposed of several kilometres away from people's homes, the manually emptied sludge from low income areas is usually deposited into nearby lanes, drains or in open piece of lands. These practices represent a significant risk to public health and have a high disease

impact on emptying operators, their families, the households living in the immediate area and on vulnerable populations in latrine-based cities. As a result, the existing research tends to focus on health risk implications and the impacts of such practices on the environment.

Research about fecal sludge emptying and transportation service delivery is both limited and weak. There are considerable knowledge gaps about fecal sludge emptying as a service, and its effectiveness as a component or an integrated part of cities sanitation service provision. Indeed, most focus on either household latrine acquisition or on treatment/reuse options. Existing data and knowledge about the market drivers and constraints on non-piped sanitation services, from the time the pit is emptied to when the contents of the pit are disposed off (whether at a treatment site, or directly into the environment), is extremely limited to non-existent.

It is acknowledged that for the extraction- transportation market segments, governments play a limited role- with most of the work conducted by private individuals and organizations (MSMEs), often on an informal basis, with limited involvement and oversight from government / utilities. Further, while there is some individual knowledge of pit emptier and truckers, and some high level rapid assessments of septage management, there is extremely limited research that provides useful information to inform investments by governments, donors, or development partners in a way that will benefit low-income.
Given this state of knowledge, exploratory research is needed in the areas of governance, management, business and operating models for fecal sludge extraction, transfer, and transportation. This includes a mapping of how transactions happen between and/or among service providers and individual households, government agencies, treatment/disposal sites, and other customers, as well as the technologies used, the market size and business models. This thus, is the scope of work we seek to undertake in assessing business models in fecal sludge management within the extraction and transportation market segments. The research will be conducted in five countries in Asia. (We will be executing a similar scope of work for five countries in Africa in parallel).

The purpose of this research is to inform the sanitation sector, for the purpose of informing more in-depth empirical research and/or investments by governments, donors and other development partners. A synthesis report from each region will provide analysis of wider patterns across countries. In the countries and cities where the work will be conducted, results will be structured to feed into discussion and debate at the local level among urban sanitation policymakers and practitioners, in order to develop a better understanding of this area of sanitation service delivery.

The study in Vietnam is being led by the Institute of Environmental Science and Engineering (IESE), Hanoi University of Civil Engineering, Vietnam.

Other main partners involved in the study are:

- Department of Environment, HCMC University of Technology.
- URENCO 12, Hanoi Urban Environment Company.
- Local partners in 3 cities: Hanoi, Hai Phong, Ho Chi Minh City.
- Other researchers and consultants.

Locations for the case studies

The five countries where this research will be carried out are: India, Bangladesh, Malaysia, Vietnam and Cambodia.

In Vietnam, three cities of Hanoi, Hai Phong, and Ho Chi Minh have been selected based on diversity of business approaches and models. In these cities, in-depth case studies will be conducted in order to better understand the full spectrum of urban sanitation service delivery models for the country. The selected cities include the capital city, a largest city, and one city with a population less than 1 million population. All cities selected have sludge treatment plants or official dumping sites.

Clarifying the Terminology

On-site sanitation systems (OSS) include both septic tanks and latrines, and different countries call the waste that accumulates inside OSS by different names: septic tank sludge, fecal sludge, septage, night soil, etc.

Septic tanks are watertight, multi-chambered receptacles that receive black and/or grey water And separate the liquid from the solid waste, which it stores and partially digests.

Many OSS are mistakenly called septic tanks, even when they are inadequately sized or designed, have only one chamber, or have open bottoms, and therefore do not perform primary wastewater treatment.

Septic tank sludge or septage is the combination of scum, sludge, and liquid that accumulates in septic tanks. Although this term technically applies only to septic tank wastewater, many people use it to describe waste from all on-site sanitation systems.

Fecal sludge is a term developed by Sandec/Eawag uses to apply to human excreta in both septic tanks and latrines.

This report refers to all types of human excreta collected from urban on-site sanitation systems, including wet and dry systems, and private or public toilets. These elements of on-site sanitation should not be confused with the piped wastewater collection system.

2. COUNTRY FSM BACKGROUND

2.1. Urban sanitation background

An estimated 65% of people in Vietnam have access to sanitation at the national level, with 88% access in cities, and 56% access in rural areas (WHO/UNICEF, 2008). Access to wastewater treatment remains very limited. About 90% of urban wastewater in Vietnam remains untreated (Nguyen V. A., 2007). Most industrial and domestic wastewater discharges directly into canals and rivers, resulting in severe water pollution. In 2007, the World Bank estimated that poor sanitation costs Vietnam $780 million in economic losses each year, or 1.3% of GDP (ESI study, WSP/WB, 2007).

Septic tanks form the foundation of Vietnam's urban sanitation infrastructure and their importance is growing. Over 77% of households in cities and provincial towns, 40% in district towns, and 19% in rural areas use septic tanks (WHO/UNICEF, 2008, and ADB, 2006). Though there are codes for septic tanks, lack of enforcement has resulted in a variety of problems with the existing stock of tanks in the country. Traditionally, septic tanks, which tend to be three to four cubic meters in size, were built inside the house; the difficulty of accessing them discourages owners from frequent desludging. In addition, households and developers do not always build standard septic tanks, even if they submit the correct designs to the local Department of Construction. Anecdotally, some new housing developments do not build septic tanks at all, and instead connect directly to the drainage system, causing blockages and flooding (Klingel et al, 2001). Especially in small towns with higher elevations, many tanks also have open bottoms that allow direct leaching into the groundwater.

The Vietnamese regulations allow household to connect direct to the sewer, avoiding septic tanks in the case whenever centralized or cluster wastewater treatment plant has been built. This relates mostly to the new development areas in the cities. In existing urban areas, most of wastewater is directly discharged to the combined drains, canals connected to the water bodies, therefore septic tank still plays important pre-treatment role in these places. According to our estimation, in order to provide 100% of wastewater connection and treatment in urban areas, Vietnam will need an investment capital of approximately USD 10 billion which 5 times more than a whole budget spent for the sector over last 20 years. Therefore, septic tank and septage management is, and will be among key issues in urban sanitation in Vietnam for the coming decades.

Vietnam has leveraged almost USD 1.2 billion in official development assistance (ODA) for more than 10 cities and provincial towns to construct sewerage and drainage infrastructure. Key funding agencies include: Asian Development Bank (ADB), Belgian Technical Cooperation Agency (BTC), Danish International Development Agency (DANIDA), Japan International Cooperation Agency (JICA) and Japan Bank for International Cooperation (JBIC), German Reconstruction Credit Institute (KfW), Swiss Agency for Development and Cooperation (SDC), the World Bank (WB), etc. Many of these projects have been incorporating septage management programs and treatment facilities as part of larger wastewater projects, such as: Ha Long environmental sanitation project, Quang Ninh province (WB), Buon Me

Thuot environmental sanitation project, Dac Lak province (DANIDA), Hai Phong environmental sanitation project (WB), Nam Dinh urban development project (SDC), etc.

While 85% of the funding in the past came from international assistance, these funding agencies are unlikely to increase or even maintain current levels of funding in Vietnam in the future. This means that new septage management programs will have to draw largely from user fees, local initiatives, and central government transfers.

2.2. Septic Tank Design

The National Design Standard of Vietnam for Wastewater Systems, which applies mainly to urban areas, sets the technical specifications and standards for the size and design of septic tanks. The Ministry of Health has issued the Manual for septic tank design, installation and O&M. The Ministry of Construction is also drafting the Design Code for the septic tank design and construction.

According to these code and manual, the septic tank desludging frequency is based on the size of the tank, incoming flows and associated number of users. Black wastewater receiving, and mixture of black and grey wastewater receiving septic tanks are also classified.

However, in practice, most cities lack the enforcement capacity to ensure compliance of the household septic tanks to the standard.

Septic tank is a most popular sanitation pretreatment mean in Vietnamese cities. It is often made from bricks, for individual houses, or reinforced concrete, for individual houses and public buildings. Tanks often are sealed by concrete base and cement mortgage. Households often place the tank in the basement, surrounded by the foundation. Tank often consists of two, or three chambers. The first, receiving chamber, often is built with largest portion of the total tank volume, giving space for solids accumulation and anaerobic digestion. Total volume of the HH septic tank, depending on available space and financial availability, often ranges from 1.5 to 5 m^3.

Most of septic tanks in Vietnamese urban households receive only black wastewater. Grey wastewater from kitchen, bathroom and washing sink is often discharged directly to the city's sewer, avoiding septic tank.

Due to poor maintenance practice, post treatment chamber filled with media is not often used, since household owners are afraid of filter clogging. Sludge from most of septic tanks is not emptied regularly. There is no enforcement, no control by the local authorities on this activity.

Removal efficiency of septic tank is often ranging from 10 to 50% for BOD and SS. Though it does not meet effluent standard, but, while cities still cannot afford to build centralized wastewater treatment plants, HH septic tanks play very important pretreatment role.

2.3. Septage Collection and Treatment

Households pay service providers to empty septic tanks when they are full, which can take from three to ten years. A mix of state-owned, limited liability companies and private companies provide desludging. Due to a lack of treatment infrastructure, service providers usually dispose of septage in drains, fish farms, and waterways.

Several cities in Vietnam have built wastewater collection and treatment systems, solid waste collection and sanitary landfills. 80% of funding for those projects is coming from the ODA grants and loans (WB, 2006). Septage management components have been also initiated in some cities such as Nam Dinh (Swiss fund), Ha Long, Da Nang and Hai Phong (WB fund), etc. Lack the operations and maintenance (O&M) budgets to fund septage collection and treatment is among big challenges in the cities.

There are no national laws governing the collection and treatment of septage yet. All desludging operators in urban areas are only required to obtain a business license to open and run the business. The national government has not mandated septage management or provided policy guidance. As a result, local governments have no incentive to promote septage management, invest scarce resources in operating treatment facilities, or support such projects once ODA project funding ends (AECOM & SANDEC, 2010).

Since septage collection companies often also collect solid waste, they commonly dispose of septage at landfills, although solid waste laws also do not address septage. The Ministry of Health is currently drafting guidelines for composting human excreta into reusable fertilizer, based on the World Health Organization's 2006 "Volume 4: Excreta and Grey Water Use in Agriculture" of the "Guidelines for the Safe Use of Wastewater, Excreta, and Grey Water." This initiative indicates that people widely apply untreated septage as a fertilizer, and that there is a future for the sustainable, and potentially profitable, reuse of treated septage (AECOM & SANDEC, 2010).

Vietnam's laws specify the do not yet regulate septage collection, treatment, or disposal. Septage in Vietnam remains a largely uncontrolled pollutant. This problem will likely worsen, as urbanization continues and new housing developments install septic tanks as a most popular and well accepted mean of pre-treatment.

3. Methodology

3.1. Literature review

The literature review is aiming at gathering information and existing sources on socio-economic and natural conditions of the selected cities, status of institutional and legal framework of the infrastructure management, status of the septic tank extraction and transportation practice, and possible involved partners in the study activities. The review will also develop background information on selected cities which will be analyzed during the case study development.

3.1. Situational analysis methodology

3.1.1. Household survey design

The main objective of Households Survey is to collect useful data at a micro level for a better description and understanding of Fecal Sludge (FS) management system in a given city.

The survey addresses the following issues:

- Identity and profile of interviewed person
- Living conditions of the Household: access to drinking water, sanitation facilities, service of FS extraction
- FS Management: perception on improvement, conditions of improvement, involvement and role to be played by each category of stakeholder.

The collected data will allow study team to analyze:

- Water and sanitation coverage in the city;
- Types of on-site sanitation facilities and their distribution in the city;
- Quantity of fecal sludge produced per year;
- System and scale of FS extraction and transportation (manual, mechanical)
- Frequency of FS extraction and transportation;
- Cost of the service (current and expected);
- Challenges faced by households;
- Willingness to improve FS Management in the city by the households

Number of households (users) surveyed:

- 400 HHs have been surveyed in Hanoi, including 300 HHs in urban areas, and 100 HHs in peri-urban areas.
- 300 HHs have been surveyed in Hai Phong, including 225 HHs in urban areas, and 75 HHs in peri-urban areas.
- 300 HHs have been surveyed in Ho Chi Minh city, including 225 HHs in urban areas, and 75 HHs in peri-urban areas.

Household selection:

- Only the houses for living have been selected. Those houses can include some small business such as car wash, foods, small shops, …
- In order to gather necessary information from the household on fecal sludge management practice, the household should use the sludge emptying service before. Considering average tank emptying period at households in urban areas in Vietnam is about 10 years, the study team has decided to select for the survey the only households who have been living in the house for more than 10 years.
- Households from the inner-city wards participated in the survey include the ones who are connected to the sewer vs. not connected (near canal or pond, soak pit), old vs. new houses (emptied before vs. not emptied).
- Besides, households from peri-urban communes have been selected whereas representing features of sanitation status could be identified such as Septic tank vs. pit latrine; Connected vs. not connected (to the drainage network); Old vs. new houses (emptied before vs. not emptied): ''10 years'' criteria; Reuse of fecal sludge vs. not reuse (for vegetables, flowers, other crops, fish).

3.1.2. FSM practices and data collection

3.1.2.1. Identification and selection of FS emptying operators

In total there 20 FS emptying operators have been selected for the survey. Among which:

10 enterprises from Hanoi city:

- 01 public utility of Hanoi Urban Environment Company (URENCO)
- 5 medium private enterprises
- 4 small private enterprises.

4 enterprises from Hai Phong city:

- 01 public utility of Hai Phong Sewerage and Drainage Company
- 2 medium private enterprises
- 1 small private enterprise

6 enterprises from HCMC:

- 01 public utility of HCMC Urban Environment Company (CITENCO)
- 3 medium private enterprises

2 small private enterprises

3.1.3. Methods to validate financial data

Financial data from surveyed enterprises have been collected through direct communication by the study team with the enterprises managers and their relevant departments, including Marketing, Accounting, Technical, etc. Data have been collected through Questionnaires, Official financial reports of the Company, Interviews, and Expert opinion (for that not accessible information). Cross-checking is a major method to validate collected financial data. Besides, expert opinion on the logic value of the data collected has been also used.

3.1.4. Treatment Plant/Dumping sites model

In three cities there are different models of fecal sludge treatment and/or dumping. The following classification provides more details:

- Public enterprives:
  - Co-composting with organic waste and selling;
  - Drying at the bed and selling;
  - Drying at the bed and dumping;
  - Dumping at the city's sanitary landfills.

- Private enterprives:
  - Co-composting with organic waste and selling;
  - Illegal dumping to the bare land;
  - Illegal dumping to the city sewers, canals and water bodies;
  - Selling to the farm owner (for fertilizing, fish feeding, etc).
  - Dumping to the city landfills.

3.2. Determination of financial flows and key stakeholders

3.2.1. Determination of financial flows

Financial flows have been identified through analysis of the business activities of the enterprises. Developed financial flows have been discussed with the enterprise staff for verification.

The following financial flows have been identified and further quantified for the surveyed households, enterprises and involved stakeholders.

Table 3-1. Financial flows analyzed in the study

No	Stakeholders	Financial flows	
		Incomes	Expenditures
1	Household		Desludging fee
			Wastewater tariff through water bill**
2	Emptier	Desludging fee	Registration and licensing fees
		City budget for desludging *	Revenue tax
		Part of revenue from wastewater fee (for scheduled desludging**)	Assets depreciation costs
		Lease of public toilet cabins*	Operation & Maintenance costs for desludging and transportation
		Income from other activities	Benefit
3	Fecal sludge treatment operator	Disposal fee from emptier	Registration and licensing fees
		Compost sale	Revenue tax
		Income from other activities	Assets depreciation costs
			Operation & Maintenance costs for FS treatment
			Benefit

*- for desludging of public toilets by state own enterprises;
**- for Hai Phong city.

3.2.2. Key stakeholders in FSM

There are two key stakeholders in FSM in the cities: households, as service provider, and fecal sludge emptying service providers, who can be public or private enterprises. At public enterprises, since FSM is not main business of the company, only activities related to the FSM have been analyzed.

Besides households and fecal sludge emptying service providers, there are other stakeholders involved in FSM and will be selected for the survey:

- Industries, commercial and public places, who use FS emptying service.
- Faecal sludge reusers.

The study team has also conducted interviews and information gathering at other stakeholders who are regulating the FSM activities, and who are setting up and controlling the environmental issues in the cities. Some professional associations have been also interviewed. Those are:

- Department of Construction under city authotiry
- Department of Natural Resources and Environment under city authotiry
- Local authorities (People's Committees): city/ district/ commune/ ward level
- Ministry of Construction – MOC;
- Vietnam Environment Administration – VEA;
- Vietnam Association for Urban and Industrial Environment

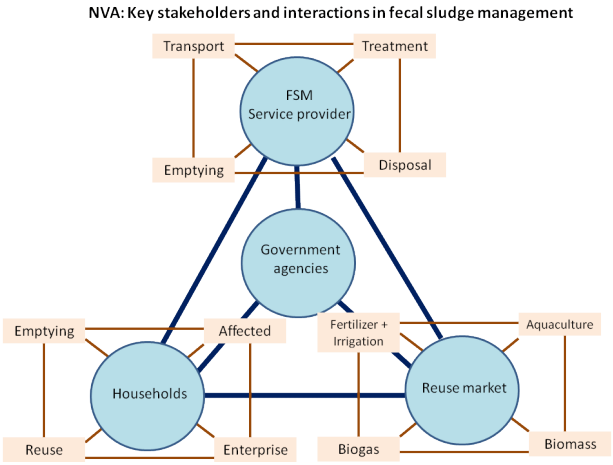


Figure 3-1.Key stakeholders involved in the fecal sludge management study

3.3. Market size calculation method

3.3.1. FS production and collection computation

FS production and collection computation is based on surveyed data as theoretical calculation as follows:

- Market size:
  - Based on the number of households, average size of septic tanks and pit latrines, actual desludging interval (from household survey), *market size value P1* is calculated;
  - Based on theoretical sludge accumulation rates (0.6 liter/cap.yr. in pit latrines, 0.3 liter/cap/yr. in septic tank receiving black wastewater), market size value P2, or *theoretical volume of sludge accumulated P2*, is calculated;
  - Assuming desludging interval will be more frequent as required: 1 year for pit latrines, 2 years for septic tanks, *projected market size P3* is calculated.
  - Based on the data from surveys at desludging enterprises (number of trucks x number of trips per year), *actual sludge volume C1* is estimated.
  - For cross-checking, *C2, actual sludge volume emptied*, based on the secondary data (available reports, etc.) is presented.

For P1, P2, P3: septic tank sludge from non-residential customers is calculated as 10% of the amount from households.

At the same time, coefficient 0.9 is applied for the amount of sludge emptied assuming only 90% of sludge is emptied every time.

For C1, coefficient 0.9 is applied, assumping right type of car is sent for desludging, and 90% of tanker volume is full per each run.

According to the traditional Asian religous and customs, people do not empty their pits during first week, especially on the 1st and 15th days of the lunar calendar month. They do not empty the pits also in the second half of December, and whole 2 first months of the lunar calendar. Therefore, number of feasible working time of each enterprise is 9 months per year, 28 days per month.

Since the survey was not conducted for all desludging enterprises in 3 cities, the actual collected sludge amount is estimated taking average number of trucks, truck volume, feasible number of trips per year, and total number of active enterprises in the city.

3.4. Financial Analysis Methodology

The Figure 3-2 presents logic flow chart of financial analysis of the study. The data collection through spread sheet to the FSM service providers to fill in, plus additional interview and cross checking company financial reports, allows the financial expert in the team conduct the financial analysis of each developed scenario.

Current status of the enterprise Income statement includes the following parameters: Expenses (Labor costs; Operation and maintenance costs for desludging, transportaion, dumping or composting; Trucks, equipment and fixed assets costs); Revenue; Profit (Loss).

The following assumptions have been made during calculations:

- Inflation rate is 11,75% (as average inflation rate over last 3 years in Vietnam) (GSO, 2010 - 2011);
- Exchange rate: USD 1 = VND 20,600 (Vietcombank, 2010);
- Depreciation:
    - 5 years for second hand trucks;
    - 10 years for new trucks;
    - 20 years for fixed assets (office, workshop, etc).

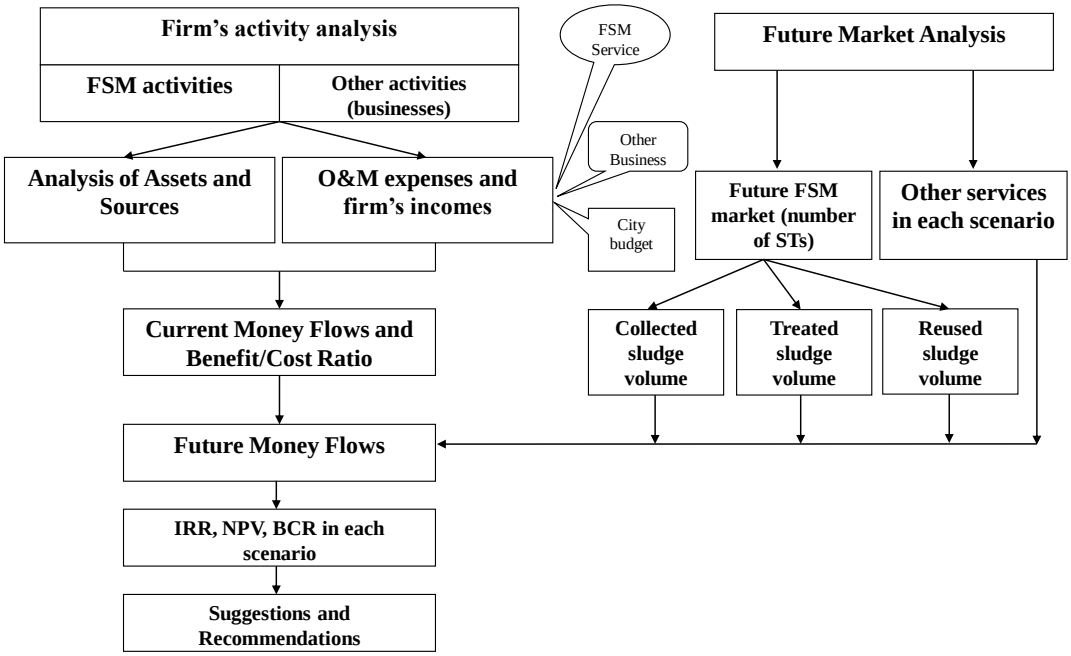


Figure 3-2. FSM Business Analysis Algorithm

3.4.1. Business cases assessment

At first, analysis of current status of business has been conducted for all surveyed enterprises. From where, different business development scenarios have be developed followed with further money flow analyses. The following scenarios were considered:

Hanoi and Ho Chi Minh City

- Current income statement is being analyzed for the surveyed enterprises. A major FSM market is being taken by the private enterprises. Public utility (Hanoi URENCO or Ho Chi Minh City CITENCO) is just responsible for desludging of public toilets.

All sludge emptied by Hanoi URENCO 11 (HN.01) and CITENCO (HCM.01) is brought into landfills for treatment and composting. Illegal dumping is still not being controlled. 100% of sludge emptied by private enterprises in Hanoi is not brought to the right landfills, while in Ho Chi Minh City, there only 30% of sludge emptied by private enterprises is brought into composting site. In Ho Chi Minh City, emptiers pay a fee to the Hoa Binh Fertilizer Company who is making compost and selling.

- *Scenario 1:* Existing situation is being kept. Based on income statement from the scenario 1, the financial projection is being made for the next 5 years.

For financial analysis with 5 year projection for enterprises, the following assumptions have been made:

- Inflation rate, based on average CPI for the last 5 years in VIetnam: 11.75%/yr;

- Expenditures for the FSM activities will increase based on applied inflation rate;
- Tariff will increase for 10%/yr. Increase of desludging tariff is based on the practical acceptance from the market.
- Depreciation values:
    - New truck and equipment: 10 years;
    - Old, second hand trucks and equipment: 5 years;
    - Building and other fixed assets: 20 years.

- *Scenario 2:* FS dumping is being more strictly controlled. In order to let private enterprises bring pumped sludge into the centralized treatment sites, the city pays more efforts in environmental inspection, and, provides encouraging fees for each cubic meter of sludge brought to the site. Analysis is being made for the next 5 years. Amount of money paid by the city budget for each cubic meter of sludge is calculated. Assuming the market size for each enterprise stays the same, number of trips per truck per day stays the same.

Payment for each cubic meter of sludge brought into the centralized treatment site can be done by the city authority, or, if applying full recovery principle at the demand side, can be converted as additional fee paid by the household using desludging service.

- *Scenario 3:* In order to keep profit while sludge is being brought into designated dumping or treatment sites, the scenario 3 is looking at the case when private enterprises utilize maximum capacity of available trucks. Maximum number of trips per day chosen is 4 as average number. The city can provide support to the enterprises by setting up the rule for FSM, forcing households to empty the tank under the schedule. (Once per 2 years). No additional payment will be made, neither from the city, nor from the households, besides increase of desludging fee due to inflation, is considered in this scenario.

In Vietnam access to getting loans from the commercial bank is not easy for the small and medium enterprises. Complexity in administrative procedures and difficulties in mobilizing of legal properties for mortgage are key barriers. Besides, high interest rates of the bank loans due to hot growth of the real estate market create significant pressure on any other business proposal in getting loans. Some small and medium enterprises are looking for unofficial loans in the black market which are much easier to get, though the rate are very high (in average 1% per day for the short term loans), and this type of loans has a very high risk.

In this study, despite of above mentioned barriers, the team has worked on *other scenarios* of *1a, 2a and 3a* from the developed scenarios of 1 and 2, 3. The additional scenarios of financial analysis were for all private enterprises in Hanoi and Ho Chi Minh City where they were accessing bank loans for running the business. In those cases, bank provided 70% of value of the trucks purchased under the Interest rates of 18%/year. The rest 30% have been paid from the own capital of the enterprises.

No bank loans were considered for the state-own enterprises.

Hai Phong city

- Current income statement is being analyzed for all of the surveyed enterprises. A major FSM market is being taken by the Hai Phong Sewerage and Drainage Company (HP SADCO). Scheduled household desludging is taken by HP SADCO and paid by part of the collected wastewater fee. Besides, HP SADCO also provides desludging service and collects fees from other customers. Private enterprises provide FS emptying service for a small part of the city market, and more active in peri-urban and rural areas. Illegal dumping is still practiced.

- *Scenario 1:* Based on income statement from the scenario 1, the financial projection is being made for the next 5 years.

As commitment by Hai Phong city with the World Bank, wastewater fee will be increased from current 15% surcharge to water bill, up to 20% surcharge in 2012, and 25% surcharge in 2015.

Since the Hai Phong city has handed over the FSM task to the HP SADCO and the city is trying to improve this model, the business of private enterprises in the urban areas is considered as a small and temporary activity. No further scenarios have been considered to private enterprises to expand their business. Results from analysis of other scenarios could be learnt from similar cases of Hanoi and Ho Chi Minh cities.

Proposal for an improved model of FSM – scenario B

Scenario B will be analyzed for one from studied areas where improved FSM model is recommended.

4. RESULTS AND ANALYSIS OF URBAN FSM PRACTICE

4.1. Situational analysis of extraction/transportation

4.1.1. Hanoi city

4.1.1.1. Demographics of Hanoi

Hanoi is the capital city with the largest area and second most populous of Vietnam. In the Red River Delta, Hanoi soon became a center of political and religious right from the beginning of Vietnam's history. In addition, Hanoi is a center of culture and education in the country. After expanding the administrative boundaries in August 2008, Hanoi has an area of 3,324.92 km², including 1 town, 10 urban districts and 18 rural districts. Hanoi is one of the two economic centers of the country. In 2007, the city's GDP increased by 12.1%, total export value meet over 4 billion USD, total revenue of about 45,709 billion VND (www.hanoiportal.gov.vn, 2010).

During the 1990s, with the suburbs of urbanization gradually, Hanoi's population has increased steadily, reaching 2,672,122 people in 1999. After expanding the administrative boundaries in August 2008, Hanoi has 6.233 million people and came into top 17 capitals with largest area in the world. According to the Census done by the General Statistics Office (GSO) April 1st, 2009, Hanoi's population is 6,448,837 people.

Now the population density in Hanoi as well as before the expansion of administrative boundaries, not equal between the urban district and rural area. Across the city, the average population density 1,979 people/km² but in Dong Da district, the density of up to 35,341 people/km². Meanwhile, in the suburban districts such as Soc Son, Ba Vi, My Duc, density of 1,000 people/km². The difference between urban and suburban also demonstrated in living standards, health conditions, education ... According to the 1st April 2009 statistics, Hanoi has 2,632,087 urban residents, equivalent to 41.1%, and 3,816,750 rural residents, or 58.1%.

Figure 4-1. Map of Hanoi city

- studied area (districts of old Hanoi, before 2008 expansion)

4.1.1.2. Drinking water supply coverage

The old Hanoi citadel has 12 medium and large water treatment plants providing about 500,000m^3/day. Groundwater is a only source for the major part of the city. Besides, there are hundreds of self-supply, groundwater source based, small-scale water supply systems operated by different organizations, and, thousands of household-scale groundwater wells. Satellite urban districts and towns equipped with centralized water supply systems are Ha Dong and Son Tay.

Recently, combating with groundwater shortage, the city has built a new water treatment plant (Song Da) taking raw water from Hoa Binh hydropower plant reservoir. The capacity of the Song Da plant is 200,000 m^3/day, providing water for the western part of the city and. In future, a larger part of peri-urban areas and satellite cities will be provided with water when the capacity of Song Da will be increased up to 600,000 m^3/day, and the pipelines will be expanded.

Total capacity of water supplied in Hanoi from both ground and surface water sources is about 780,000 m^3/day. In order to meet a demand of 1,233,000 m^3/day from the whole city

area, an existing groundwater treatment plants will be upgraded, the Song Da capacity will be expanded up to 600,000 m^3/day. Besides, there will be two new water treatment plants, with capacity of each 150,000 m^3/day, taking raw water sources from Red and Duong rivers.

In the area whereas centralized water supply does not cover, the population have to drill individual wells, or, to use other water sources, including rainwater, surface water sources, or, in some cases, to purchase water from vendors.

The water supply coverage from the whole Hanoi area is given in the Table 2. In the studied area (14 old Hanoi districts), the total centralized water supply coverage is estimated 80%. Besides, 1% of population is using piped water from public tapes, 18% of population is using groundwater source, and 1% is using other water sources.

Table 4-1. Water supply coverage in Hanoi city (% of population)

No.	9 old urban districts	5 old peri-urban districts	Ha Dong district	Son Tay town	8 new districts (from former Ha tay province)	Me Linh district (from Vinh Phuc province)	The whole city area
1	96	15	90.8	72	1	1	38.5

(Source: Hanoi Water supply company, 2010).

4.1.1.3. Sanitation coverage

Toilets: Approximately 99% of urban households have toilets. In the old urban and peri-urban districts, about 80% of households have septic tanks and connection to the city sewer. Most of septic tanks (99%) receive black wastewater from toilet only. After septic tank, black wastewater and untreated grey wastewater go to the connected combined sewerage and drainage system. The other 19% of population are not connected to the sewers. Types of toilet in those households include septic tanks, pit latrines, ventilated improved pit latrines, septic tanks followed by soak pits, pour-flush toilets or sulabh, etc. The population without toilet in old Hanoi is 1%. Hoan Kiem District rates lowest ''no toilet'' status. About 13% of households have to share the public toilets with other households.

In this study fecal sludge is considered as all types of human excreta collected from urban on-site sanitation systems, including wet and dry systems, and private or public toilets. These elements of on-site sanitation should not be confused with the piped wastewater collection system.

Wastewater treatment: Wastewater from toilets in urban areas flows through septic tanks and discharge into the drainage system. According to previous studies, 80% of households connected to sewage systems. The rests have separate sanitation facilities, including septic tanks, dumping wastewater directly to the soil, soak pits, or open canals and lakes.

Hanoi Sewerage and Drainage Company (HN SADCO) is the Public utility (State One member Company limited) responsible for wastewater management in the city. The company provides sewerage and drainage services for inner-city core area, mostly for the sewers along named streets, open canals and lakes, as well as core drainage and sewerage facilities such as

wastewater treatment plants, pumping stations, etc. Majorly HN SADCO current function is to provide operation and maintenance (O&M) of the sewer network in the city to alleviate localized flooding in the city during rainy season.

Services in the new urban expansion or peri-urban areas are provided through special service contracts with local authorities.

Drainage and sewerage network in the urban living quarters and in the alleys are maintained by the local authorities and local communities.

Total capacity of treated wastewater plants in Hanoi are 13,000 m^3/day, making 2% of the total wastewater flow from the old city.

Solid waste collection: Around 6,200 tons of solid waste is generated from the city every day. At present, collection services provided by the Hanoi Urban Environment State One member Company limited (HN URENCO) cover 90% of the solid waste generated from the citadel part of Hanoi city. The rest is covered by nearly 30 private enterprises. In the citadel, about 95% of solid waste is being collected. In the peri-urban districts, the collection ratio is about 60 – 70%. Particularly in Soc Son district ranges lowest garbage collection, only 30 Collection ratio of the industrial waste is 85 – 90%. Nam Son landfill receives most of waste from the old Hanoi and surrounding areas. Cau Dzien composting plant receives market waste and fecal sludge from public toilets from where compost is produced. Other landfills are Xuan Son (Son Tay town), Nui Thoong (Chuong My district). Besides, Seraphin plant (Son Tay town) is sorting out solid waste and making fuel blocks. Average increase rate of solid waste in Hanoi is about 15% per year, threatening full filling of the dumping sites. Hanoi is urgently looking for other solutions for the solid waste treatment and disposal.

4.1.1.4. Institutional and legal framework

In Vietnam, at the central level, several agencies are responsible for issuing and guiding the implementation of policies for the development of water supply, drainage, and sewerage infrastructure. While these agencies are aware that septage collection and disposal is a problem in the country, they have taken no steps to provide guidance at the national level. There is no information on FSM neither in Decree 88 (Urban and industrial wastewater management) nor in Decree 59 (Urban and industrial Solid Wastes Management).

Particularly in Government's Decree No 150/2005/ND-CP regulating administrative fines in the field of safety and social order, an Article No. 9 contains statement relating to the content of fecal sludge: "fine from 100,000 to 300,000 VND for dropping of fecal sludge during transportation in the City or not maintaining the hygienic conditions''.

Ministry of Construction (MOC): The MOC is responsible for establishing and implementing policies on sanitation and wastewater infrastructure in the country. In particular, it develops infrastructure for flood control, water supply, sanitation, and wastewater programs and plans; establishes national and sector codes and standards on the technical and economic norms for the design, construction, and maintenance of sanitation systems; and guides, instructs, and monitors the implementation and adoption of these plans and codes. For many of these activities, it delegates responsibility to the Provincial People's

Committees, although the division of labor between MOC and the provincial agencies is unclear, and sometimes undermines policy implementation.

Ministry of Health (MOH): The primary responsibility of the MOH is to issue standards on drinking water quality and sanitation in rural areas. It has written guidelines for the development of toilets and septic tanks in rural areas, and also conducts awareness campaigns in urban areas to raise local understanding of the relationship between water quality and health risks.

Following a cholera outbreak in Hanoi in April 2008, an MOH official commented that, "The sewage from septic tanks flows into the lakes…when people use the lake water for different purposes, such as washing food, they are helping to spread the disease." Together with

MOC, MOH is now updating national codes on the design of septic tanks.

Ministry of Planning and Investment (MPI) and Ministry of Finance (MOF): The MPI is responsible for making sure the country reaches its national targets for sanitation; in coordination with MOF, it arranges effective financing for sanitation programs approved by the central government. The MOF sets tariff frameworks in cooperation with the MOC to guide, check, and monitor tariffs and fee collection.

At the local level, the responsibility for water and sanitation service provision is managed and controlled by the provincial People's Committees, through the provincial Department of Construction (in most of provinces) and Department of Transportation and Public Works (in case of Ho Chi Minh city). The provincial government control budgets and tariffs, ordering the public service State One-member Limited Companies to provide services and retain equipment relevant to drainage, wastewater and solid waste management activities. The Government is aiming to reduce government subsidies to the public companies and eventually combine water supply, sanitation, and drainage companies into one company in small- and medium-sized cities. Government Decrees 67 (2003) and 88 (2007) respectively, require all cities to charge a wastewater fee to raise revenue for urban environmental protection. Currently, the public service companies are responsible for collecting a 10% fee on all water bills. Besides Ha Long, Hai Phong, and Da Nang where World Bank projects required a cost recovery component, however, few cities have implemented this charge, fearing public opposition. Even so, the World Bank estimates that a 10% charge would not be sufficient to cover septage O&M costs. There is only in Hai Phong city where the government has increased the wastewater un to 15% and allowed the Sewerage and Drainage Company to use part of this funding for the scheduled desludging (since 2005).

Recently within the German Wastewater and Solid Waste Management Program providing wastewater and solid waste infrastructure and capacity improvement in 10 provinces in Vietnam (2005 – 2011 and beyond) the Soc Trang province authority has set up the new wastewater tariff in the Soc Trang city where wastewater tariff is ranging from 32 to 52% of the water fee depending on the type of users (domestic, commercial or industrial).

The most common public desludging service provider is the Urban Environment Company (URENCO). These companies operate the landfill or, in some cases, wastewater

treatment plants in the city. Besides, there are number of private enterprises that are providing desludging service in the cities. The national government is in the process of equitizing a number of publicly owned companies. Equitization has thus far been adopted for fewer than 10 provincial water supply companies, and some URENCOs. While public service companies have the engineering, environmental, and planning staff to improve their septage management services, they require additional training in desludging services. These companies have little managerial autonomy, and therefore, little accountability to meet or improve standards. Furthermore, the local People's Committees set restrictive tariff rates that prevent cost recovery for O&M, much less capital investment reserves (Lai, Trinh Xuan. 2005). As a result, many URENCOs tend to take a passive stance towards service provision and expansion.

Private FSM Service Providers: There are 40 private enterprises to provide desludging services in the Hanoi city. Many continue to illegally dispose septage.

Figure 4-2. The car with fake Hanoi HSDC logo has been caught when illegally dumped fecal sludge to the city sewer at the central street
(Source: www.vnexpress.net, September 6th, 2011)

Public Awareness and Willingness to Pay: Expanded media coverage of the environmental police catching desludging companies illegally dumping septage, and scheduled desludging efforts may be increasing public awareness of the need to manage household septic tanks. With current GDP in Hanoi (around USD 1,900 per capita per year), a cost of USD 20 – 40 for a desludging of a household septic tank could still be a costly expense for many households. Besides, low tariff structures and unwillingness to adopt the regular wastewater fee has made it difficult for city with septage treatment facilities to maintain.

Legislative documents related to the FSM activities:
- Environmental Protection Law, 2005.
- Water Law 20th May, 1998.
- Land Law 26th November 2003.
- Strategic management of urban solid waste and industrial parks in Vietnam to 2020, issued by Ministry of Construction (2010).
- Decree No. 59/2007/ND-CP on management of solid waste.

- Resolution No. 41 of the Politburo dated 15/11/2004 on environmental protection during the period of accelerated industrialization and modernization of the country.
- Directive on 23/2005/CT-TT on 06/21/2005: "To promote the management of solid waste in urban and industrial areas"
- Decision 2149/QD-TTg dated 17/12/2009 approve the National Strategy for integrated management of solid waste in 2025, vision to 2050.
- The technical standards, environmental standards, construction surveys of Vietnam.
- QCVN 14:2008/BTNMT: Domestic wastewater discharge standard.
- QCVN 24:2009/BTNMT: Industrial wastewater discharge standard.

4.1.1.5. Flow of money chart for FSM transactions

Money fluxes are illustrated in Figure 4-3 and Figure 4-4, for public utility and for private enterprise, respectively. For a public utility of Hanoi URENCO (HN.01) the only FSM related activities and money flows are considered. For a private enterprise, the money fluxes are less since the enterprise has less scope of work. A major percentage of private enterprises only focus in the FSM service.

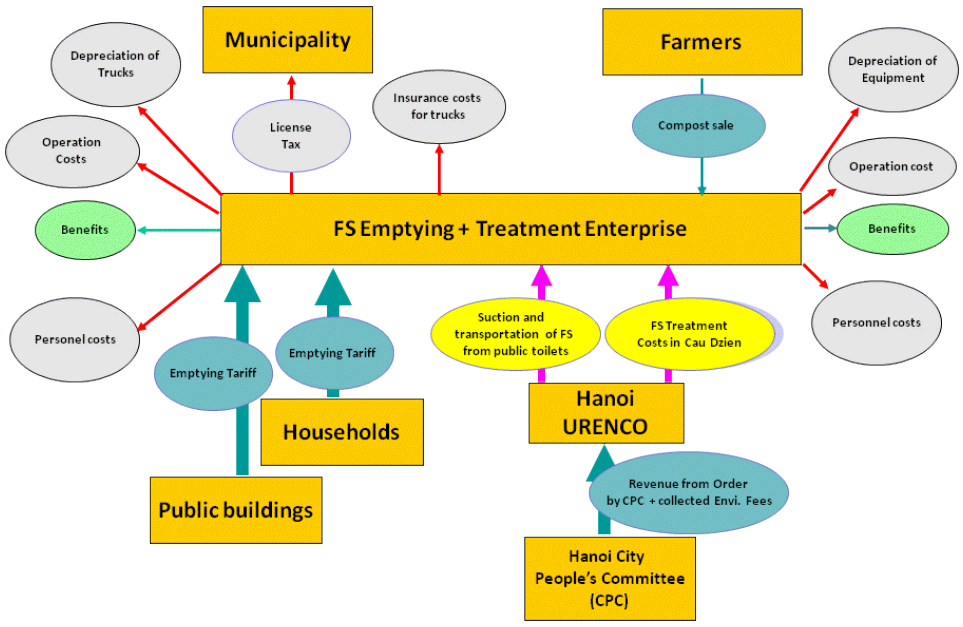


Figure 4-3. Flow of money chart for FSM transactions at Hanoi URENCO

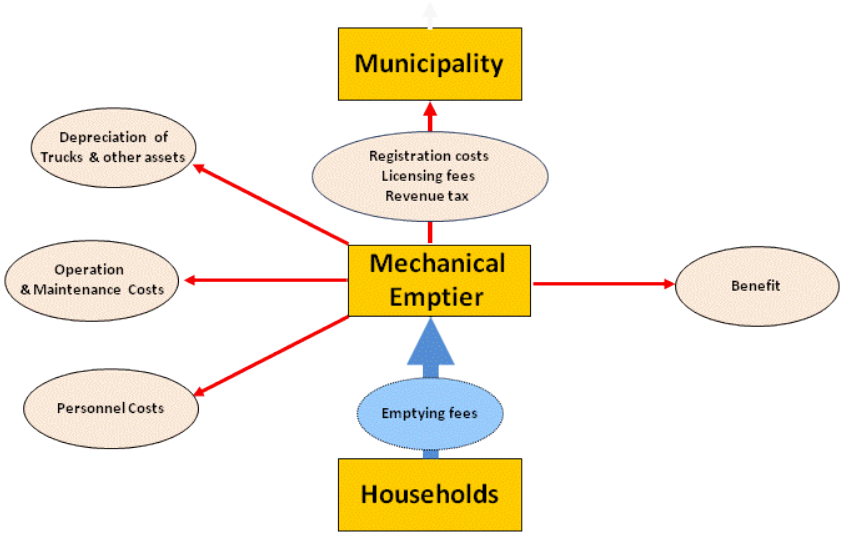


Figure 4-4. Typical flow of money chart for FSM transactions at private enterprise

4.1.1.6. FS emptying business owners' profile

The public work enterprise called Hanoi Urban and Environment One member state Company limited (Hanoi URENCO) is responsible for collection, transportation and treatment of domestic, commercial, hospital, industrial and construction wastes in Hanoi city. Besides, the Company has number of other activities such as: providing of cleaning service for houses and public work places; waste recycling; manufacturing of mechanical products, specialized equipments and mechanical transport vehicles; consultancy, design and construction of civil and industrial works; professional training, technology transfer in urban environment field; Materials and equipments import, export; Doing business in real estate business, office for lease; Labor export. The Companies has 14 branch enterprises. Cau Dzien waste treatment is one of its branch enterprises responsible for sludge collection, waste collection and treatment for compost production, and land filling of inorganic waste. Fecal sludge desludged by Cau Dzien enterprise is mostly from public toilets from the Hanoi city territory. Solid waste brought into Cau Dzien is mostly from the city markets.

Fecal sludge management is not a major business of Cau Dzien enterprise, the income from desludging service and from sale of compost product does not cover the plant expenses. Hanoi URENCO has to provide partial subsidy to Cau Dzien.

Out of 40 enterprises dealing with FSM, the following enterprises took part in the surveys (Table 4-2).

Table 4-2. List of FSM enterprises took part in the survey in Hanoi city

Code	Company's name	Truck number	Company type	FS business classification
HN.01	Hanoi urban service and environment JSC – Cau Dzien composting plant	5	State own, one member Co. Ltd.	Large

	(URENCO 11)			
HN.02	HN02: Hanoi Urban Service and Environment	1	Co. Ltd.	Small
HN.03	Hanoi environment service	2	Co. Ltd.	Medium
HN.04	Hanoi Urenco Technical company	3	JSC	Medium
HN.05	Hanoi Urenco No1	4	JSC	Medium
HN.06	Hanoi Environment Company	3	JSC	Medium
HN.07	Thanh Xuan Hanoi URENCO	3	JSC	Medium
HN.08	Hanoi URENCO	3	JSC	Medium
HN.09	URENCO SERVICE	3	JSC	Medium

For the surveyed private enterprises providing desludging service is their major business. Some of enterprises have additional income utilizing purchased trucks for other activities such as emptying and transportation and dumping of industrial waste, construction waste, etc. Number of owners, managers and key staff of the private enterprises used to work for the Hanoi URENCO or Hanoi SADCO. This shows desludging in Hanoi seems a profitable business which may attract people from the city's URENCO to leave the work and to join them.

4.1.1.7. Household survey results and analysis

This paragraph discusses about results from the surveys at 300 urban and 100 peri-urban households (HH) in Hanoi. Surveyed households are distributed among 57 urban wards and 232 peri-urban communes out of total 232 wards and communes of old Hanoi (before 2008 expansion).

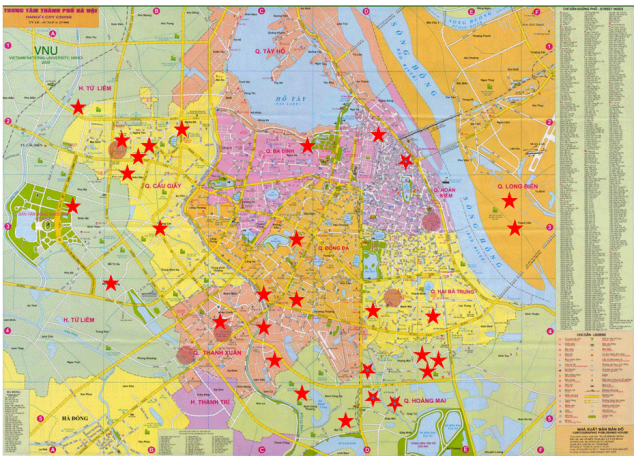


Figure 4-5. Location of wards (marked as red stars) participated in the HH survey in Hanoi

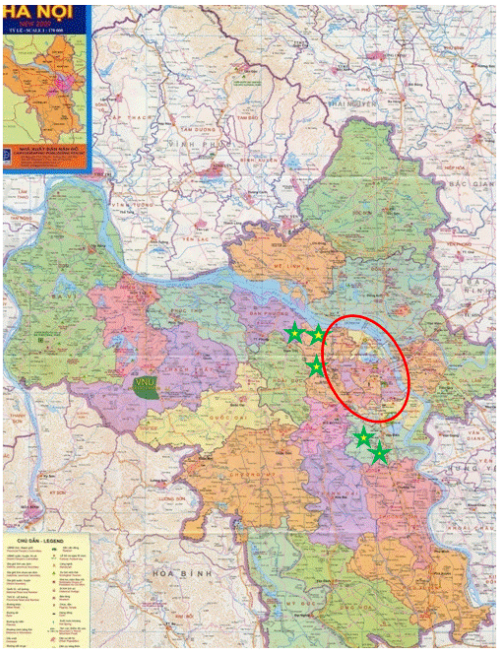


Figure 4-6. Location of communes (marked as green stars) participated in the HH survey, Hanoi peri-urban area

Number of sanitation facility users per HH (see Table 4-3***)***

Table 4-3. Number of sanitation facility user per household

Number of persons per HH	No. of HHs, urban Hanoi	No. of HHs, peri-urban Hanoi
< 5 persons	185	42
From 5 to 10	110	56
> 10 persons	5	3
Number of surveyed HHs	300	101
Average, urban or peri-urban	4.5	5.1
Average, urban + peri-urban	**4.7**	

Income

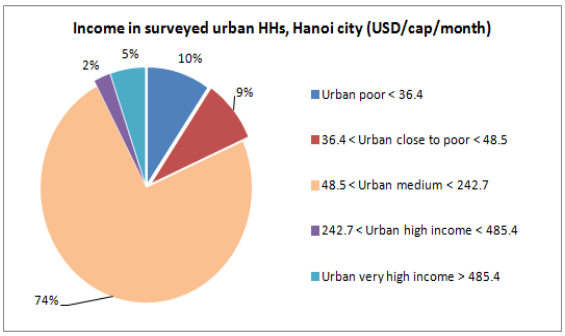
According to the Decision 09/2011-QD-Ttg of Prime Minister, Poor in urban area is considered household with income less than VND 500,000 (USD 24.3) per person per month, Poor in rural area: income less than VND 400,000 (USD 19.4) per person per month. Close to poor is a household with income from VND 501,000 (USD 24.3) to VND 650,000 (USD 31.6) in urban area, from VND 401,000 (USD 19.5) to VND 520,000 (USD 25.2) in rural areas. Some cities like Hanoi and Ho Chi Minh City have their own poor and close to poor household classification, since those cities have highest GDP per capita compared with all other provinces in Vietnam. Table xxx provides more details on poverty classification of the households in Vietnam. This Decision has been in force from January 2011, and set up for the period of 2011 – 2015. Therefore, economic status of the surveyed HHs in all 3 cities has been analyzed based on the mentioned classification.

Table 4-4. Classification or poor household in Vietnam

Location	Income, VND/cap.month		Income, USD/cap.month		Income, VND/cap.month		Income, USD/cap.month	
	Urban poor	Rural poor	Urban poor	Rural poor	Urban Close to Poor	Rural Close to Poor	Urban Close to Poor	Rural Close to Poor
Vietnam	500,000	400,000	24.3	19.4	501,000 – 650,000	401,000 – 520,000	24.3 – 31.6	19.4 – 25.2
Hanoi	750,000	550,000	36.4	26.7	751,000 – 1,000,000	551,000 – 750,000	36.5 – 48.5	48.6 – 26.7
HCMC	1,000,000	833,000	48.5	40.4				

(Source: Decision 09/2011/QD-TTg of Prime Minister).

(a)



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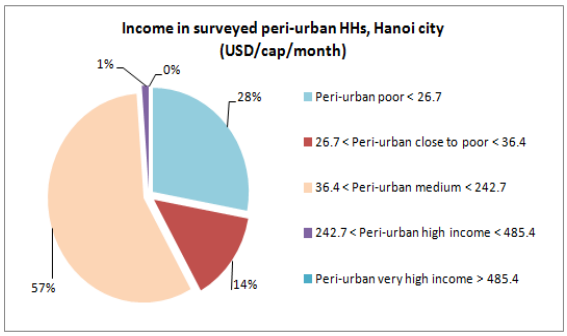
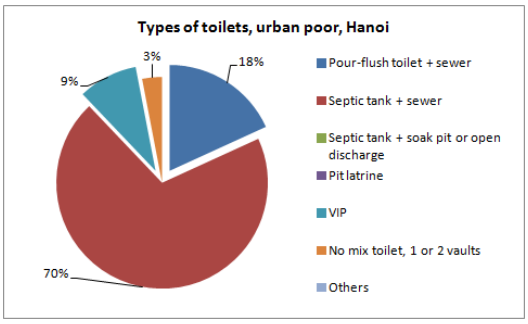


Figure 4-7. Income status of surveyed HHs in Hanoi urban and peri-urban areas

Percentage of poor and close to poor HHs in urban areas is much (10% and 9%, respectively) less than in peri-urban areas (28% and 14%, respectively). Even though expenditures for living in urban areas are more, but different jobs can be found, while there is much less chance for peri-urban and rural households. Number of people has to go to the city for finding job to have additional income, and just get back to the home village in peri-urban and rural areas for some busy period of farming.

Types of sanitation facilities vs. income

(a)



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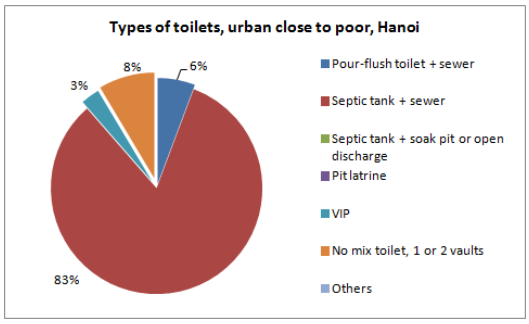


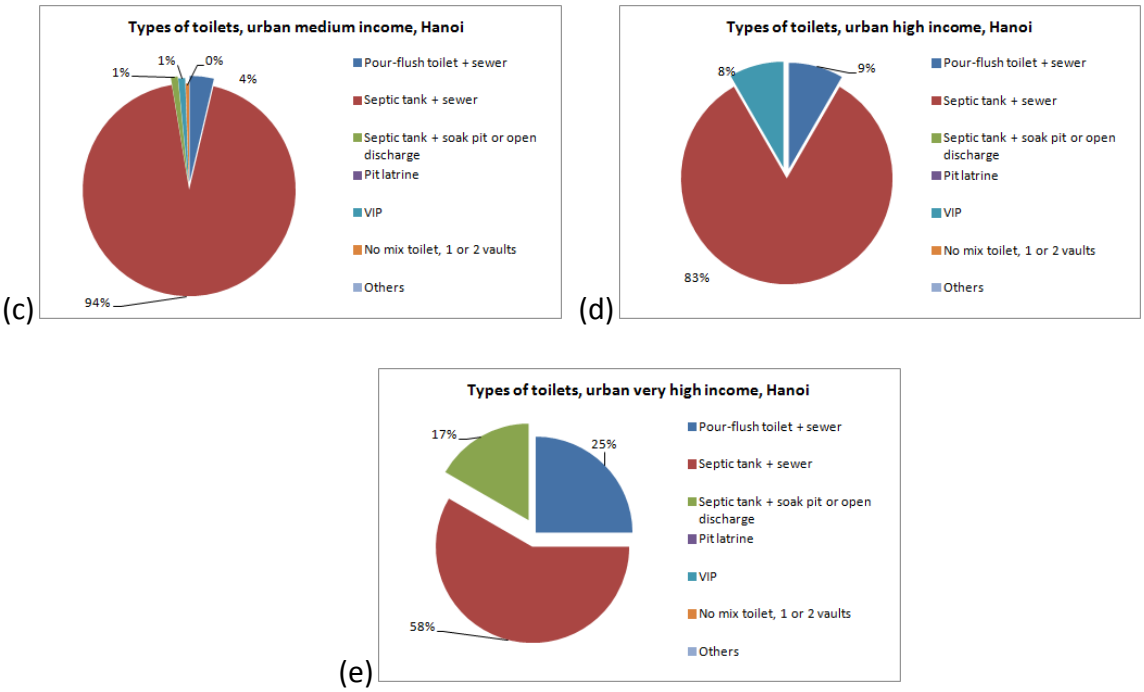
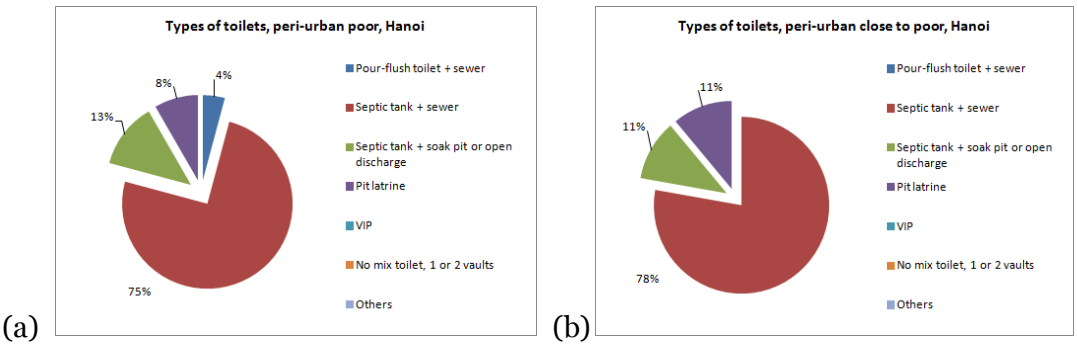


Figure 4-8. Types of sanitation facilities in urban Hanoi vs. income (GDP per cap per month)

Figure 4-7 shows types of sanitation facilities in urban Hanoi vs. income summarized from all surveyed HHs. Relatively similar picture of sanitation types is observed across all levels of income of surveyed HHs, where septic tank is still a most popular type of sanitation. Interesting observation has been found at group of very high income people in Hanoi urban, where a scheme of septic tank + sewer is only 58%, less than any other income group. 17% of HHs is with septic tank, but effluent from this on-site sanitation facility is going to a soak pit or open land. The reason is the owner can afford to build new houses in expanded area of the city where drainage and sewerage did not reach yet. High percentage of a scheme our-flush toilet + sewer (25%) also shows high or very high income of the family does not mean awareness of sanitation is high. This picture is also strangely seen in the high income group of HHs where 17% of HHs has septic tank + soak pit or open dumping scheme, and 9% of HHs has no primary treatment step, and wastewater goes directly to the sewer. It is worth to note there only about 3% of wastewater in Hanoi is treated in centralized wastewater treatment plants, and therefore, on-site primary treatment facilities play very important role in pollution mitigation for the city environment.



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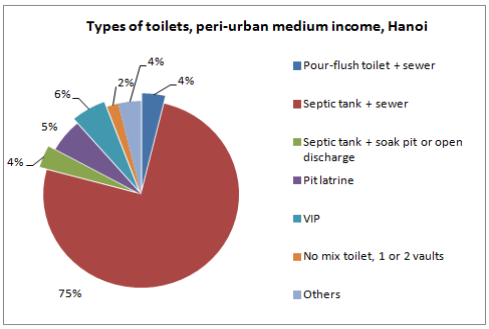


Figure 4-9. Types of sanitation facilities in urban Hanoi vs. income (GDP per cap per month)

Figure 4-9 shows types of sanitation facilities in peri-urban Hanoi vs. income summarized from all surveyed HHs. Septic tank is also a most popular type of sanitation. Compared with poor and close to poor households, the medium income households have more varieties of toilet types; especially there are toilets with resource recovery such as no mix toilets, VIPs. Intensive cropping is a main reason for users to select such types of toilet. A common picture of peri-urban households in most of cities in Vietnam is households are shifting from pit latrines to convenient pour-flush toilet + septic tanks.

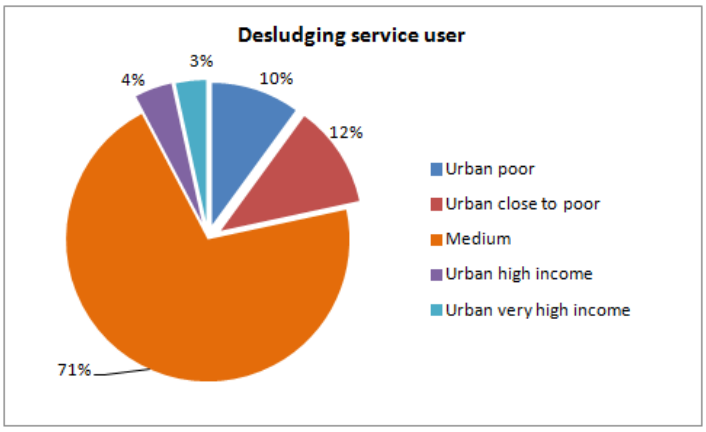
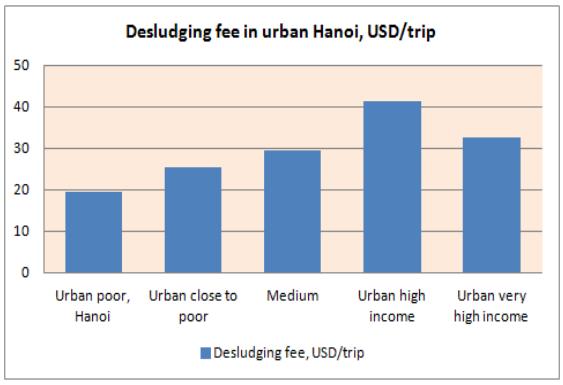


Figure 4-10. Users of desludging service

Figure 4-10 shows a major part of users of the FS emptying service in urban areas of Hanoi is coming from the medium income group (71% of total customers). The rest customers are from urban poor (10%), close to poor HHs (12%), high income group (4%) and very high income group (3%). This is important to set up a proper tariff policy in FSM as well as for other urban infrastructure services in the city.

(a)



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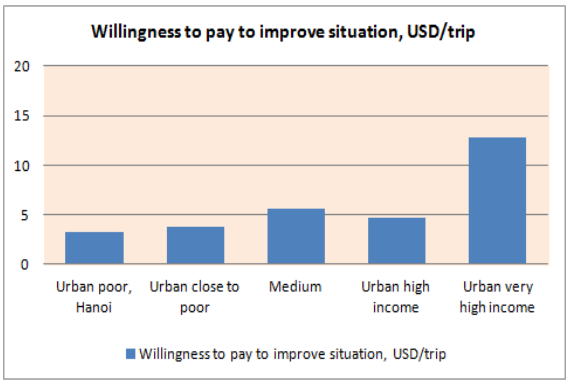
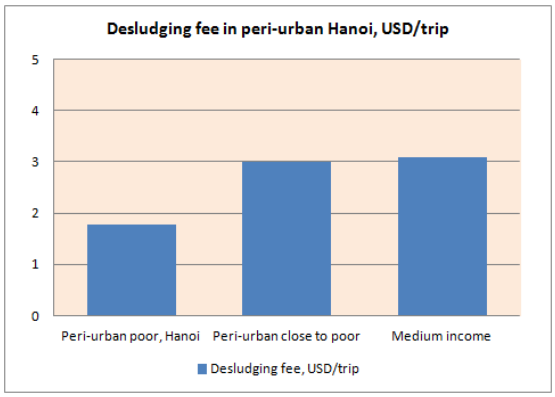


Figure 4-11. Desludging fee and willingness to pay in Hanoi urban

There is a trend of increasing of desludging fee among income groups. The more income, the higher desludging fee is observed. This relates to the size of the tank which in its turn very depends on the affordability of the household owner. Similar picture has been also seen when the HHs were asked ''how much would you be ready to add on the top of the current desludging fee for the FSM situation improvement in the city?''.

(a)



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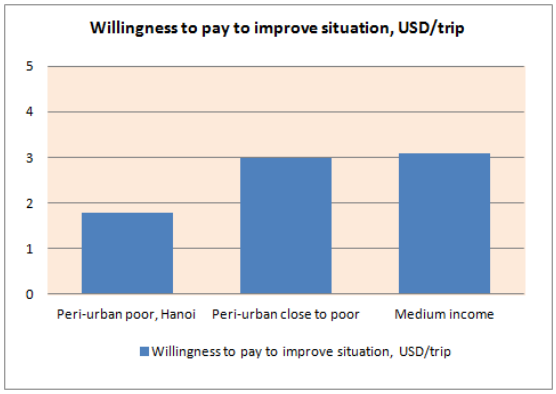


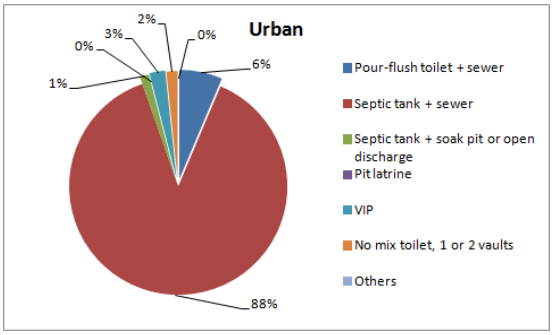
Figure 4-12. Desludging fee and willingness to pay in Hanoi peri-urban

Medium income HHs in peri-urban areas of Hanoi pays also more for the desludging, and more additional fees, if needed, for improving the situation, compared with the poor and close to poor households. There are about 30% of asked HHs said ''I would prefer to negotiate'' when they were asked ''how much would you be ready to add on the top of the current desludging fee for the FSM situation improvement in the city?''

4.1.1.8. FSM emptying practices and technologies used: manual and mechanical

Figure 4-13 presents sanitation type at surveyed households in urban and peri-urban areas of Hanoi city. The most popular is a "water closet" type with septic tank (88%). The scheme of "septic tank + sewer" is 86% whereas ''septic tank + soak pit or open discharge'' is only 2%. Latrine pit types are around 4% and majorly used in the peri-urban areas (10% of peri-urban HHs). There are 8% of population not using FS emptying service including 5% of HHs with direct sewer connection (without septic tank), 2% of mo mix toilet, and 1% without toilet facilities.

(a)



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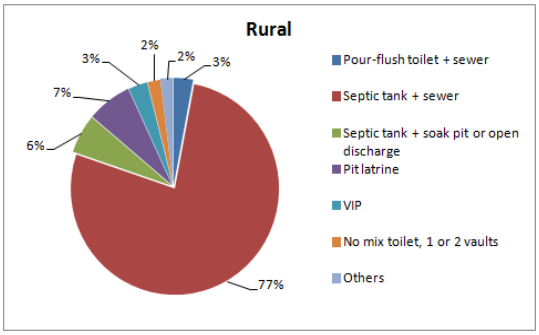

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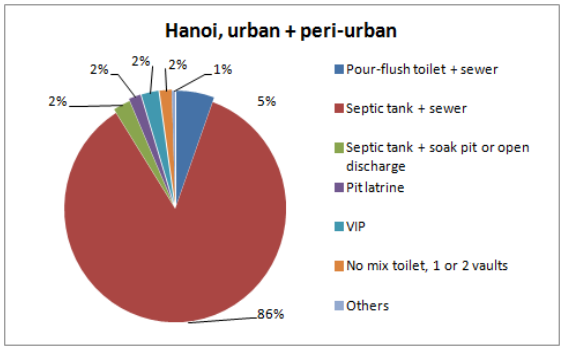


Figure 4-13. Sanitation types in Hanoi city

Using the surveyed results and the total population of Hanoi in the studied area, the number of HHs using desludging service has been calculated 39,149 of those who have pit latrines, and 430,638 of those who have septic tanks.

Figure 4-14. Construction of septic tank in urban area of Hanoi

Figure 4-15. Septic tank construction for a public building

Average latrine pit volume in Hanoi is 1.3 m^3; average cesspool, holding tank volume in Hanoi is 1.8 m^3 (data gathered from the field survey).

High groundwater table and limited space in dense population area are main reasons of small size of pit latrines in Hanoi area. Users have to desludge the pits frequently. Some of them reuse emptied sludge from pit latrines after co-composting with agricultural waste for few months (see paragraph 4.1.1.10).

The size of the pit or the tank was among questions at the surveys. However, many HHs could not answer. Septic tanks are often built underground, surrounded by the house foundation. The floor tiles are on the top. Many households even do not leave the access to the tank. Some of HH owners even do not know where exactly their septic tank is.

The study team uses another way to calculate the average value of the tank size, based on survey data as follows:

Tank volume = CPT / UC / LC

Where:

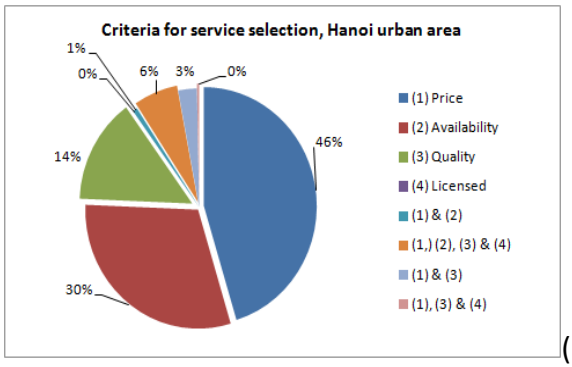
- CPT: Cost per trip paid by the household (from household survey);
- UC: Unit cost charged by the emptier (from enterprise survey);
- LC: Coefficient considering emptied volume of sludge = 80... 90% of actual tank volume (LC = 0.8...0.9).

Calculated average septic tank volume in Hanoi is 2.6 m^3.

Table 4-5. Septic tank size calculation, Hanoi city

No.	Parameters	HN.01	HN.02	HN.03	HN.04	HN.05	HN.06	HN.07	HN.08	HN.09	Average, private Co.
1	Number of trucks	5	1	2	3	4	3	3	3	3	2.8
2	Average tank volume	3.7	2.5	2.5	2.67	2.75	3	2.67	4	2.5	2.8
3	Average trips per day	8	3.5	6	2.5	7	9	9	8	10	6.9
4	Unit cost, USD/m3		13.6	12.6	12.6	13.1	12.1	12.6	9.71	11.2	12.2
5	Cost paid by HH, USD/trip										28.1
6	Average septic tank size, m3										2.6

(a)



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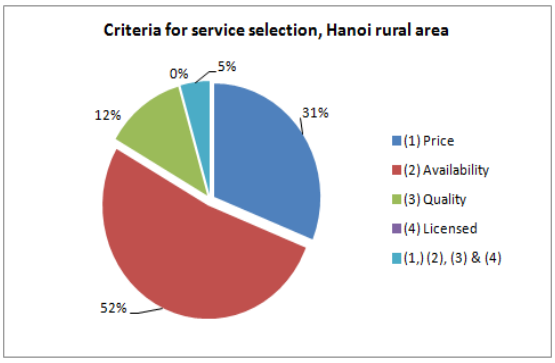

Figure 4-16. The criteria to choose a desludging service provider

Figure 4-16 presents the criteria for selection of the desludging service provider by the households. In urban area, where service is always available, users select price is a most important criterion. In peri-urban areas due to limited number of demand and long travel distance, the service provider may refuse to travel. The peri-urban customers select the availability as the most important criteria. Having or not having license is not a concern for the users. Quality of service is a 3rd reason for service selection.

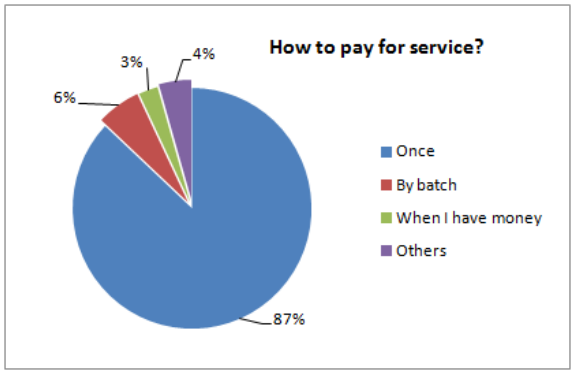

Figure 4-17. How to pay for FS empty service

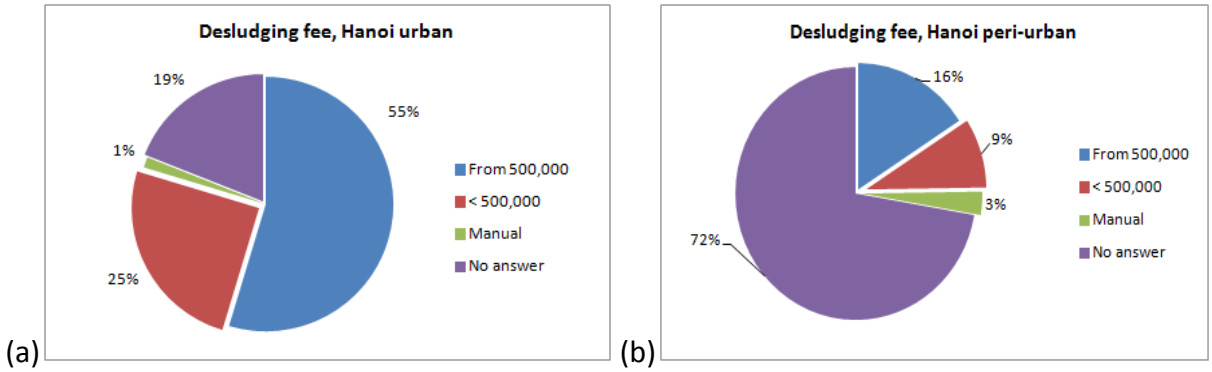

Figure 4-18. Cost for empty service

Figure 4-18 presents overview of desludging fee in urban and peri-urban areas of Hanoi based on the HH survey results. In most of cases the desludging fee is higher than VND 500,000 (USD 24.30). Volume of septic tanks in urban areas is mostly more since septic tank size mostly depends on the size of the house, which relates to the economic status of the household owner, and number of users. ''No answer'' often relates to the surveyed household who never emptied the tank, or, do not remember how much did they pay for the emptying service.

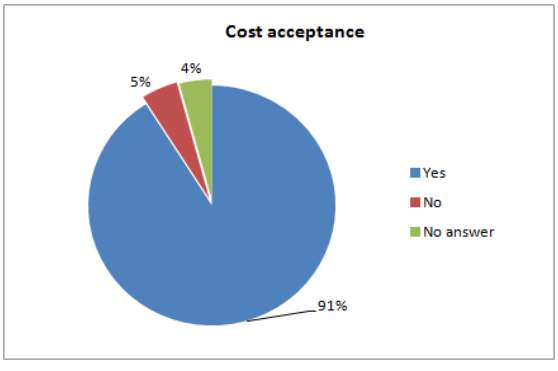

Figure 4-19. Satisfaction of users with current FS emptying fee

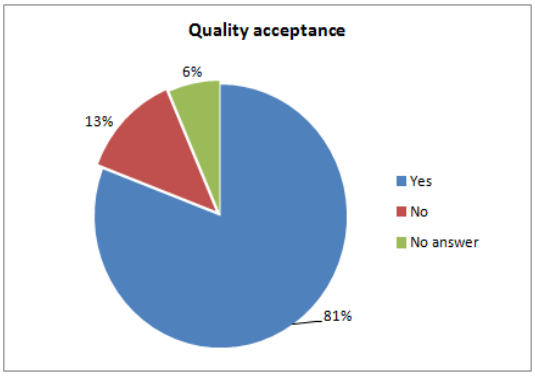

Figure 4-20. Satisfaction of users with FS emptying service quality

Figure *4-19* and Figure 4-20 show equal percentage of acceptance of the users, urban and peri-urban, at the emptying service cost, and quality of the service. 91% of users accept the current fee for FS emptying. 81% of users accept the FS emptying service quality. There are 7 urban users, out of 19 users in total providing answer ''No'' considering cost for emptying is high. 36 urban users from total 51 gave the answer ''No'' in service quality acceptance. ''No answer'' mostly came from household who did not use FS emptying service.

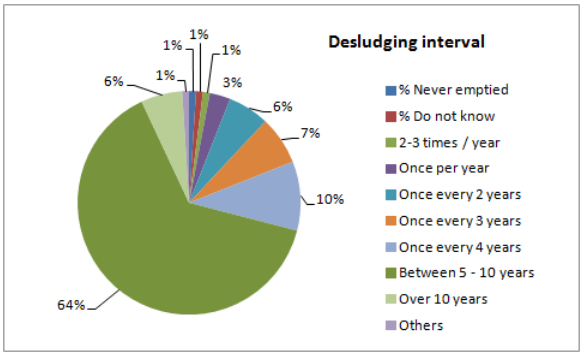

Figure 4-21. Frequency of fecal sludge empty in Hanoi

Figure 4-21 shows that the emptying frequency of once for 5 - 10 years occupies 64% of the total surveyed households. About 1% of households emptied twice a year. Those septic tanks probably were built very small, or, overloaded. *The average desludging interval of septic tanks in Hanoi is 6.2 years.*

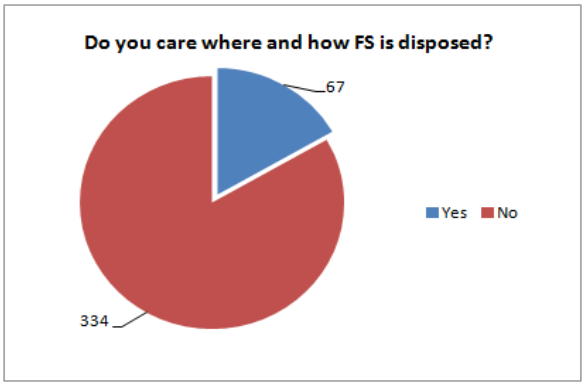

Figure 4-22. Awareness of FS disposal after emptying in Hanoi

Most of the households seem do not care where their fecal sludge will be transported and dumped or treated. Awareness raising activities in FSM need improvements and more efforts in the near future.

Range of tank volume of trucks at Hanoi FSM service providers is from 1.0 to 7.5 m^3. Large volume trucks are often used for desludging of septic tanks from offices, commercial complexes, factories and construction sites. They are also used for other purposes besides FS emptying. Smaller volume trucks are mostly used for desludging for households.

Different types of trucks are used: brandy new truck, imported; brandy new specialized truck, locally made based on the imported car chassis; second hand specialized truck; second hand truck converted from old car chassis.

Except one enterprises of the Hanoi Urban Environment Company (Hanoi URENCO 9) who manufactures brandy new specialized truck, based on the imported car chassis (Figure 4-23), there is no other specialized sludge emptying truck in Hanoi. However, there are number of shops selling imported trucks from Japan, Korea, China, etc. Number of mechanical workshops in Hanoi can also make tanks and truck accessories under order.

Error! Reference source not found. presents some products of Hanoi URENCO 9. The enterprise manufactures sludge emptying and transportation trucks with volume from 2 to 7.6 m^3 based on imported chassis of HINO trucks.

Figure 4-23. FS suction trucks of Urenco Hanoi

Tankers can be emptied by ''self dumping'', where the mechanism of tank rotating is designed. However, conventional method for tank emptying among FS emptiers is by gravity via discharge pipe. Modern tankers can be provided with pressured emptying (for faster and more complete emptying).

Sludge pumping is operated, either by the truck engine, through transmission system, or, by separate motor - vacuum pump system (power take off – POT system) (Figure 4-24). Trucks can be specially made from the factory, or, based on the new or used chassis; the tanker, pump and accessories are mounted at the workshop. Typical sludge emptying truck shown in Figure 4-24 has been made from cheap, old chassis of an East German car IFA (1980s). Since maximum lifespan of the truck is 25 years according to the Vietnamese regulations, many trucks are being converted, or parts of them are utilized in different ways.

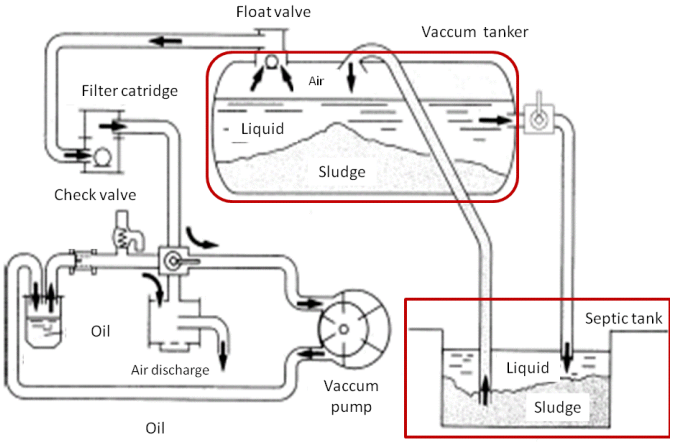

Figure 4-24. Operation principal scheme of vacuum tanker for fecal sludge emptying

Figure 4-25. Truck with separate vacuum pump at work

Separate vacuum pump is mounted on most of small trucks (less than 2 m^3 tank volume). The reason is small trucks have a small engine not suitable for sludge sucking and pumping. Small trucks are used for emptying of sludge from small septic tanks, and, for the cases when larger trucks can't access to the tank. Figure 4-26 presents a typical vacuum pump with Honda motor mounted on the small truck (1 m^3 tank volume) in Hanoi city. Additional investment is required for a motor, but, the operators confirm they are consuming less gasoline (0.1 – 0.2 L/m^3) than the case when sludge pump is connected with the car engine via transmission mechanism (0.2 – 0.3 L/m^3).

Figure 4-26. Small truck with separate vacuum pump mounted

Error! Reference source not found. presents a typical procedure of one ''FS deal''. Customers contact service providers mostly by telephone call. FS service providers advertise their service on local newspapers, or stick leaflets on the walls, street lamps, etc. Some enterprises even have 3 – 4 telephone numbers as they want to collect more calls than competitors. Call receiver often play a role of negotiator, where he/she is asking the HH location, approximate volume of the tank, and offering a price. He/she should also know availability and schedule of work of each truck at his/her enterprise, and agrees about the desludging time with the household owners. Telephone and address of customers are important information to be recorded. In case negotiation (1) is successful, car is being sent as scheduled. In some cases, when customers do not have such information as exact tank location and size, methods for accessing to the tank, etc. the service provider is sending a person to check the site, the access road, desludging possibility, and, at the same time, negotiate with the household owner. After that, car is being sent under agreed time.

In many cases, septic tank was built without access covers. The emptier should drill the concrete floor to make a whole (100mm diameter in average) for accessing of suction pipe to the tank. Suction pipe diameters are often ranging from 50 to 200 mm. Concrete floor drill and associated construction materials is often available by the FS operators.

A driver and a helper are often making a team for desludging. However, 3 persons are needed when site or access road needs to be checked out, and when the floor needs to be drilled through.

After accessing of the suction pipe to the tank, pumping process starts. Factors often affecting desludging time are volume of the tank, capacity of the suction pump, distance from the car to the septic tank, type of motor and pump used etc. The whole desludging period starting from truck arrival to the moment when the truck is leaving is ranging from 20 min. to 60 min. If return travel time to the dumping site is calculated, the whole cycle is about 60 – 120 min.

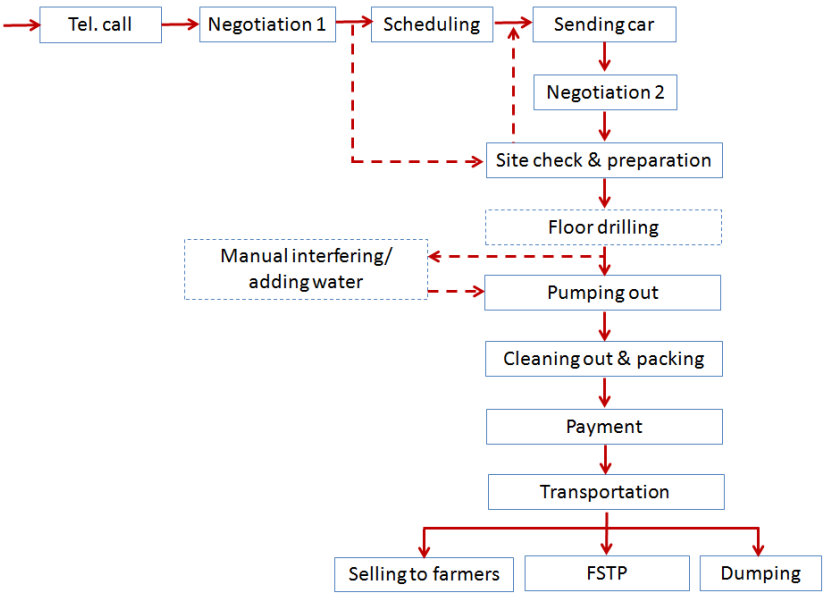

Figure 4-27. Typical procedure of one ''FS deal''

Most popular FS disposal way by private enterprises in Hanoi is illegal dumping. Emptiers often find places along city's highways and unused land plots where they can quickly dump the sludge and hide from the public. Only a very small portion of the FS (4%, see paragraph 4.1.1.10) is being sold to the farmers for making compost or fed to the fish. FS from public toilets run by URENCO 4 is sent to Cau Dzien composting plant. From the survey, some desludging operators shared that each enterprise have several options of dumping sites, and they are even changing the dumping sites in the same day, to compensate high risk to be caught by the police, and higher income from more trips they can make.

4.1.1.9. Overview of all WWTP, FSTP or dumping sites

Hanoi is currently discharging around 650,000 m^3 of wastewater per day. Among which, there is only 6,000 m^3 is treated at 2 pilot wastewater treatment plants of Truc Bach and Kim Lien (see Figure 4-28). Combined sewerage and drainage system in the system which was developing without planning over centuries is creating number of difficulties in wastewater collection and treatment. Over last decade, the city was trying to improve the drainage capacity in order to avoid flooding. In coming decades, the city will focus more on different solutions for wastewater collection and treatment. The Yen So wastewater treatment plant (200,000 m^3/day capacity, BT project by Gamuda corp., Malaysia) will start operation in the beginning of 2012. Treated wastewater is discharged to Nhue or Red rivers. In near future, some other wastewater treatment plants will be also built in the urban part of the city.

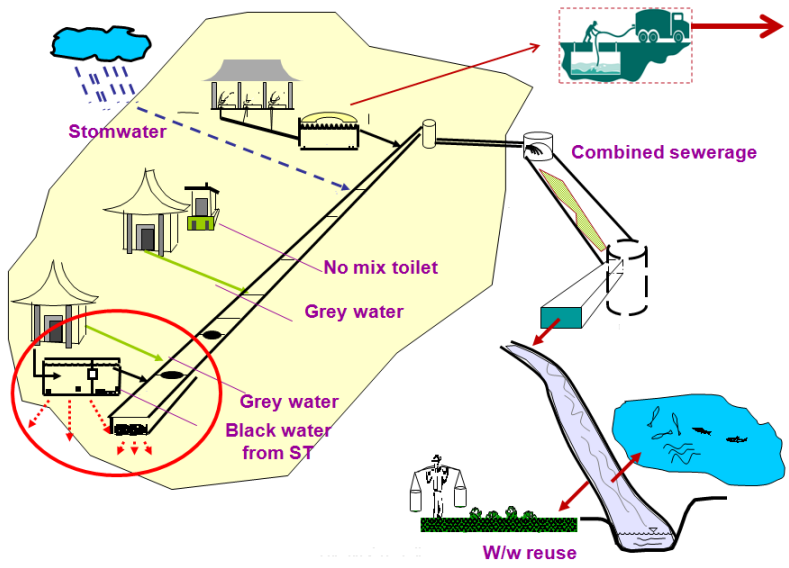

Figure 4-28. Typical combined sewerage and drainage system in Hanoi city

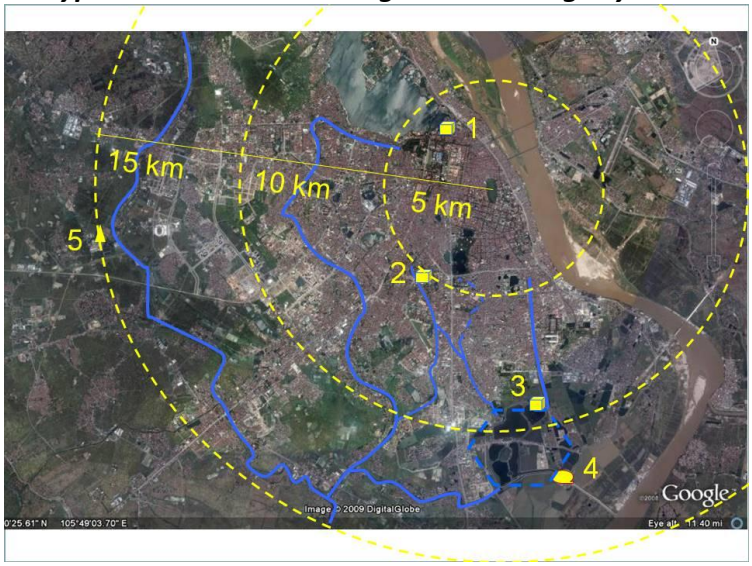

Figure 4-29. Location of waste treatment sites in Hanoi citadel

(1) Truc Bach pilot Wastewater treatment plant, 2,300 m^3/d;
(2) Kim Liem pilot Wastewater treatment plant, 3,700 m^3/d;
(3) Yen So Wastewater treatment plant, 200,000 m^3/d (start up in 2012);
(4) Yen So drainage pumping station, 90 m^3/s;
(5) Cau Dzien Composting Plant, 13,600 tons compost/yr.

Activated sludge is a most common treatment technology for WWTPs in Hanoi. The most challenging for the sewerage works, as mentioned above, is to provide connection and synchronization of the 3 components: household septic tanks, combined sewerage and drainage, and centralized wastewater treatment plants. Furthermore, in the downstream of the area, high number of population is reusing wastewater for the irrigation and aquaculture purposes. Safe water reuse and recovery of resources is not well considered in Hanoi so far.

Most of solid waste is Hanoi, including domestic and industrial, is collected and brought to the Nam Son waste treatment complex, which is located in Soc Son district, 50 km north from the Hanoi center. Nam Son is receiving 2,500 tons of solid waste per day. Sanitary landfill is an only technology applied. Recently, the system for collection of biogas from landfill cells in Nam Son has been installed. Collected biogas is sent to electricity generator or flared. The system is running under the CDM.

Fecal sludge collected by the Cau Dzien enterprise (or Hanoi URENCO 4) is mostly from public toilets. Solid waste brought into Cau Dzien is mostly from the city markets. The plant has been built in 1992, and upgraded in 2002 by the ODA loan from Spain. The design capacity of Cau Dzien composting plant is 13,600 tons/year. Fecal sludge is an additional material which is co-composted with separated market organic waste for the composting process. Theoretically addition of fecal sludge into the composting pile at appropriate sludge/organic waste ratio provides more favorable environment of C/N ratio and moisture for the composting process and for having a better quality of the compost product. The current capacity of the plant is around 5,000 tons of compost per year.

There are 80 staff of the plant, including 15 engineers, 5 vocational school graduates, 60

workers from different departments dealing with organic waste collection, transportation, separation, compost production, marketing and sale of compost. FSM is only a small business of the plant. Even though the reported amount of sludge collected and brought to Cau Dzien is 50 tons/day, the team has found the actual sludge brought into the plant is only 10 – 20 tons. There is no evidence during the survey that Cau Dzien has a constant number of fecal sludge trucks delivered. Compost product is any way produced from organic waste at Cau Dzien despite of if there is fecal sludge in the composting process line or not.

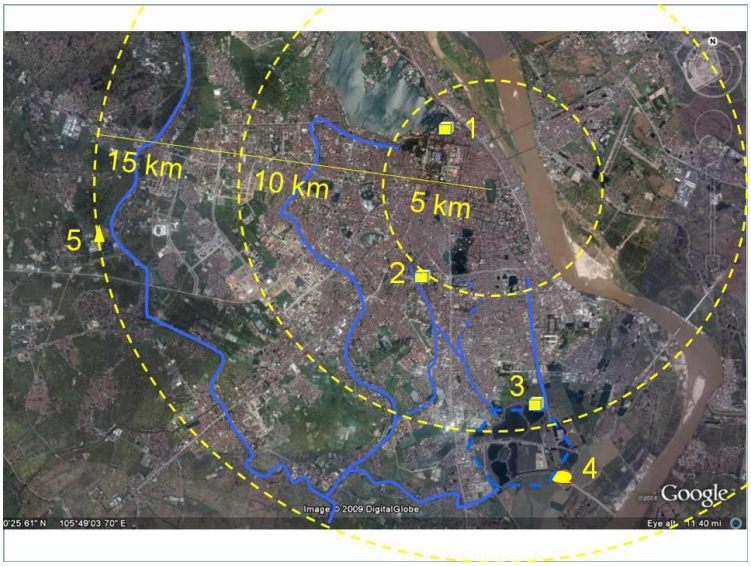

Figure 4-29 presents the principal flow chart for making compost in Cau Dzien waste treatment plant.

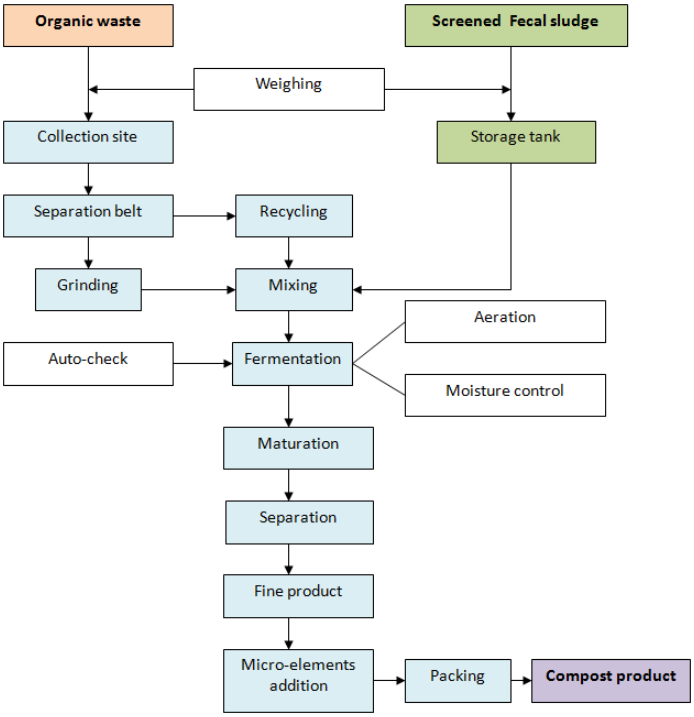

Figure 4-30. Flowchart of co-composting process at Cau Dzien waste treatment plant

Figure 4-31. FS treatment at Urenco11, Hanoi

Current, actual fecal sludge receiving capacity of Cau Dzien is only from 20 to 50 tons/day, due to limitation of treatment and marketing capacities. That amount is still far from estimated city's need or market, whereas an actual amount of fecal sludge emptied daily is around 189 tons/day (see paragraph 4.2).

4.1.1.10. FS end re-use in the Hanoi city

Table 4-6 presents the projection of compost fertiliser demand in Hanoi area.

Table 4-6. Projection of compost fertiliser demand in Hanoi area

Year	2006	2 010	2 015
Cereals	15 100	18 875	22 650
Vegetables	8 000	25 069	45 011
Flower gardens	1 980	8 659	9 870
Fruits and other trees	2 100	7 213	15 250
Total, tons	**27 180**	**59 816**	**92 781**

(Source: Institute of Industrial Chemistry, Institute of Natural compounds, Vietnam Academy of Science and technology (VAST) – JICA. 2008 – 2009)

In the peri-urban areas, where farming activities are still prevailing, the night soil from pit latrines and fecal sludge from septic tanks is reused at a small scale for making organic fertilizer (4 – 6 months composting, mixing with agricultural waste) or for fresh feeding to the fish pond. The farmers reuse night soil or fecal sludge from their own toilet and from neighbors who do not have need in fertilizers. There are some venders who are buying night soil from non-farming families in the area, making compost, and selling compost to the farms. The business is rather small, operated by one person in the family, who might have also some other activities for income. Manual emptying (some time dine by the household owners by themselves) is applied for night soil from on-site sanitation systems. Both manual and

mechanical methods are used for septic tank desludging in peri-urban areas. For mechanical emptying, small trucks equipped with pump are often used. Due to high ammonia concentration, septic tank sludge is often mixed with agricultural waste for co-composting. Small septic tank size, long desludging interval, long distance for travel to the low-income communities are major factors not attracting desludging enterprise in peri-urban areas.

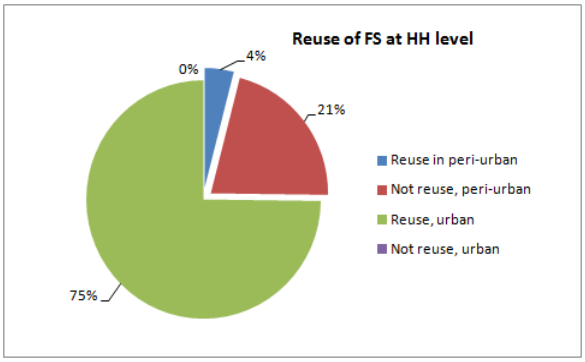

Figure 4-32. Fecal sludge reuse in Hanoi (not including Cau Dzien co-composting plant)

4% of households, who are living in peri-urban areas, are practicing FS reuse by themselves. Co-composting with organic wastes and using as fertilizer is a most common reuse method. Feeding to the fish ponds is another method of FS reuse which is not popular due to potential risk of fish death and low price of fish fed by FS.

Figure 4-33. Composting pile by Mr. Hoang Cong Loc (Ha Tri village, Lien Trung commune, Dan Phuong district, Hanoi).

4.1.2. Hai Phong city

4.1.2.1. Demographics of Hai Phong

Haiphong is located in the Red River delta, at the distance approximately of 100 kilometers from Hanoi. Hai Phong serves as a primary sea port for the northern region of the country for several centuries. The city has been one of Vietnam's principal trading centers.

Key data of Hai Phong City:
- Area: 1,520.7 km²;
- Population: 1,837,173 habitants (GSO, 4/2009); among which 47% of population live in rural areas including islands.

- Administrative divisions: Urban districts: Hong Bang, Ngo Quyen, Le Chan, Kien An, Hai An, Duong Kinh, Do Son; Peri-urban and rural districts: Thuy Nguyen, An Duong, An Lao, Kien Thuy, Tien Lang, Vinh Bao, Cat Hai, Bach Long Vi.
- Climate condition: Located within the belt of tropical monsoons of Asia and adjoining the Eastern Sea Hai Phong is under monsoon influence. The cold and dry north-east monsoons last from November to April (during winter time). The cool and fresh south-eastern monsoons (during summer time) cause a lot of rain from May to October. The average annual rainfall varies from 1,600mm to 1,800mm. There is often storm from June to September. The annual average temperature varies between 23ºC and 24ºC.

4.1.2.2. Drinking water supply coverage

Among 1.8 millions of population, 900,000 people are provided with centralized water supply from Hai Phong Supply Company. Besides, there are more than 140 small and medium water supply systems providing water to the population in towns and rural areas. Total clean water supply coverage in Hai Phong is about 91%, whereas coverage in rural areas is about 40% (www.haiphong.gov.vn).

Hai Phong Water Supply Company is among leading water utilities in Vietnam. The company is well recognized by its successful reduction of non-revenue water and sustainable water supply system development for the urban and rural communities.

4.1.2.3. Sanitation coverage

Hai Phong lies within the tidal influence of the Red River delta. It is very flat. The floor levels of buildings are typically around +4.00m above mean sea datum and the river level into which the drains discharge is regularly +2.5m above datum as a result of the tidal influence. Annual rainfall is around 1,800 mm spread throughout the year, with a peak in August. Rainfall often comes in relatively short duration, high intensity, storms. Flooding is a frequent occurrence throughout the city with water depths of up to 0.50 m and durations more than one day.

Hai Phong was taking part in the three cities WB Project (1B project, 2002 - 2008). The project components implemented similarly in central areas of Da Nang, Hai Phong and Quang Ninh (Halong City and Cam Pha town) provinces included (a) sewerage and sewage treatment; (b) drainage; (c) institutional development and construction management; and (d) revolving funds for household sanitation facilities. There are also solid waste management components in Da Nang and Quang Ninh. In Hai Phong, solid waste was already being improved through assistance from other sources. The project was upgrading the urban environment and reducing pollution by intercepting, and providing an appropriate level of treatment to sewage flows, where economically justified and affordable, and by improving the collection and safe final disposal of solid waste. Flooding reduction was by rehabilitating existing drains and constructing new drains in areas where regular flooding occurs. In each city, revolving funds were established to assist low-income households to construct on-site sanitation facilities (mainly toilets and septic tanks) and make connections to the combined sewers/drains to reduce pollution in areas where sewage treatment is not currently affordable.

Around 100,000 m^3 of sludge and sediments have been dredged from the sewers, drains and lakes under 1B project in Hai Phong. Land has been allocated adjacent to the existing sanitary landfill to build drying beds to dewater the material.

Septage arising from the desludging of septic tanks was designed to be transported to a site located adjacent to the existing sanitary landfill. The septage will be mixed 1:1 with biodegradable waste sorted from the municipal waste and left to compost for 2 months. During that period the compost will be dug over for aeration. Further, it will be transferred to a maturing basin for four months. From there it will be transferred to the sanitary landfill for use as cover and final reinstatement material.

Some equipment have been purchased under 1B project to improve maintenance and provide some capacity for emptying septic tanks: 4 sewer jets; 6 small vacuum tankers (2 m^3); 3 vacuum tankers (4 m^3); CCTV equipment; 2 trucks with mounted cranes; and a wheeled bucket loader.

Solid waste generated from the city is 1,100 m^3/day. The only disposal method is dumping at the landfill. Hai Phong is facing also a serious problem of waste generated from the sea ports and supporting activities.

Number of septic tanks in Hai Phong city is about 221,000 (88%). Pit latrines number is about 25,100 (10%). About 2% of Hai Phong citizens have no toilet facilities. The number of septic tanks is increasing fast over last years, especially after 1B project, whereas low-income families could have an access to the Revolving Fund operated by the local Women's Union for the household toilet upgrading and to sewer connection. In other cases, the city population is shifting to the septic tank especially when the house is upgraded or newly built.

4.1.2.4. Institutional and legal framework

As commitment signed between Vietnamese Government and the World Bank within the 1B project, Hai Hong city has had to collect wastewater fee as 15% surcharge added to the water bill, and, to increase that fee gradually. From 2005, the Hai Phong SADCO started to collect that wastewater fee. Until now, all other cities in Vietnam, except Hai Phong and Soc Trang are collecting wastewater fee as 10% surcharge from water bill.

Based on the approved plan of activities of the sewerage and drainage system O&M ordered by the City's authority, the Hai Phong SADCO is paid from the annual city budget. Approximately 15% of the budget is paid for the scheduled desludging of septic tanks from households, communal houses or living quarters and public toilets in the city. The amount of collected wastewater fee is increasing annually, and, became sufficient enough to cover sewerage and drainage O&M and scheduled septic tank desludging expenses since 2010.

The Company is planning to ask the city's authority to increase wastewater fee percentage from 15 to 20% surcharge of water bill in 2012, 25% in 2015, and 40% in the later stage.

4.1.2.5. Flow of money chart for FSM transactions

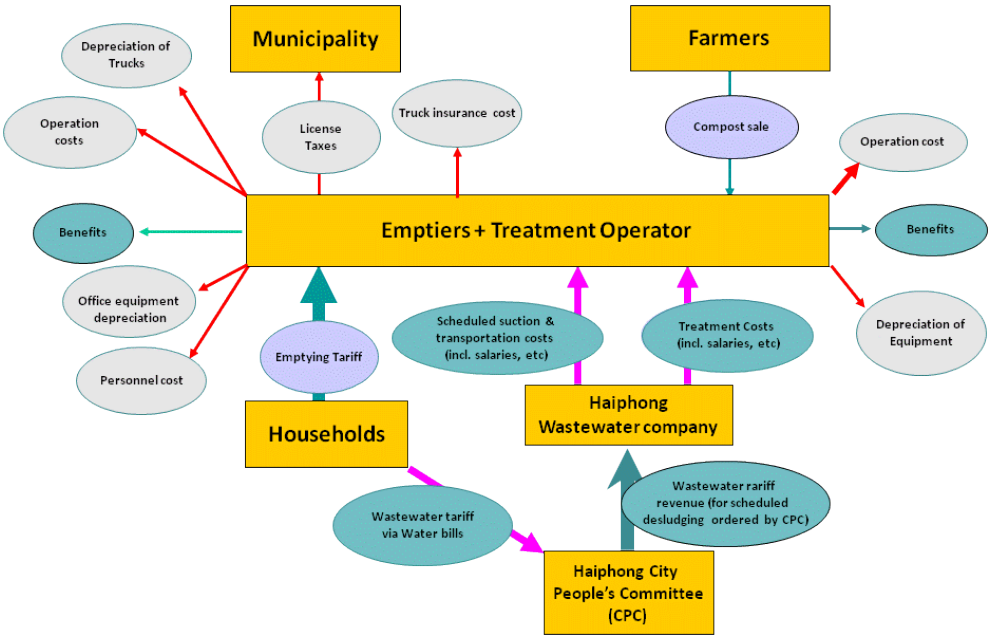

Figure 4-34. Flow of money chart for FSM transactions at Hai Phong SADCO, FSM related activities

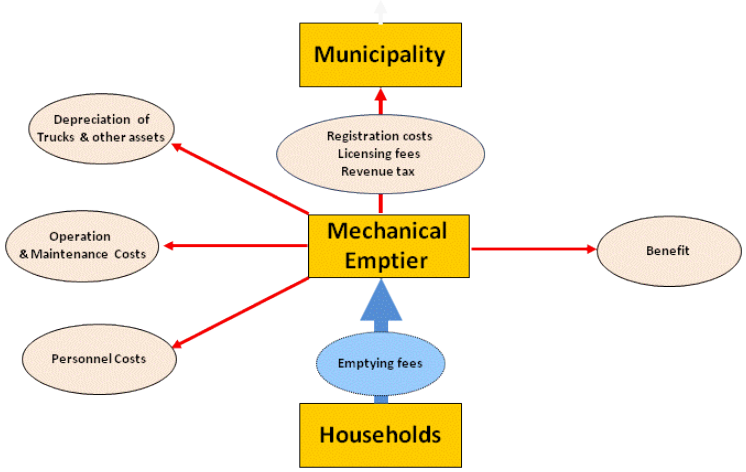

Figure 4-35. Typical flow of money chart for FSM transactions at private enterprise

4.1.2.6. FS emptying business owners' profile

The public work enterprise called Hai Phong Sewerage and Drainage One member state Company limited (Hai Phong SADCO) is responsible for O&M, rehabilitation, construction ò sewerage and drainage, wastewater and sludge treatment systems in Hai Phong city and surrounding areas. Besides, the Company has number of other activities such as design and construction of civil and industrial works. The Companies has 7 branch enterprises covering whole territory of the city. Trang Cat sludge treatment is one of its branch enterprises responsible for treatment of sludge collected from septic tanks, drainage and sewerage system.

Fecal sludge management is not a major business of Hai Phong SADCO. Besides scheduled desludging for households in the city paid by the part of collected wastewater fee,

the income from desludging services does not cover the expenses. Hai Phong SADCO has to provide cross- subsidy to FSM activity.

In the HP SADCO's GIS database there are 86,501 septic tanks under scheduled desludging located in 4 urban districts. HP SADCO is planning a desludging interval for household septic tanks once per 5 - 6 years, and for the communal houses (living apartments) once per 1 - 2 years. All the expenses came from collected wastewater budget. From the year 2000 up to now, Hai Phong Sewerage and Drainage Company (HP SADCO) has provided free-of-charge scheduled desludging of 80,270 m^3 of fecal sludge from 44,682 septic tanks spread over 40 from 47 wards and living quarters in 4 urban districts.

Hai Phong SADCO is also operating Trang Cat sludge treatment complex built from the WB 1B project. The total area of Trang cat is 162,844 m^2, design capacity is 120,000m^3/yr for receiving and treatment of both sludge dredged from sewers, canals and lakes, and, fecal sludge from septic tanks.

Out of 14 private enterprises dealing with FSM, the following enterprises took part in the surveys (Table 4-7).

Table 4-7. List of FSM enterprises took part in the survey in Hai Phong city

No.	Company's name	Truck number	Company type	FS business classification
HP.01	Hai Phong Sewerage and Drainage Company	11	One member Co. Ltd (State own)	Large
HP.02	Hai Phong Commercial and Industrial Cleaning Company	12	JSC	Large
HP.03	Hoa Anh JSC	3	JSC	Medium
HP.04	Tran Dang Khoa company	3	JSC	Medium

For the private enterprises desludging service is their major business. Some of enterprises have additional income utilizing purchased trucks for other activities such as emptying and transportation and dumping of industrial waste, construction waste, etc. Number of owners, managers and key staff of the private enterprises used to work for the Hai Phong URENCO or SADCO before they left and invested in this business. Since a large part of FSM market in Hai Phong is owned by the Hai Phong SADCO, private enterprises are trying to minimize running expenses, offer additional services such as hazardous waste collection and disposal, and, desludging of septic tanks from industrial sites. The enterprises are also expanding their working place to the surrounding areas where sludge can be emptied and resold to the fish ponds or agricultural farms.

4.1.2.7. Household survey results and analysis

This paragraph discusses about results from the surveys at 232 urban and 64 peri-urban households (HH) from 64 wards and communes randomly selected out of total 133 in Hai Phong city.

Figure 4-36. Hai Phong city

★ Location of wards (urban) and communes (peri-urban) with surveyed HHs

---------- Hai Phong urban area

○ Trang Cat sludge treatment plant

The average number of persons in urban Hai Phong HHs is 4.1, and in peri-urban areas is 4.0. The average number of persons per HH in Hai Phong, including urban and peri-urban areas, is 4.1 persons (Table 4-8).

Table 4-8. Number of users per HH

Number of persons per HH	No. of HHs,	No. of HHs,
	Urban Hai Phong	Peri-urban Hai Phong
< 5 persons	163	49
From 5 to 10	69	15
> 10 persons	0	0
Number of surveyed HHs	232	64
Average, urban or peri-urban	4.1	4.0
Average, urban + peri-urban	**4.1**	

Income

According to the new classification of poverty in Vietnam for the period of 2011 – 1015, out of 232 HHs surveyed in Hai Phong city, there is only 1 HH classified as poor, with average income VND 250,000 (USD 12.1) per person per month, 1 HH classified as high income (with average income VND 6,666,667 or USD 323/per/month). Except 1 HH without answer, all other 229 HHs belong to the medium income group, with income is ranging from VND 666,667 to VND 5,000,000 (from USD 32.4 to USD 242.7) per person per month.

3 HHs is classified as poor in the surveyed peri-urban area in Hai Phong, with income from VND 400,000 to VND 500,000 (from USD 19.4 to USD 24.3)/cap/month. All other HHs is in medium group.

Types of sanitation facilities vs. income

Figure 4-37 shows types of sanitation facilities in medium income HHs in urban Hai Phong. Septic tank is a most popular type of sanitation; making 98% of the total urban HHs. Aver septic tank, 94% of the HHs is connected to the city sewer. The remaining 4% is discharging septic tank effluent directly to the environment. There is no HHs in Hai Phong urban area that use pit latrines.

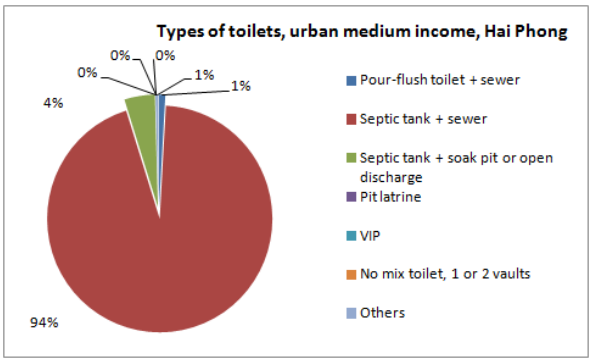

Figure 4-37. Types of sanitation facilities in urban Hai Phong (medium income HHs)

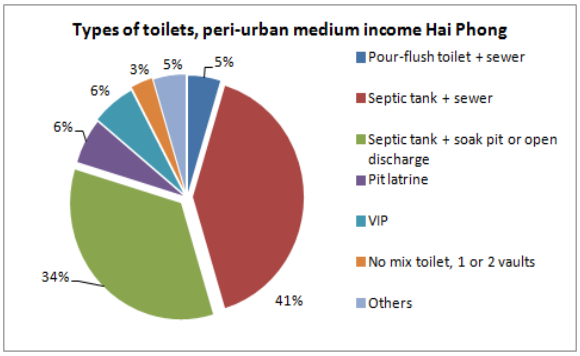

Figure 4-38. Types of sanitation facilities in peri-urban Hai Phong (medium income HHs)

Average desludging fee for medium income urban HHs in Hai Phong is USD 22.0.

Out of 64 surveyed HHs in peri-urban areas, there only 1 HH did not have answer on the income. 3 HH belongs to the poor group. The rest 60 HHs belong to medium income group. It shows the income among HHs in Hai Phong city, in both urban and peri-urban areas, is quite flat.

Average desludging fee for medium income peri-urban HHs in Hai Phong is USD 17.0.

Out of 229 HHs, 98 HHs or 43% replied they are ready to pay more fees for a better FS management in the city. Average additional fee paid by the HH is USD 7.1 or 32% of the existing one.

In peri-urban area surveys, out of 60 HHs, 20 HHs or 33% replied they are ready to pay more fee for a better FS management in the city. Average additional fee paid by the HH is USD 5.7 or 34% of the existing one.

Figure 4-39. Hai Phong city, with peri-urban areas

★ Location of wards (urban) and communes (peri-urban) with surveyed HHs

4.1.2.8. FSM emptying practices and technologies used: Manual and mechanical

Figure 4-13 presents sanitation type at surveyed households in urban and peri-urban areas of Hai Phong city. The most popular is a "water closet" type with septic tank (98%). The scheme of "septic tank + sewer" is 94% whereas ''septic tank + soak pit or open discharge'' is only 4%. Latrine pit types are around 2% and majorly used in the peri-urban areas (12% of peri-urban HHs). There are only 4% of population not using FS emptying service including 2% of HHs with direct sewer connection (without septic tank), 1% of mo mix toilet, and 1% without toilet facilities.

Figure 4-16 presents the criteria for selection of the desludging service provider by the households. In urban area, availability and quality of service are most important criteria. In peri-urban areas, the customers select the price as the most important criteria, then availability. Having licensed and quality of works are not a concern for the users. Quality of service is a 3rd reason for service selection.

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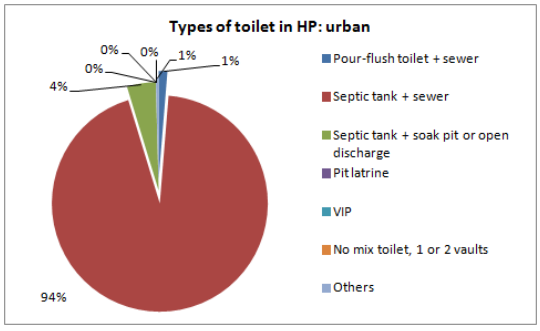

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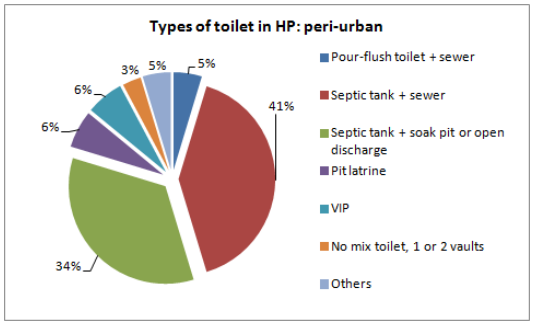
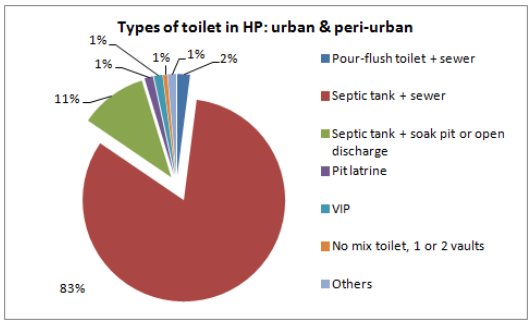
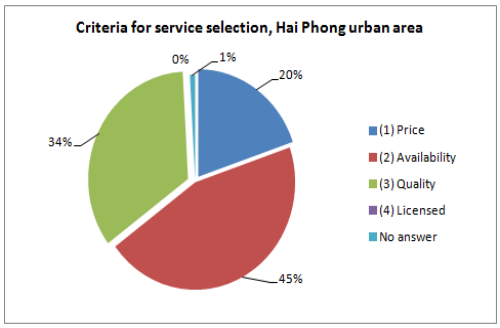




(c)

Figure 4-40. Sanitation types in Hai Phong city



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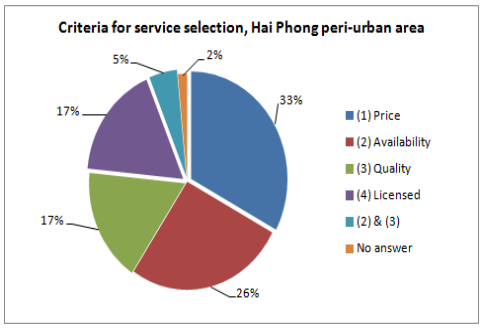

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Figure 4-41. The criteria to choose a desludging service provider

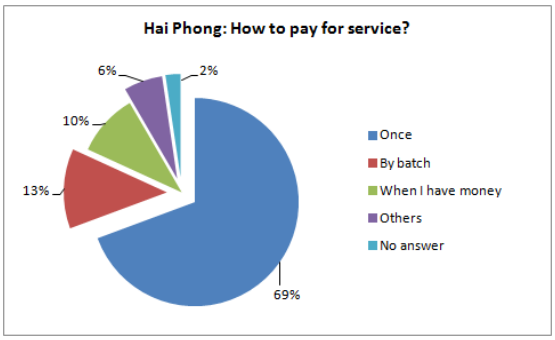
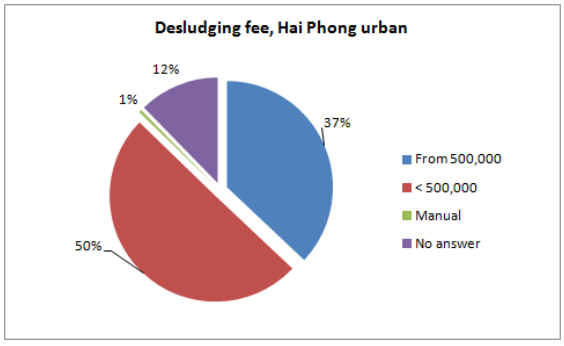


Figure 4-42. How to pay for FS empty service



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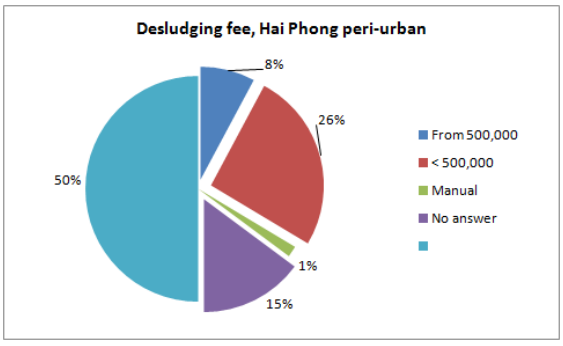


(b)

Figure 4-43. Cost for empty service

Figure 4-18 presents overview of desludging fee in urban and peri-urban areas of Hai Phong. In most of cases the desludging fee is higher than VND 500,000 (USD 24.30). Volume of

septic tanks in urban areas is mostly more since septic tank size mostly depends on the size of the house, which relates to the economic status of the household owner, and number of users. ''No answer'' often relates to the surveyed household who never emptied the tank, or, do not remember how much did they pay for the emptying service.

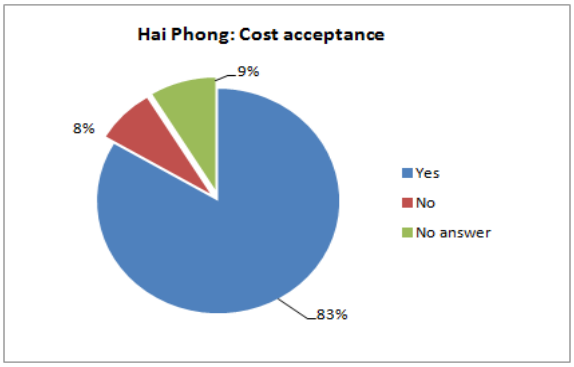


Figure 4-44. Satisfaction of users with current FS emptying fee

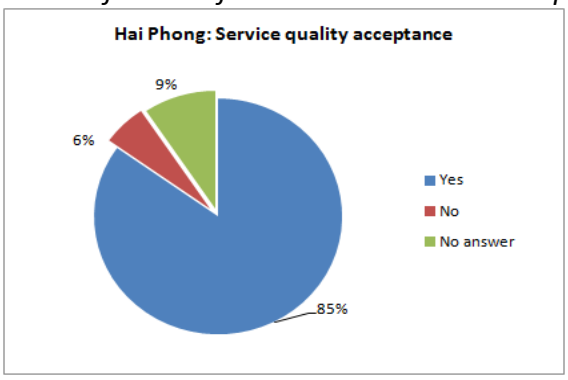


Figure 4-45. Satisfaction of users with FS emptying service quality

Figure *4-19* and Figure 4-20 show equal percentage of acceptance of the users, urban and peri-urban, at the emptying service cost, and quality of the service. 83% of users accept the current fee for FS emptying. 85% of users accept the FS emptying service quality.

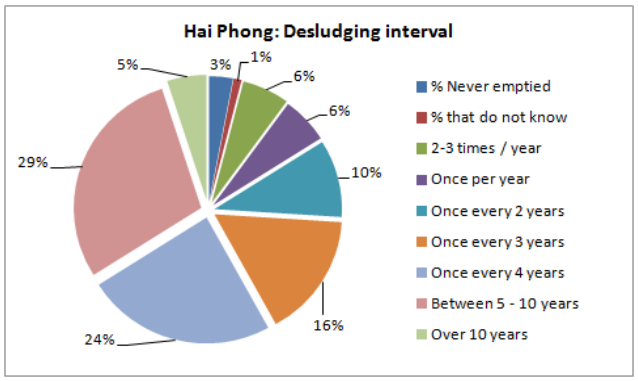


Figure 4-46. Frequency of fecal sludge empty in Hai Phong

Figure 4-21 shows that the emptying frequency of once for 5 - 10 years occupies 29% of the total surveyed households only. About 6% of households emptied twice a year. *The average desludging interval of septic tanks in Hai Phong is 4.4 years.*

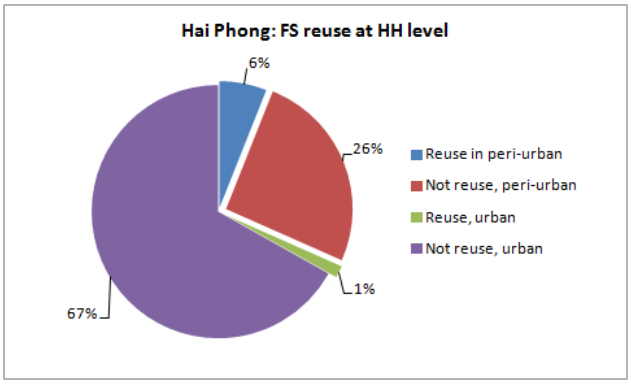


Figure 4-47. Fecal sludge reuse in Hai Phong (not including Trang Cat FS treatment plant)

6% of households, who are living in peri-urban areas, are practicing FS reuse by themselves. Co-composting with organic wastes and using as fertilizer is a most common reuse method. Feeding to the fish ponds is another method of FS. In urban areas, only 1% of population is able to reuse of FS. They likely live in the plots with area for agriculture.

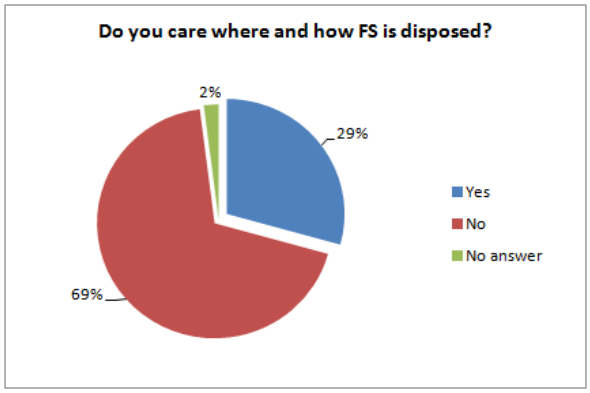


Figure 4-48. Awareness of FS disposal after emptying in Hai Phong

Most of the households seem do not care where their fecal sludge will be transported and dumped or treated. Awareness raising activities in FSM need improvements and more efforts in the near future.

Mechanical emptying is applied in most of cases in Hai Phong. The Company has been equipped with 16 cars from the 1B project with the tank volume from 0.5 m^3 to 7.75 m^3. Especially, in order to reach to the household in narrow and long alleys in the city, the project has made three 0.35 m^3-small tankers equipped with a small pump and storage volume. The tanker can be mounted behind a special truck, or, rolled manually. The small vacu-tug collects sludge from the HH(s) in the alley and discharge to an intermediate tanker of 10 m^3 volume waiting on the main street.

In 1B project (WB) has also developed a special cap used to seal an access hole on the top of septic tank after desludging. Since most of septic tanks in Vietnamese cities are placed in the kitchen or bath, covered and sealed with the tiles, many household owners neglect desludging because they do not want to deal with the floor breaking and resealing. After first time of desludging, using specially made plastics cover, the owner can be sure next time he

does not have to break the floor again. This cap is now widely disseminated throughout the country.

Information of septic tank and desludging time is managed by GIS-based software and in close cooperation with the local authority (wards' People Committee).

Table 4-9. Septic tank size calculation, Hai Phong city

No.	Parameters	HP.01	HP.02	HP.03	HP.04	Average, private Co.
1	Number of trucks	9	12	3	3	6.0
2	Average tank volume	3	2.6	2.5	2	2.4
3	Average trips per day	12.7	12	6	7.5	8.5
4	Unit cost charged by emptier, USD/m3		13.6	14.3	10.7	12.9
5	Cost paid by HH, USD/trip					21.5
6	Average septic tank size, m3					1.9

Figure 4-49. 2.5 m^3 desludging truck

Figure 4-50. 0.35 m^3 manual desludging truck and supporting 10m^3 intermediate tanker

Application of a plastic movable cap on the floor for access to the septic tank in Hai Phong was a good contribution from the World Bank project. Installing the cap (made locally by the Tien Phong Plastics Co. in Hai Phong) from the first time of desludging, an annoying floor breaking will be avoided in the next desludging times. As discussed before, floor breaking, with a number of inconveniences, is one among reasons why households hesitate to empty the tank. At least 20 minutes and VND 50,000 – 100,000 (USD 2.4 – 5.0) can be also saved in the next desludging.

Figure 4-51. Floor breaking for desludging

Figure 4-52. Plastic cap for access to septic tank

4.1.2.9. Overview of all WWTP, FSTP or dumping sites

Trang Cat treatment area is 5 ha, including 3 composting lines for sludge and organic wastes, 0.4 ha settling pond, 1 ha sludge drying bed, 0.6 ha receiving pond, 1.2 ha treatment ponds. The plant is equipped with modern tools like crane, mixing and turn over machines, sieving machines, pumps, etc.

The amount of sludge brought to Trang Cat is ranging from 10,000 to 25,000 m^3 per year. The projected sludge to be treated at the plant will be increased when the Environmental Sanitation project (2011 – 2015, JICA fund) will be effective.

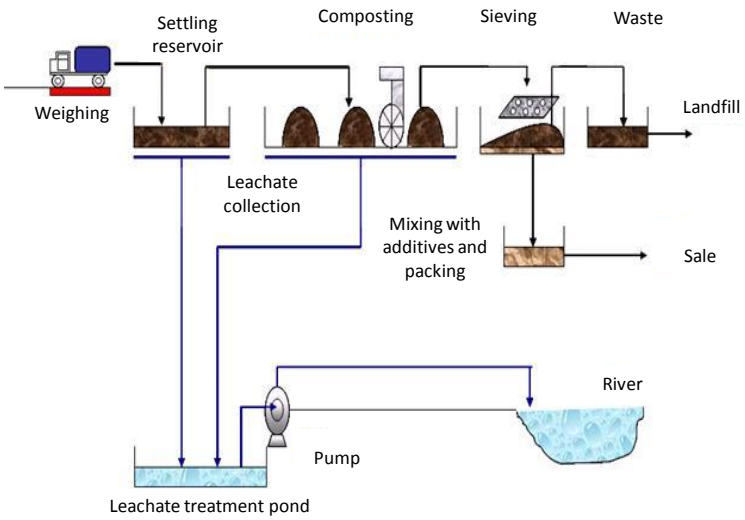


Figure 4-53. Process line of FS treatment in Trang Cat plant

Figure 4-54. Settling pond for FS treatment in Trang Cat

4.1.3. Ho Chi Minh city

4.1.3.1. Demographics of Ho Chi Minh city

Ho Chi Minh City (hereafter HCMC) is located in the south of Vietnam, and is the biggest city in Vietnam. It is located from 10 10'- 10 38'North and 106° 2'-106° 54' East. HCMC is 1,730 km from Hanoi and is at the crossroads of international maritime routes. The city center is 50

km from the East Sea in a straight line. It is a transport hub of the southern region and has the largest port system and airport in Vietnam. HCMC covers 0.6% of the total area of the whole country and has 6.6% of the total population. The city's population has increased from 3 million people in 1975 to 8 million people in 2011. The city natural land area is 2,095 km^2 with a present average population density of 2,687 persons/km^2.

There are about 30,000 factories in the industrial sector of HCMC, including many large enterprises, high-technology, electronic, processing, light industries, construction, building materials and agro-products. Currently, the city has 15 industrial parks (IP) and export-processing zones (EPZ). There are 171 medium and large scale markets, tens of supermarket chains, dozens of luxury shopping malls and many modern fashion or beauty centers. Over 50 banks with hundreds of branches and about 20 insurance companies are situated inside the city. In 2010, the city's Gross Domestic Product (GDP) was estimated at 20 billion USD, or about 2,800 USD/capita, (up 68% from 2005) and accounting for 20% GDP of the country. The city's Industrial Product Value was 30% of the whole nation. Export - Import Turnover through HCMC ports took 40 billion USD, or 40% of the national total. Ho Chi Minh City has also contributed about 30% to the national budget's revenue annually.

Currently urbanization in Ho Chi Minh is about 40% of the total area of the city (MOC, 2010).

4.1.3.2. Drinking water supply coverage

Ho Chi Minh city is based on both surface and ground water sources. Water from Dong Nai River is piped to Thu Duc water treatment plant with a capacity of 650,000 m^3/day and Binh An with a capacity of 95,000 m^3/day. The Sai Gon WTP, with a capacity of 300,000 m^3/day, takes raw water from Saigon River and supplies clean water to the western part of HCMC. It is estimated the water demand for domestic and industrial water supply in HCMC will be increased from 1,800,000 m^3/day in 2010 to 3,100,000 m^3/day in 2020. Up to the year 2025, average water consumption for urban citizens will be 180 liters/per/day, 150 liters/per/day for rural and peri-urban areas. Upstream reservoirs of Tri An and Dzau Tieng are being considered as future water sources for the city. Number of BOO projects with private sector participation enhances water supply service in the city significantly (SAWACO, 2011).

There are some urban districts of HCMC with 100% water supply coverage such as districts 1, 5 and 10. In the other urban districts (districts 3, 4, 6, Phu Nhuan…) water supply coverage is about 90%. In peri-urban areas of Go Vap, Tan Binh, the coverage is ranging from 65.9% to 85.8%. In the new urban districts of 2, 7, 9, Thu Duc, Tan Phu, Binh Tan, water supply coverage is 76.2%. Water supply coverage is still very low in rural and other peri-urban districts: Go Vap (20.1%), Can Gio and Cu Chi (almost 0%) and district 12 (4%). Average water supply coverage for a whole city is 83% (SAWACO, 2011).

4.1.3.3. Sanitation coverage

Drainage and flooding:

The common drainage system for rain and wastewater: the open drainage system (channels) and closed drainage system (underground sewage). Total length of sewage is about 777 km; the service area id about 62 km^2 (10% urban area) (60% services) (Source: Ho Chi

Minh sewerage and drainage Company, 2010). Irrigation system covers the service area of 26.9 ha. Stone embankment along the Can Gio beach is about 13 km.

Due to low elevation along the Sau Gon river affected by the daily tidal regime, Ho Chi Minh city is suffering floods frequently. There are about 100 flooding points in the city with the depth of 10 - 50 cm and sometimes reach 100 -150 cm, lasting from few hours to one day.

Solid waste management:

Solid waste (SW) generated daily about 7,900 tons of domestic solid waste (in average 0.66 kg waste/person/day), 1,500 tons of construction waste, 200 tons of industrial waste and 4 - 5 tons of hospital waste (2011). There are 3 solid waste transfer stations, 1 SW compaction station, 39 dumping sites, 7,500 public waste bins and 3 sanitary landfills.

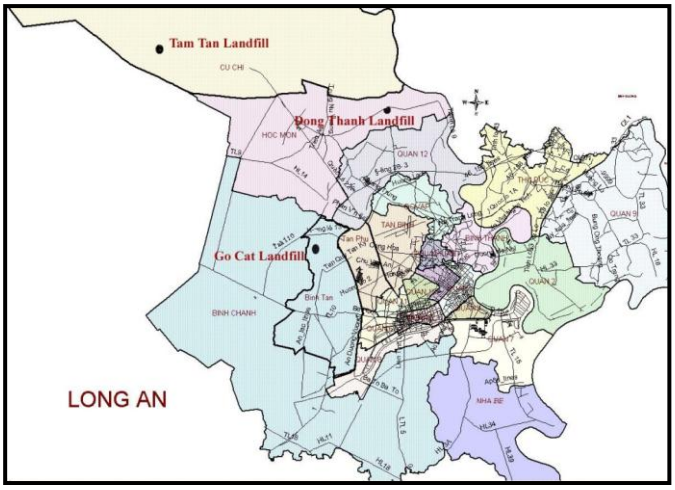


Figure 4-55. Locations of landfills in HCMC (N.P. Dan et al., 2007)

Currently, there are two sanitary landfills are in operation (Tam Tan - Da Phuoc and Phuoc Hiep landfills) in Ho Chi Minh city. Dumping site of Dong Thanh and Go Cat has been closed few years ago, but their leachate is still harming groundwater with organics, ammonia, etc. The location of landfills is presented in Figure 4-55.

Da Phuoc waste treatment complex has design capacity of 3,000 tons/day. Out of total 128 ha area, 78 ha will be for landfill, 50 ha for green belt, dykes, and office, composting plant and sorting out lines.

There will be 4 composting plants in Ho Chi Minh city area, including VietStar (US investment), Saigon Earth Care (Vietnam), Tam Sinh Nghia (Vietnam), Thanh Cong (Vietnam). One incineration plant will be built with design capacity of 1,500 tons/day. Waste recycling plant (FFK, Germany) will be built in Phuoc Hiep.

4.1.3.4. Institutional and legal framework

Service Providers: There are many private environmental companies emerged to provide desludging services in Ho Chi Minh city. One private company (Hoa Binh fertilizer Co.) has built a treatment facility and is now successfully operating the facility. The national

government is currently exploring models of privatization for public service companies to improve effectiveness and efficiency.

In 2007, the Department of Natural Resources and Environment (DONRE) has advised the HCMC People's Committee issued on Decision No 73/2007/QD-UBND dated 10/05/2007 on service management, collection, transport and treatment of fecal sludge, dredging sludge from sewerage and canals in the city. This regulation was partly tighten the management of collection services, fecal sludge transportation through to register forms at Office of Natural Resources and Environment (in District level). This contributes to improve the quality of service supplier to ensure the requirements for environmental protection through the regulation of the conditions to participate in the collection and transportation services. In addition, the violations and fines were regulated in details in Decision No. 73/2007/QD-UBND to ensure the service supplier gradually stop dumping fecal sludge into rivers, and canals in the city.

According to assess the Office of solid waste management of HCMC (DONRE) nearly one year after they issued the decisions No. 73/2007/QD-UBND, status of illegal disposal fecal sludge decreased significantly. The service company has contacted DONRE to register a license for fecal sludge services. However, the number of registration was very limited (District 2: 3 companies, Tan Phu: 1 company, Thu Duc District: 1 company and Distric 11: 3 companies). Besides, according to the information from the authorized organizations from district level the tank trucks often operate in the many districts (instead of district registered) so DONRE cannot manage through the registration forms only. On the current situation it shows that beside external forms of management by regulation, need to attach management based on technical equipment and improve organizational structure and personnel specialized in this field. In the near future, DONRE is planning to ask HCMC People's committee to modify the content of regulation No. 73/2007QD. From this regulation, the management on fecal sludge in HCMC will be transfer from the District level Office of Natural Resources and Environment to the DONRE's Office of Solid Waste Management. The activities including Registration and Licensing, Control of FS collection and transport will be conducted by DONRE only. This is to avoid the unregistered trucks operation in districts and to increase fines for violation.

4.1.3.5. Flow of money chart for FSM transactions

Figure 4-56 presents flows of money occurred in One member state Company of Ho Chi Minh city for Environmental sanitation (HCMC CITENCO). One of area of the CITENCO activities is to lease the mobile public toilets, to empty public toilets and to transport emptied sludge to the treatment site. Fee of VND 30,000 per truck is paid by CITENCO to Hoa Binh Fertilizer Company at the dumping site.

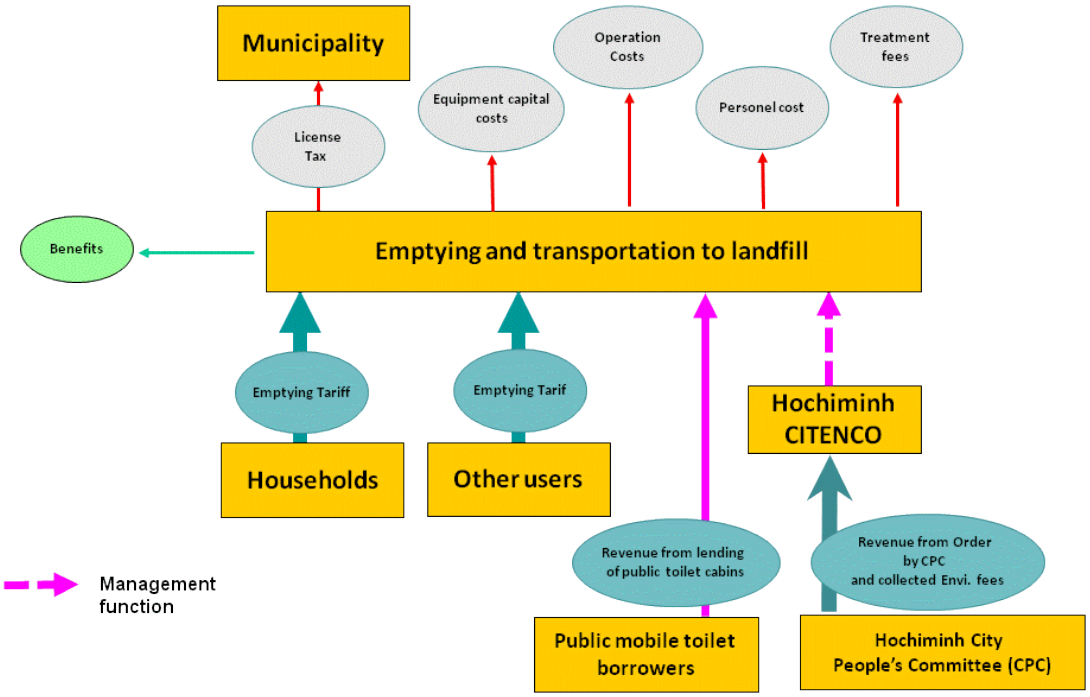


Figure 4-56. Flows of money in Ho Chi Minh city CITENCO

Figure 4-57 presents flows of money occurred in private enterprises proving desludging service in Ho Chi Minh city. Besides illegal dumping, part of emptied sludge is brought to the treatment site. Fee of VND 30,000 (USD 1.5) per truck is paid by CITENCO to Hoa Binh Fertilizer Company at the treatment site.

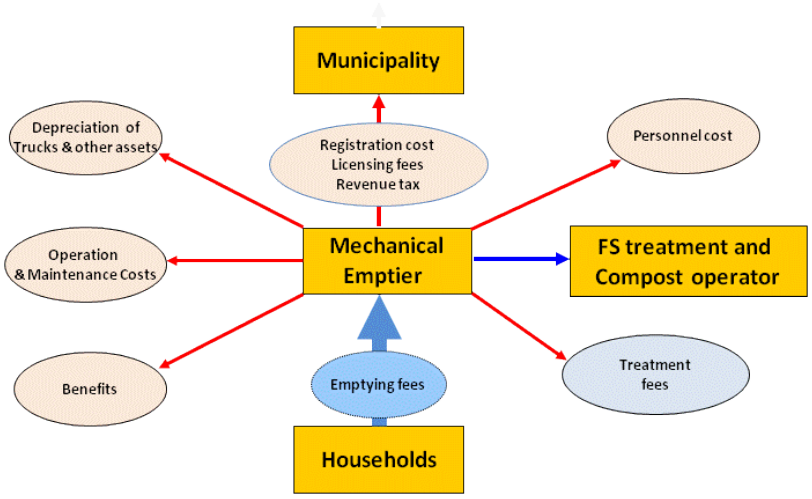


Figure 4-57. Flows of money at private enterprises proving desludging service in HCMC

4.1.3.6. FS emptying business owners' profile

There are 4 types of enterprises dealing with FSM service as follows:

(1) The public utility CITENCO;
(2) The private enterprises having only FSM emptying and transportation business;
(3) The private enterprises having FSM as one of different activities;

(4) FS treatment and making fertiliser companies.

The public work enterprise called Ho Chi Minh city's Environment One member state Company limited (HCMC CITENCO) is responsible for collection, transportation and treatment of domestic, commercial, hospital, industrial and construction wastes in Ho Chi Minh city. Besides, the Company has number of other activities such as: providing of cleaning service for houses and public work places; waste recycling; manufacturing of mechanical products, specialized equipments and mechanical transport vehicles; consultancy, design and construction of civil and industrial works; professional training, technology transfer in urban environment field; Materials and equipments import, export; Doing business in real estate business, office for lease; Labor export.

The Companies has 5 branch enterprises, dealing with different activities. Sludge emptying from public toilets is only a small part of activities of the company. Desludging is not only a single business. Diverse activities of the large private desludging enterprises and the CITENCO urban environment company include installation of water supply system, solid waste collection, transportation and delivery of goods by truck, repair and construction of septic tanks and sewerage, hazardous waste transportation, bonsai and green spaces care, sales and lease of sanitary equipment (such as mobile public toilets), civil and industrial construction, transportation and irrigation, etc ... Related to FS management, CITENCO does emptying mostly of public toilets, including fixed and mobile ones, leasing mobile public toilets. The Company has 7 trucks with average tank volume of 5.5 m^3. Urban customers often prefer to use service from state enterprise, which should have more capacity, clarity and credibility.

Out of 5 surveyed private enterprises, there are 2 enterprises dealing with FS emptying service only. The others have other activities such as installation of drainage systems, domestic, commercial and industrial solid waste collection, hazardous waste collection, water and wastewater treatment, construction and repair of septic tanks, sewer dredging, etc. Some are utilizing purchased FS trucks for emptying and transportation and dumping of commercial, industrial and construction waste, etc.

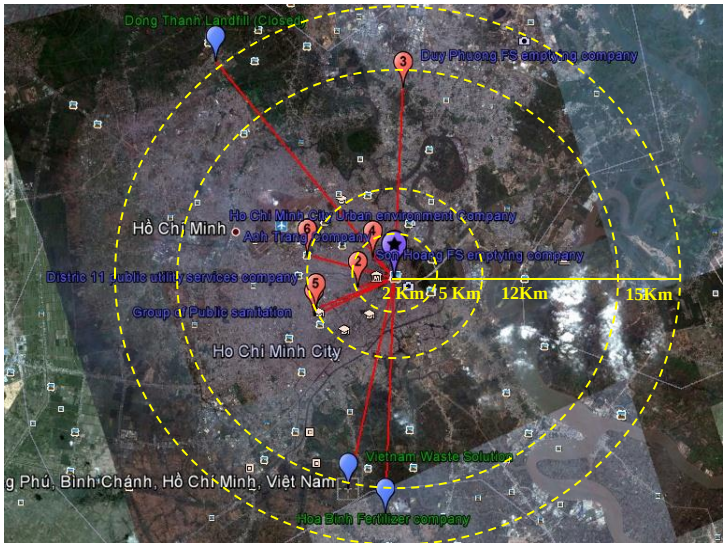


Figure 4-58. Location of surveyed FS emptiers and landfills in HCMC

Note: Blue pin point 1: Dong Thanh landfill (closed); Blue pin point 2: Da Phuoc landfill and waste treatment complex (by VWS); Blue pin point 3: Hoa Binh fertilizer Co.; Red pin points (1 … 6): surveyed FSM enterprises

Table 4-10 presents brief information of sureyed enterprises in Ho Chi Minh city.

Table 4-10. Brief information of surveyed enterprises in Ho Chi Minh City

No	Enterprise	Address	Type of business	FS business classification
HCM.01	Ho Chi Minh City Urban Environment State One Member Co. Ltd. (CITENCO)	42-44, Vo Thi Sau Street, Q.1	Urban public works including SWM, cemetery, FS emptying	Large
HCM.02	Duy Phuong FS emptying JSC	61, Cong Hoa Street. Ward 13, Tan Binh Dist.	FSM only	Medium
HCM.03	Public sanitation team JSC	22/2 floor 1, 5 Lo Sieu Street, ward 6, District 11	Trade & service	Large
HCM.04	Son Hoang FS emptying JSC	644/4/25, Street 3-2, ward 11, District 10	FSM only	Medium
HCM.05	District 11 public utility services JSC	2/12, Lu Gia tenement, ward 15, Dist. 11	Trade & service	Medium
HCM.06	Anh Trang JSC	70/32D, Cong Hoa Street, Tan Binh dist.	Trade & service	Small

The size of the enterprises depends on the available capital investment. Mostly the enterprises belong to a small (one truck only) and medium (from 2 to 5 trucks). For the 3rd type of enterprises, funds invested in facilities for desludging service is often ranging from 30 – 40% of total capital. In desludging, in order to compete with others and to maintain profits, the enterprises are trying with marketing, using advertisements in newspapers, distributing leaflets and based on individual relationships.

4.1.3.7. Household survey results and analysis

This paragraph discusses about results from the 300 households (HH) survey across 127 wards, out of total 322 words in Ho Chi Minh City.

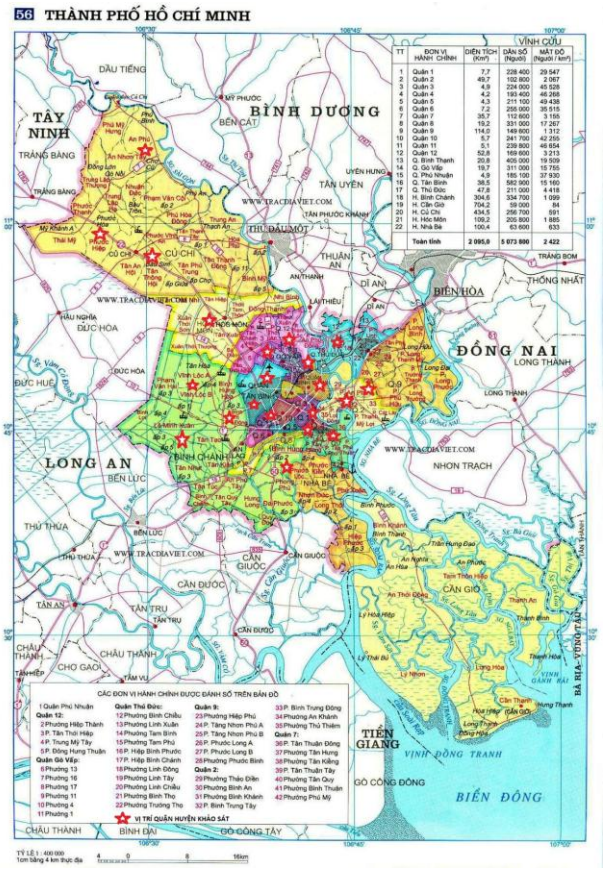


Figure 4-59. Locations of wards and communes (marked with red stars) where HHs took part in the surveys, Ho Chi Minh City

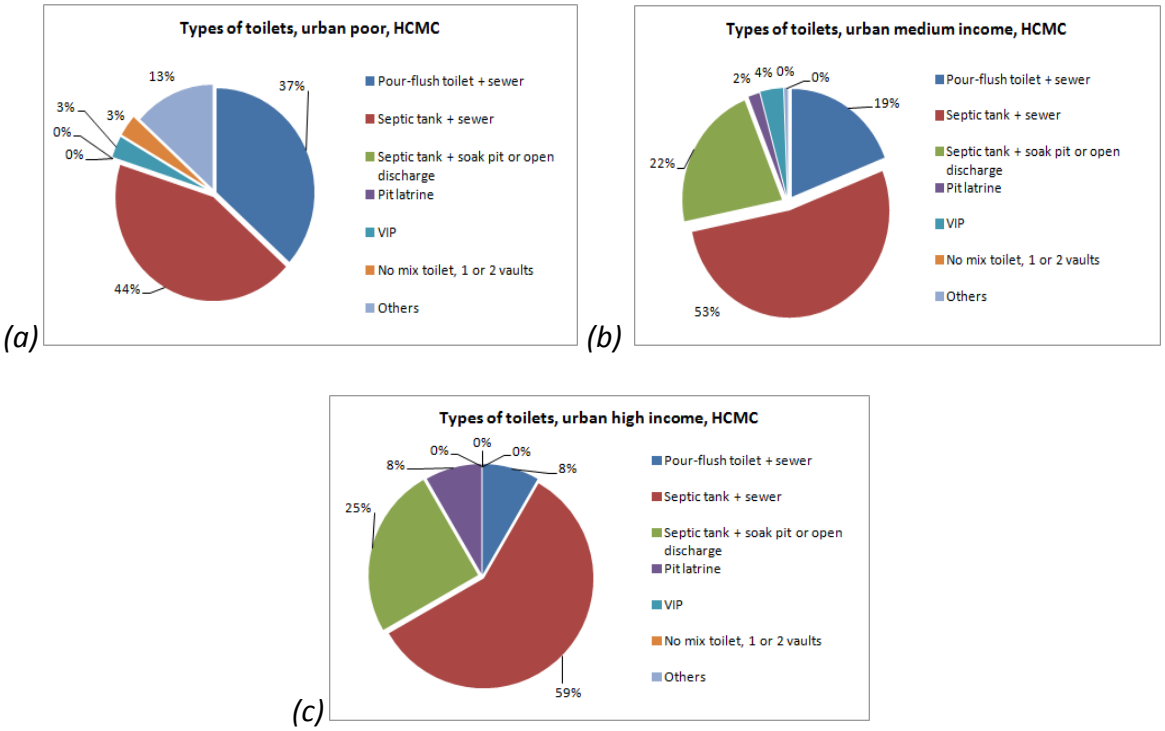


Figure 4-60. Types of sanitation among income groups in urban HCMC

A different picture is observed in Ho Chi Minh City compared with sanitation types in Hanoi and Hai Phong. In Ho Chi Minh City, a very high percentage of low and medium income HHs have no septic tanks, discharging wastewater directly to the combined sewers. The percentage of HHs with sanitation scheme pour-flush toilet & sewer in Ho Chi Minh City urban areas, respectively for the poor, medium and high income groups, are 37%, 19% and 8%. In the reverse trend are a percentage of septic tanks: 44%, 77% and 84%. Septic tank is presenting in two schemes: septic tank & soak pit or open dumping, and septic tank & city sewerage, drainage system.

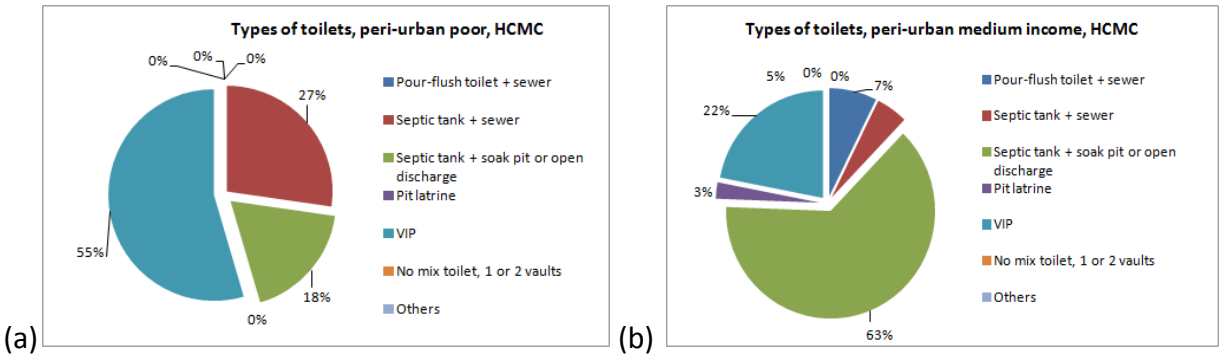


Figure 4-61. Types of sanitation in peri-urban HCMC

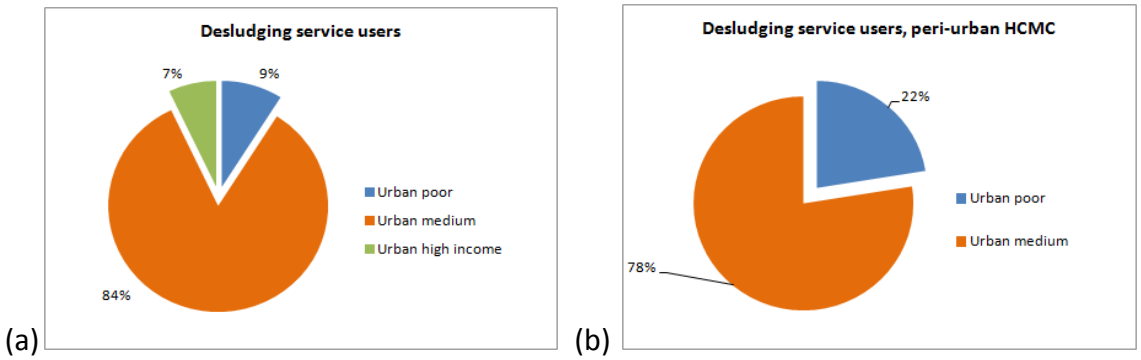


Figure 4-62. Users of desludging service

Figure 4-52 shows a major part of users of the FS emptying service in urban areas of Ho Chi Minh City is coming from the medium income group (84% of total customers). The rest customers are from urban poor (7%) and high income group (9%). This seems logic since in Ho Chi Minh City the highest percentage of HHs with septic tank and pit latrines are from medium and high income groups.

4.1.3.8. FSM emptying practices and technologies used: Manual and mechanical

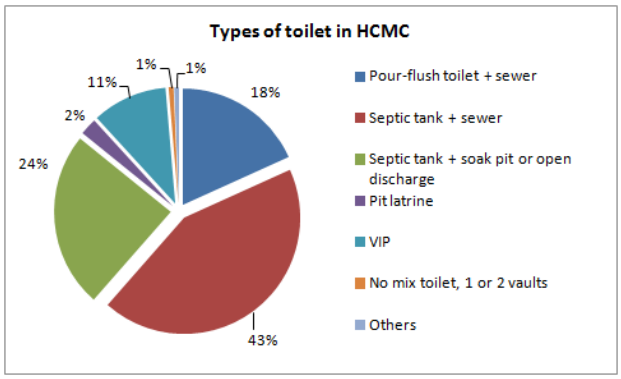


Figure 4-63. Sanitation types in Ho Chi Minh city

Figure 4-63 shows the sanitation types of households in HCMC. The most popular is a septic tank + sewer type (43%). The other on-site sanitation type with septic tank is septic tank + soak pit or open dumping (24%), making total percentage of septic tank system is 67%. Besides, there are two other sanitation types using desludging service. They are: Pit latrine (2%) and Ventilated pit improved latrine (11%). Compared to Hanoi and Hai Phong, Ho Chi Minh City has a largest percentage (18%) of HHs discharging wastewater directly to the combined sewer and canals without primary treatment.

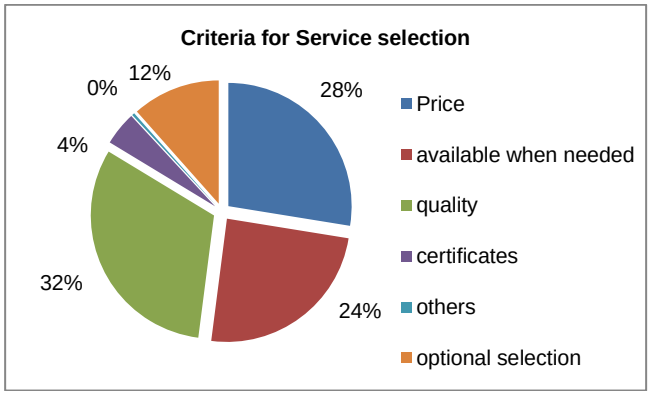


Figure 4-64. The criteria to choose a desludging service provider

Figure 4-64 presents the criteria for selection of the desludging service provider by the households. The price, availability of service, and quality of services are often key factors. The price of the service is dominating factor compared to the two others.

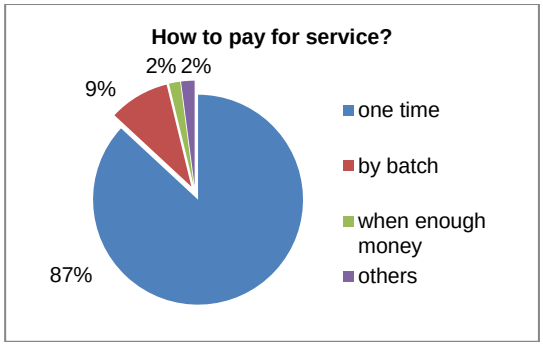


Figure 4-65. How to pay for FS empty service

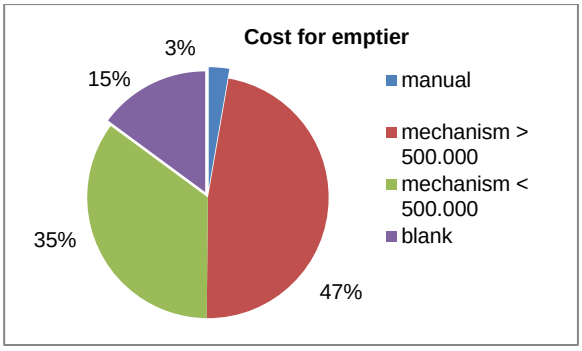


Figure 4-66. Cost for empty service

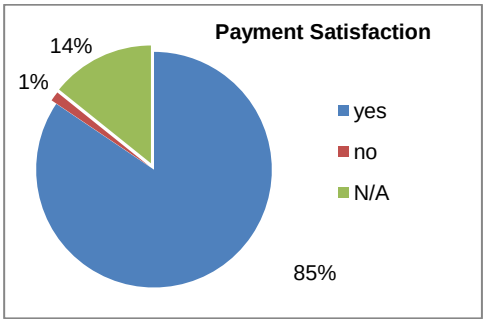


Figure 4-67. Satisfaction with current payment methods

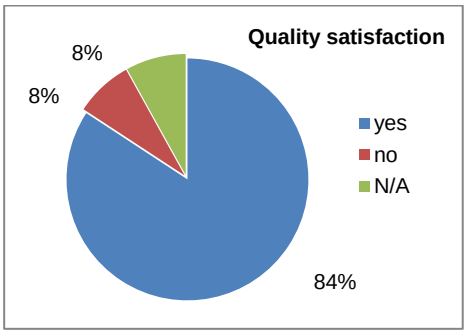


Figure 4-68. Satisfaction level of service quality fecal sludge suction

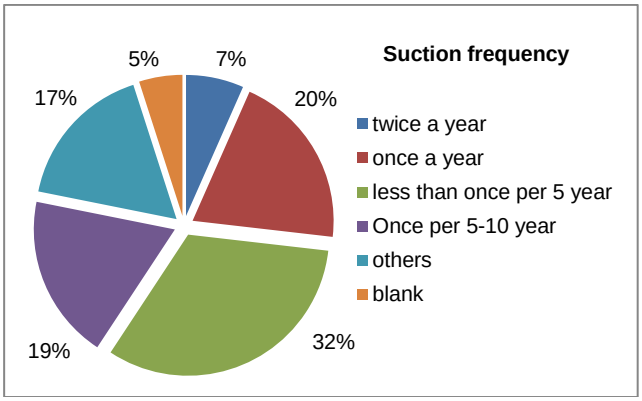


Figure 4-69. Frequency of fecal sludge empty in the household

Figure 4-66, *Figure 4-66 Figure 4-66* show households prefer to pay the service one time (87 %) and the satisfaction level about payment and quality of service is also high (85% and 84 % respectively). For the empty service, the manual service is negligible. This manual empty service is conducted only when the mechanical suction does not able to operate due to some reason. The emptier will dig or excavate some parts and the use the mechanical suction. When doing this, the operator will add some cost for home owner. Therefore, cost to pay for manual emptier is also very low proportion. The payment for one suction time was about 500,000 VND (25 USD). The service cost was higher and lower than 500,000 VND is approximately 35% and 47%, respectively. Compared to the survey costs from the FS service company, the service fee was not misleading. The average cost varies from 300,000-500,000 VND/m^3.

Figure 4-66 shows that the emptying frequency of once for 1-5 years occupies 52% of the total survey numbers. About 7% of households emptied twice a year. This indicates that there is a portion of septic tanks built not following the construction standards in HCMC. Furthermore, people only call the emptiers when the tank is full, generating bad smell, etc. If it does not happen, most people do not know about details of their septic tanks, providing negative answers to the questions such as tank dimension, empty duration, tank performance and upgrading the septic tank, etc.

Most of households when using desludging service just care about the tank will be emptied well and will not cause the disturbance to their living conditions. The households seem do not care where their fecal sludge will be transported and dumped or treated. Awareness raising activities in FSM need improvements and more efforts in the near future.

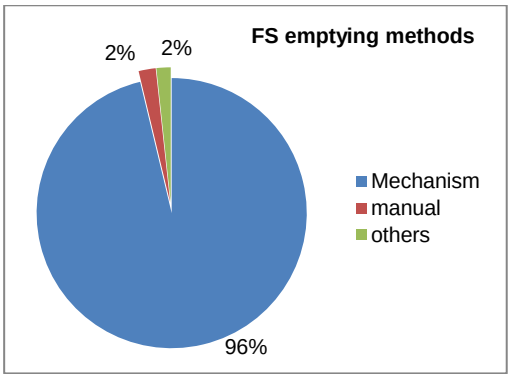


Figure 4-70. Fecal sludge emptying methods

Figure 4-66 illustrates that the mechanical empting is a major (96%) in HCMC. There is still a small amount of households using manual emptying. Most of them are located in peri-urban areas, when septic tank sludge is too dry, not suitable for mechanical pumping. 84% of manual emptying households are hiring temporary manual workers for this task. Adding water and mixing up before mechanical pumping is another method used in desludging of tank with dry matters.

Table 4-11. Septic tank size calculation, Ho Chi Minh City

No.	Parameters	HCM.01	HCM.02	HCM.03	HCM.04	HCM.05	HCM.06	Average, private Co.
1	Number of trucks	7	4	6	3	3	1	4.3
2	Average tank volume	5.5	2	3	3	4	6	2.7
3	Average trips per day	11	6	9	6	13.5	1	7.0
4	Unit cost charged by emptier, USD/m3	12.1	21.8	17	17	17.3	19.4	17.4
5	Cost paid by HH, USD/trip							21.7
6	Average septic tank size, m3							1.6

4.1.3.9. Overview of all WWTP, FSTP or dumping sites

FS treatment at Dong Thanh landfill: Dong Thanh landfill was designated by HCM City People's Committees to be the place to receive and treat the fecal sludge with an average capacity of 180 m^3/day. The treatment area was about 4000 m^2.

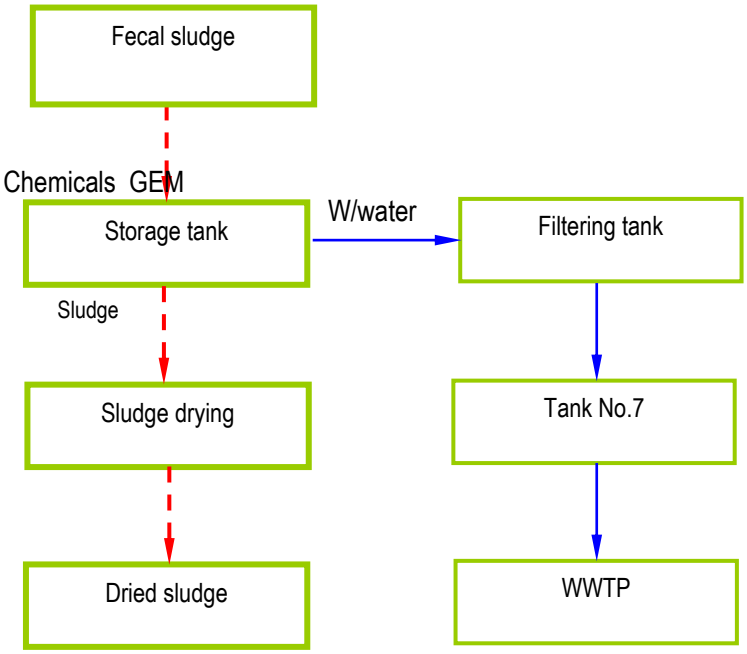


Figure 4-71. Fecal sludge treatment at Dong Thanh landfill

Figure 4-72. Fecal sludge treatment plant at Dong Thanh landfill

Treatment of liquid phase from fecalsludge

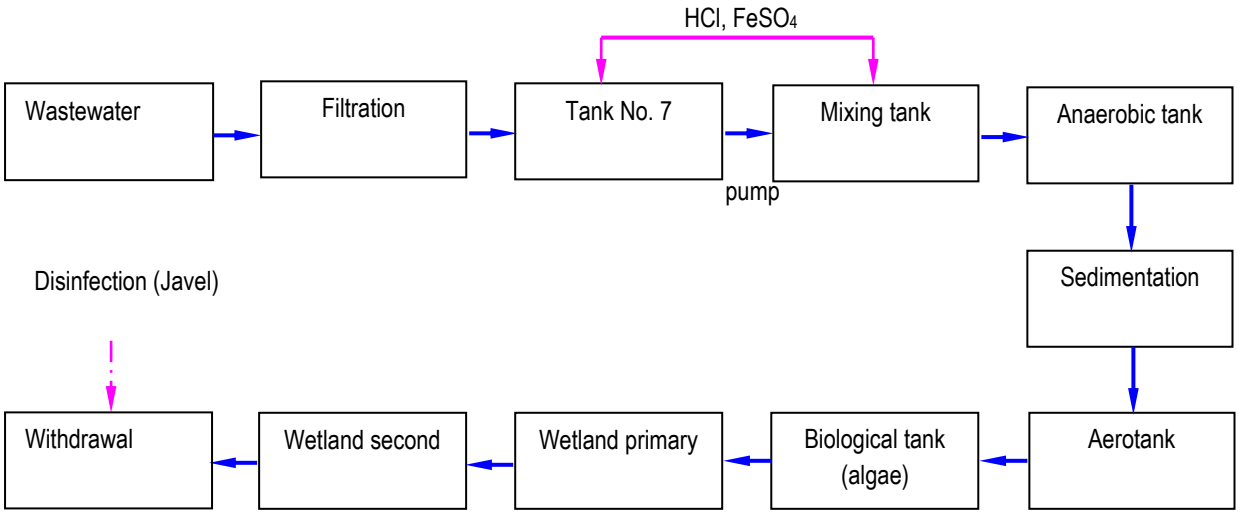


Figure 4-73. Wastewater treatment process in Dong Thanh landfill

Fecal sludge treatment by Hoa Binh Fretilizer Company in Da Phuoc Waste Treatment Complex:

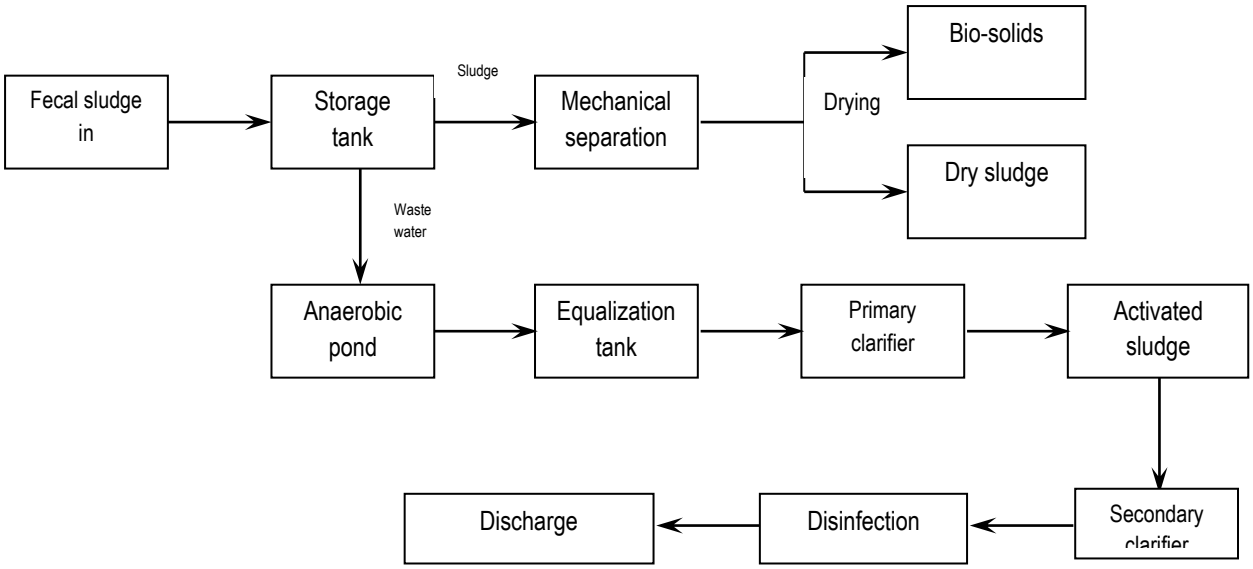


Figure 4-74. FSTP of Hoa Binh waste disposal company.

Figure 4-75. Dried sludge before separation

Figure 4-76. Mechanical separation

Figure 4-77 Bio-solids

Figure 4-78. Dried sludge

Figure 4-79. Grass land receiving wastewater after treatment

There are two types of product: dried sludge from the process will be sold to households in the area to fertilize crops, with the prices around 600,000 VND/ton (30 USD/ton). Biological sludge is sold to the wastewater treatment company for 800,000 VND/ton (40 USD/ton).

4.1.3.10. FS end re-use in the Ho Chi Minh City

In HCMC there are 70 registered enterprises active in manufacturing and selling fertilizers. Among them, there are 15 enterprises are producing organic fertilizers. Ho Chi Minh City is a largest fertilizer market in Vietnam. 11% of fertilizers produced in Ho Chi Minh City are organic fertilizers. 40% of fertilizers traded in the market are made in the city which supplies about 60% of total fertilizer demand for the southern provinces.

Some years ago source separation campaigns have been initiated in Ho Chi Minh City. However, due to limited capacity and coordination, the program has stopped after some pilot activities at the ward level. In 2011, the city is trying to renovate the program again, with more systematic planning.

According to the HCMC DONRE, 10% of organic waste generated in HCMC is being processed to compost. The city is aiming at the target: composting 40%, recycling 10%, incineration for power generation 10%, sanitary landfilling 40% of solid waste by the end of 2015.

The market for composting products in Ho Chi Minh City and surrounding areas is very potential, whereas the demand is much more than current supply.

4.2. Market analysis per city

For market size analysis, the following parameters have been calculated (Table 4-12 shows results of calculation):

- P1: Market size value based on the number of households, average volume of septic tanks and pit latrines, actual desludging interval. 10% is added up, accounting volume of FS from offices, commercial and public places. Only 90% of tank is emptied each time.

- P2: theoretical volume of sludge accumulated per year, assuming accumulation rate of sludge in pit latrines 0.6L/cap/yr., in septic tanks 0.3L/cap/yr. 10% is added up, accounting volume of FS from offices, commercial and public places. Only 90% of tank is emptied each time.

- P3: Market size value based on required desludging interval: 1 year for pit latrines, 2 years for septic tanks. 10% is added up, accounting volume of FS from offices, commercial and public places. Only 90% of tank is emptied each time.

- C1: actual sludge volume emptied, based on the data from surveys at desludging enterprises (number of trips by all trucks per year x effective volume of the tank);

- C2: actual sludge volume emptied, based on the secondary data.

Table 4-12. Market size calculation for surveyed cities

No	Items	Hanoi	Hai Phong	Ho Chi Minh city	Note
1	Number of HHs having pits in the city	39,149	4,655	200,322	
2	Number of HHs having septic tanks in the city	430,638	218,795	1,017,019	
3	Typical volume of the septic tanks, m^3	2.6	1.9	1.6	
4	Typical volume of the pits, m^3	1.3	1.5	1.5	
5	Total pits to be emptied per year	11,576	1,741	59,235	
6	Total septic tanks to be emptied/year	103,138	87,124	508,916	
7	Average desludging interval, years	6.2	4.4	4.4	From HH surveys
P1	Total volume of sludge to be emptied P1, m^3/year	280,376	166,466	894,087	With current desludging interval
P2	Total volume of sludge generated, m^3/year	574,385	257,439	1,599,974	Based on theore. sludge accumulation rate
P3	Total volume of sludge to be emptied, m^3/year	604,616	212,689	1,102,957	With desludging interval: 1 year for pits, 2 years for septic tanks
C1	Current FS collected C1, m^3/year	141,750	60,291	268,605	Based on enterprise survey
C2	Current FS collected C2, m^3/year	127,750	51,100	229,950	Secondary data from city authorities

4.3. Service delivery models review

4.3.1. Overview of existing models

4.3.1.1. Hanoi city

The most common public desludging service provider is the Urban Environment Company (URENCO). These companies operate the landfill or, in some cases, wastewater treatment plants in the city. Besides, there are number of private enterprises who are providing desludging service in the cities. The national government is in the process of equitizing a number of publicly owned companies. Equitization has thus far been adopted for fewer than 10 provincial water supply companies, and some URENCOs. While public service companies have the engineering, environmental, and planning staff to improve their septage management services, they require additional training in desludging services. These companies have little managerial autonomy, and therefore, little accountability to meet or improve standards. Furthermore, the local People's Committees set restrictive tariff rates that prevent cost recovery for O&M, much less capital investment reserves (Lai, Trinh Xuan. ADB sector review). As a result, many URENCOs tend to take a passive stance towards service provision and expansion.

Private FSM Service Providers: There are 40 private enterprises to provide desludging services in the Hanoi city. Most continue to illegally dispose septage.

4.3.1.2. Hai Phong city

Fecal sludge management is not a major business of Hai Phong SADCO. Besides scheduled desludging for households in the city paid by the part of collected wastewater fee, the income from desludging services does not cover the expenses. Hai Phong SADCO has to provide cross-subsidy to FSM activity.

In the HP SADCO's GIS database there are 86,501 septic tanks under scheduled desludging located in 4 urban districts. HP SADCO is planning a desludging interval for household septic tanks once per 5 - 6 years, and for the communal houses (living apartments) once per 1 - 2 years. All the expenses came from collected wastewater budget.

Hai Phong SADCO is also operating Trang Cat sludge treatment complex built from the WB 1B project.

For most of the private enterprises desludging service is their major business. Some of enterprises have additional income utilizing purchased trucks for other activities such as emptying and transportation and dumping of industrial waste, construction waste, etc. The Company of HP.03 (Hoa Anh JSC) recently has newly expanded their business to emptying and treatment of wasted oil from ships, collection and disposal of industrial hazardous waste. That's why HP.03 has purchased a new truck of HINO at the cost of USD 77,670 for not only FS emptying but also for ship waste oil emptying and disposal, while such an expensive truck would not be affordable for most of other enterprises providing FS emptying service only. The company has also recently built the incinerator for oil and industrial waste treatment at the cost of USD 150,000 by its own capital.

Since a large part of FSM market in Hai Phong is owned by the Hai Phong SADCO, private enterprises are trying to minimize running expenses, offer additional services such as hazardous waste collection and disposal, and, desludging of septic tanks from industrial sites. The enterprises are also expanding their working place to the surrounding areas where sludge can be emptied and resold to the fish ponds or agricultural farms.

In total there are 14 private enterprises to provide desludging services in the Hai Phong city. Most of them are illegally disposing septage.

4.3.1.3. Ho Chi Minh City

The public work enterprise called Ho Chi Minh city's Environment One member state Company limited (HCMC CITENCO) is responsible for collection, transportation and treatment of domestic, commercial, hospital, industrial and construction wastes in Ho Chi Minh city. Besides, the Company has number of other activities. The Companies has 5 branch enterprises, dealing with solid waste collection, treatment, cemetery operation and other activities. Related to FS management, CITENCO does emptying mostly of public toilets, including fixed and mobile ones, leasing mobile public toilets.

There are 50 private environmental companies emerged to provide desludging services in Ho Chi Minh City. One private company (Hoa Binh fertilizer Co.) has built a treatment facility and is now successfully operating the facility. The city government is currently exploring models of privatization for public service companies to improve effectiveness and efficiency.

For the surveyed private enterprises providing desludging service is their major business. Some of enterprises have additional income utilizing purchased trucks for other activities such as emptying and transportation and dumping of industrial waste, construction waste, etc.

4.3.2. Comparison with solid waste management service models

The studied areas are 3 largest cities in Vietnam representing different modes of FSM. Difference in FSM models applied in each city is discussed as follows:

Hanoi: desludging of HH and office septic tanks is by private enterprises; public toilet desludging is by State one member Company limited Hanoi URENCO's enterprise No. 11. URENCO 11 is producing compost from fecal sludge and organic waste and selling. URENCO 11 gets cross-subsidiary from the Hanoi URENCO who has major income from solid waste collection and other services.

Hai Phong city: scheduled desludging of HH septic tanks is done by State one member Company limited Hai Phong SADCO for free; other HH and office septic tank desludging is done by HP SADCO and by private enterprises for some fees; public toilet desludging is by HP SADCO; HP SADCO is allowed to use part of collected wastewater for scheduled desludging. City provides partial sub-subsidiary since 15% surcharge from water bill for wastewater fee is not enough for O&M expenses of the enterprise.

Ho Chi Minh city: desludging of HH and office septic tanks is by private enterprises; public toilet leasing and desludging is by HCMC State one member Company limited CITENCO; fecal sludge treatment is done by another private company who is collecting some fee for each delivered m^3 of sludge and selling the compost product. FSM business is regulated mostly by the market.

Potential chance for improvement: In Hai Phong, FSM is a part of urban drainage and sewerage system management, where in two other cities, Hanoi and Ho Chi Minh, solid waste management company is taking over. Improvement of FSM situation in the cities can be realized through following options:

(1) Consideration of FSM as a part of drainage and sewerage system. FSM can be operated by the ''polluter's pay principle'' through increase of wastewater fee (Hai Phong model);

(2) continuing to leave FSM to the private sector while city enhances control and inspection, and, at the same time, provides financial incentive measures for FS emptiers to bring sludge to the right dumping or treatment sites (Hanoi model);

(3) Increase of desludging fee paid by the household owners, as alternative option apart from option (2) to reach recoverable level for the emptiers. Strict control on FSM will avoid illegal dumping.

(4) Integrated waste management model is applied in the city. Waste flows are treated or co-treated for recovery of resources, for example, biogas, fertiliser, wastewater reclamation, etc. Integration of sustainable waste management concepts should be incorporated into long-term urban planning.

4.4. Financial and Business Model analysis

4.4.1. City level - Hanoi

4.4.1.1. ***Company level financial analysis:***

4.4.1.1.1. Income statements

Income statements of 9 surveyed enterprises are presented in Table 4-13. The analysis has been made for State own enterprise of URENCO 11, for small enterprise HN.02 (with 1 truck each) and medium enterprises (with 2 to 4 trucks each).

URENCO 11 income statement shows the company has a big loss of USD 93,045 per year. This amount is being compensated by the mother company, Hanoi URENCO. The reasons of loss of URENCO 11 business are:

- High capital costs, leading to high depreciation costs for fixed assets of URENCO 11, including Cau Dzien composting plant.
- The enterprise receives limited desludging order from the households in the city. It seems, even though URENCO 11 charges a lower fee for desludging, the enterprise can not compete with private enterprises in hunting and serving customers from the market.
- The Cau Dzien composting plant is operating not at full capacity (actual capacity 4,500 tons per year vs. 13,200 tons per year of design capacity). The output compost product has not high quality. Cau Dzien compost has to compete with other types of organic fertilisers in the market.

Small FSM enterprise HN.02, with an only 1 truck, capital of USD 33,010, and running cost of USD 25,012, can make net (after tax) profit of USD 3,719 per year (data from 2010).

All surveyed medium private enterprises do have benefit in the business. With number of trucks from 2 to 4, capital cost from USD 6,311 per old truck to USD 30,340 per new truck, and running cost from USD 39,595 to USD 70,834 (average USD 58,276), they can make net (after tax) profit from USD 6,085 to USD 12,633 (average USD 8,380) per year (data from 2010).

Money fluxes in a public enterprise HN.01, and average values of money fluxes in private enterprises HN.02 .HN.09 are illustrated in Figure 4-80 and Figure 4-80.

Table 4-13. Income statement of FSM enterprises in Hanoi city (USD)

Item	Public firm	Small private firm	Medium private firms								Private firm
	HN01	HN02	HN03	HN04	HN05	HN06	HN07	HN08	HN09	Average	Average
Input data											
Number of trucks	5	1	2	3	4	3	3	3	3	3.0	**2.8**
Average tank volume, m3	3.7	2.5	2.5	2.7	2.75	3	2.7	4	2.5	2.9	**2.8**
Average cost of new truck		33,010			30,340				16,181		**26,510**
Average cost of second hand truck	14,563		9,223	9,909	6,311	9,385	12,136	11,327	12,136		**10,624**
Average return trip distance, km	35	15	20	30	40	40	25	17	20	27.4	**25.9**
Typical emptying fee, USD/m3	8.4	13.6	12.6	12.6	13.8	12.1	12.6	9.7	11.1		**12.3**
Typical emptying fee, USD/trip		34.0	31.6	33.7	38.1	36.4	33.7	38.8	27.9		**34.3**
Personnel Costs	**54,524**	**9,157**	**25,025**	**27,542**	**24,885**	**35,301**	**43,619**	**39,146**	**36,350**	**33,124**	**30,128**
Registration fees of company and licensing fees for truck	**1,699**	**194**	**194**	**194**	**194**	**194**	**194**	**194**	**194**	**194**	**194**
Registration fees of company	1,699	194	194	194	194	194	194	194	194	194	
Operating costs - Fixed	**12,816**	**3,428**	**4,019**	**5,024**	**5,326**	**5,895**	**4,254**	**5,828**	**4,086**	**4,919**	**4,733**
Office building rent		1,748	2,330	2,913	2,913	3,495	2,330	3,495	2,330	2,829	2,694
Electricity, Water, chemical ...	10,922										10,922
Telephone		583	641	699	874	874	699	874	699	766	743
Electricity		534	408	583	641	583	524	583	408	533	533
Water		117	117	175	204	175	146	117	117	150	146
Misc other costs	631	149	175	218	232	256	185	253	178	214	206
Annual maintenance provision	1,262	298	350	437	463	513	370	507	355	428	412
Operating costs - Variable	**15,259**	**8,900**	**6,540**	**13,952**	**15,259**	**23,718**	**12,262**	**9,388**	**10,900**	**13,145**	**12,615**
Fuel (pumping & transport)	13,872	2,266	5,945	12,683	13,872	21,561	11,147	8,535	9,909	11,950	10,740
Sludge dumping	-	5,825									
Other	1,387	809	595	1,268	1,387	2,156	1,115	853	991	1,195	1,147
Equipment Capital costs											
Insurance costs for trucks	159.22	31.84	127.38	95.53	127.38	95.53	95.53	95.53	95.53	105	96
Truck Depreciation Cost	14,563	3,301	3,689	5,825	8,592	5,631	7,282	6,796	9,709	6,789	6,353
Office equipment depreciation costs	35,000										
Subtotal	49,722	3,333	3,817	5,921	8,720	5,727	7,377	6,892	9,804	6,894	6,449
Revenue Sources											
Emptying (all customers)		29,971	47,709	63,691	67,113	82,573	76,429	78,291	70,340	69,450	64,515
Public Emptying	15,414										
Household emptying	2,018										
Compost sale	21,845										
Subtotal	39,277	29,971	47,709	63,691	67,113	82,573	76,429	78,291	70,340	69,450	64,515
Profit /Loss											
Revenue before Tax	**(94,744)**	**4,959**	**8,113**	**11,059**	**12,729**	**11,738**	**8,723**	**16,843**	**9,006**	**11,173**	**10,396**
Income tax	**-**	**1,240**	**2,028**	**2,765**	**3,182**	**2,935**	**2,181**	**4,211**	**2,251**	**2,793**	**2,599**
Profit (loss) after Tax	**(94,744)**	**3,719**	**6,085**	**8,294**	**9,547**	**8,804**	**6,542**	**12,633**	**6,754**	**8,380**	**7,797**

Table 4-14. Break-even analysis, Hanoi city

Item	State Co.	Small private co.	Medium private companies								Private Co
	HN01	HN02	HN03	HN04	HN05	HN06	HN07	HN08	HN09	Average	Average
Number of truck	5	1	2	3	4	3	3	3	3	3	**2.8**
Truck volume	3.7	2.5	2.5	2.67	2.75	3	2.67	4	2.5	3	**2.92**
Trips/year (2010)	2,016	882	1,512	1,890	1,764	2,268	2,268	2,016	2,520	2,034	**1,890**
Breakeven (trip/year)	9,826	666	1,207	1,462	1,324	1,808	1,953	1,518	2,130	1,629	**1,509**
Breakeven (trip/truck/year)	1,965	666	603	487	331	603	651	506	710	556	**570**

Table 4-15. Scenario 1, 5 years analysis with existing FSM model, Hanoi city

Item	State Co.	Small private co.	Medium private companies								Private Co
	HN01	HN02	HN03	HN04	HN05	HN06	HN07	HN08	HN09	Average	Average
NPV @18% discount rate	(847,079)	1,314	14,364	(3,291)	1,755	18,753	5,833	34,551	(10,435)	8,790	**7,856**
After Tax IRR - 5 years	N/A	20%	90%	-5%	19%	80%	31%	117%	9%	49%	**45%**
Pre-tax IRR - 5 years	N/A	30%	146%	N/A	30%	127%	44%	203%	15%	94%	**85%**
Avg 5 yr monthly cash to operator	(13,416)	289	429	(13)	561	576	326	984	250	445	**425**
Average annual 5 year ROE	-28%	11%	16%	-2%	10%	15%	8%	18%	6%	10%	**10%**
Year of capital recovery within 5 years	No	No	IV	No	No	III	No	III	No		

Table 4-16. Scenario 2, additional payment for all sludge to landfill, 5 years analysis, Hanoi city

Item	State Co.	Small private co.	Medium private companies								Private Co
	HN01	HN02	HN03	HN04	HN05	HN06	HN07	HN08	HN09	Average	Average
NPV @18% discount rate		9,727	14,521	6,055	22,804	(7,878)	28,254	31,140	24,883	17,111	**16,188**
After Tax IRR - 5 years		36%	125%	99%	41%	N/A	127%	130%	44%	94%	**86%**
Pre-tax IRR - 5 years		55%	274%	N/A	64%	N/A	283%	264%	70%	191%	**168%**
Avg 5 yr monthly cash to operator		466	397	126	977	(148)	769	858	995	568	**555**
Average annual 5 year ROE		14%	15%	12%	13%	-11%	15%	16%	13%	10%	**11%**
City subsidy or tariff increase USD/m3		3.9	3.9	6.8	6.8	6.3	5.8	2.4	5.8	5.4	**5.2**
Year of capital recovery within 5 years	No	No	IV	No	No	III	No	III	No		

Table 4-17. Scenario 3, maximum trips per truck and all sludge to landfill, 5 years analysis, Hanoi city

Item	State Co.	Small private co.	Medium private companies								Private Co
	HN01	HN02	HN03	HN04	HN05	HN06	HN07	HN08	HN09	Average	Average
NPV @18% discount rate	(704,715)	3,016	32,659	13,627	152,867	(11,117)	26,594	105,168	(15,838)	43,423	**38,372**
After Tax IRR - 5 years	N/A	23%	314%	156%	290%	-23%	86%	N/A	4%	138%	**121%**
Pre-tax IRR - 5 years	N/A	35%	2390%	8	1530%	N/A	138%	N/A	8%	971%	**815%**
Avg 5 yr monthly cash to operator	(10,082)	327	850	314	4,067	(135)	802	2,622	118	1,234	**1,121**
Average annual 5 year ROE	-109%	12%	23%	7%	26%	-8%	15%	28%	5%	14%	**14%**
Year of capital recovery within 5 years	No	No	II	III	II	No	IV	I	No		

Table 4-18. Scenario 1a, 5 years analysis with existing FSM model and bank loan, Hanoi city

Item	State Co.	Small private co.	Medium private companies								Private Co
	HN01	HN02	HN03	HN04	HN05	HN06	HN07	HN08	HN09	Average	Average
NPV @18% discount rate		(18,763)	3,474	5,964	(53,084)	7,133	(15,659)	14,491	(3,343)	(5,861)	**(7,473)**
After Tax IRR - 5 years		-11%	32%	33%	-23%	38%	-15%	51%	15%	19%	**15%**
Pre-tax IRR - 5 years		-11%	45%	45%	N/A	54%	-21%	73%	23%	37%	**30%**
Avg 5 yr monthly cash to operator		(165)	183	308	(686)	317	(160)	531	447	134	**97**
Average annual 5 year ROE		-1%	9%	9%	-9%	10%	-6%	12%	8%	5%	**4%**
Year of capital recovery within 5 years	No	No	No	No	No	V	No	V	No		

c

Item	State Co.	Small private co.	Medium private companies								Private Co
	HN01	HN02	HN03	HN04	HN05	HN06	HN07	HN08	HN09	Average	Average
NPV @18% discount rate		(11,443)	3,473	20,659	(32,036)	(10,407)	6,327	11,080	31,974	4,439	**2,453**
After Tax IRR - 5 years		-1%	39%	112%	-10%	N/A	38%	49%	50%	46%	**40%**
Pre-tax IRR - 5 years		2%	65%	228%	-11%	N/A	66%	77%	78%	84%	**72%**
Avg 5 yr monthly cash to operator		(13)	146	573	(269)	(194)	269	405	1,191	303	**264**
Average annual 5 year ROE		4%	7%	14%	0%	-15%	7%	10%	14%	5%	**5%**
City subsidy or tariff increase USD/m3		3.88	3.88	6.80	6.80	6.31	5.83	2.43	5.83	5.41	**5.22**
Year of capital recovery within 5 years	No	No	No	III	No	No	No	III	V		

Table 4-19.Scenario 3a, maximum trips per truck and all sludge to landfill, with bank loan, 5 years analysis, Hanoi city

Item	State Co.	Small private co.	Medium private companies								Private Co
	HN01	HN02	HN03	HN04	HN05	HN06	HN07	HN08	HN09	Average	Average
NPV @18% discount rate		(14,859)	21,769	34,047	70,008	(27,738)	5,101	79,350	1,268	26,258	**21,118**
After Tax IRR - 5 years		-5%	141%	134%	86%	N/A	29%	6	19%	170%	**145%**
Pre-tax IRR - 5 years		-4%	269%	242%	137%	N/A	40%	N/A	28%	143%	**119%**
Avg 5 yr monthly cash to operator		(77)	604	951	2,165	(510)	316	2,035	548	873	**754**
Average annual 5 year ROE		2%	19%	19%	20%	41%	8%	26%	9%	20%	**18%**
Year of capital recovery within 5 years	No	No	III	III	III	No	No	II	No		

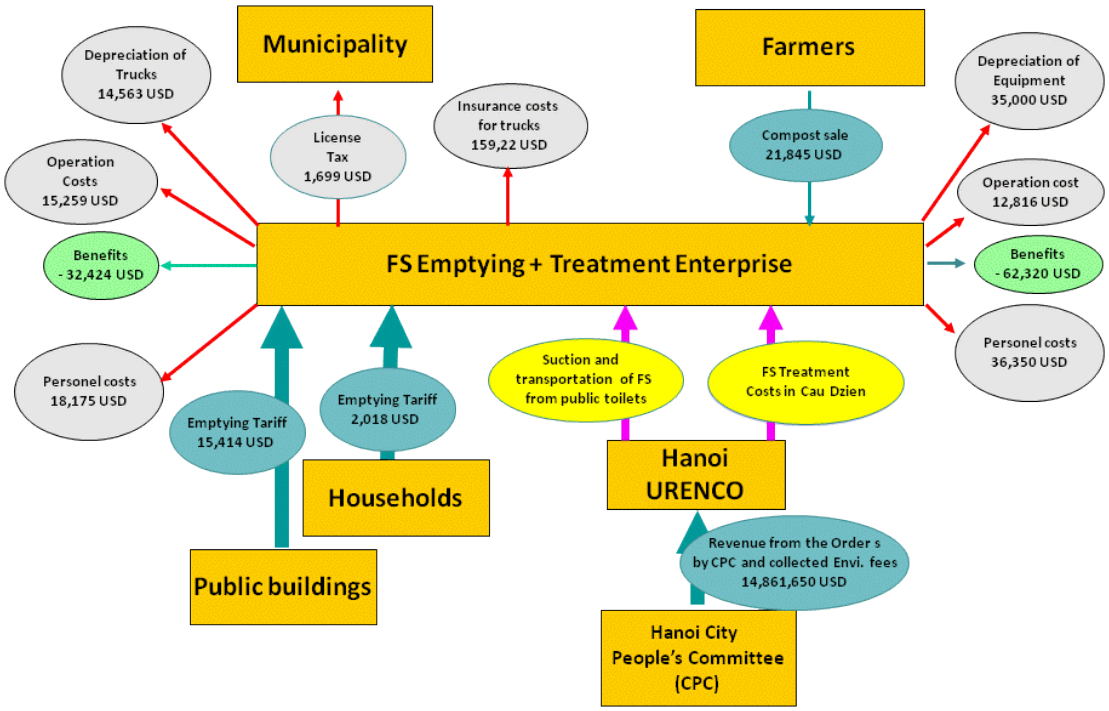


Figure 4-80. Money fluxes in a public utility HN.01

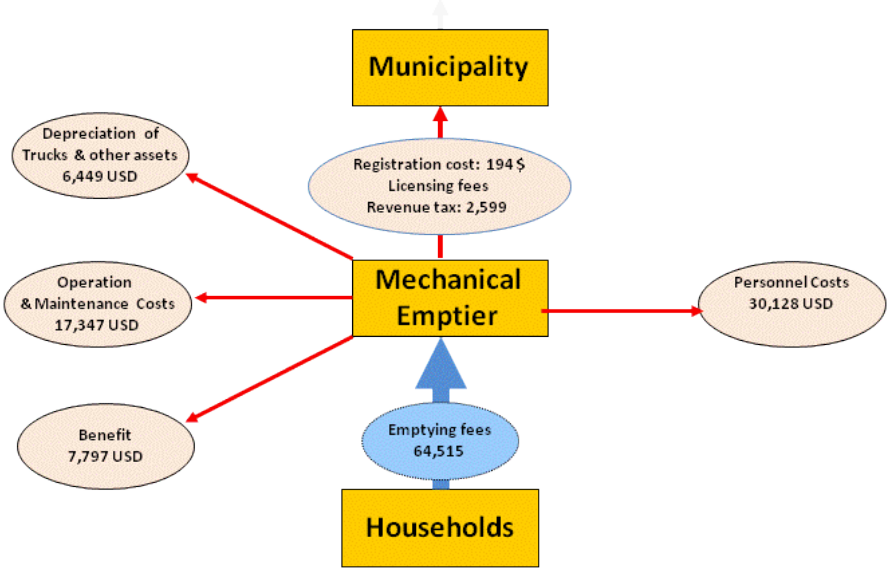


Figure 4-81. Average values of money fluxes in Hanoi private enterprises HN.02 … HN.09

4.4.1.1.2. Breakeven analysis

Break-even analysis (Table 4-14) confirms the findings from Income statement. Due to high capital and running costs, HN01 (Hanoi URENCO 11) should have more trips made in order to cover expenditures (9,826 trips per year, versus current total number of trips 2,016 in 2010). Meanwhile, all private enterprises are trying to reduce expenditures and maximize benefits. With volume of tank ranging from 2.5 to 4 m^3, the current number of trips of all private enterprises is more than their respective break-even points, making average number of

trips per enterprises is 2,034 trips (or 556 trips per truck per year) versus break-even point 1,629 trips per year.

4.4.1.1.3. IRR, NPV, Cash Flow and ROE

Scenario 1 (keeping the same FSM model, 5 year financial projection):

The analysis has been conducted with the local discount rate of 18%. For URENCO 11 (HN.01), after 5 years projection, under the same working environment in the FSM, all financial indicators are still negative. NPV<0, IRR<0 and average ROE <0 show Cau Dzien waste treatment enterprise still needs a cross-subsidy from other activities of the Hanoi URENCO.

Results of scenario 1 analysis show that: keeping the same model of FSM, in the coming 5 years, the average Rate of return on equity (ROE) at all private enterprises is 10%. However, there only HN.03, HN.06 and HN.08 can get their capital recovery within a period less than 5 years: HN.06 and HN.08 can get recovered within 3 years, HN.03 gets recovered within 4 years. For other private enterprises, low average annual 5 year ROE (from -2 to 11%) show they need more time to get recovered. The picture shows private enterprises are running business with somehow modest benefit. Under strong competitive market conditions, enterprise would hardly increase their travel distance to bring sludge to the right sites.

Scenario 2 (significant increase of desludging fee, or payment from city budget for sludge brought into legal dumping sites):

In scenario 2, in order to bring all sludge to the designated city's landfill or composting plant, additional payment on each emptied m^3 of sludge should be required, so that firm still can have a benefit in the business while going further (for 20 km per trip in average). Additional minimum desludging fee required is ranging from VND 50,000 (or USD 2.43, for HN.08) to VND 140,000 ((or USD 6.80, for HN.04 and HN.05) per m^3 of sludge delivered to the composting plant. In average, the amount of VND 107,500 (USD 5.22) per m^3 of sludge delivered to the composting plant should be charged additional to the households, or, subsidized by the city's budget. With that minimum additional payment, however, there only 3 firms can find capital recovery within 5 years: HN.03 (after 4 years), HN.06 (after 3 years) and HN.08 (after 3 years).

Scenario 3 (maximizing number of trips per truck thanks to available market size, increase of business marketing and legal enforcement in frequent desludging by the city, sludge is brought into designated dumping or treatment sites):

In this scenario, private enterprises will utilize maximum capacity of their available trucks. Maximum number of trips per day is 4. City or household will not pay additional fee to the sludge emptiers, even though all sludge is considered to be delivered to the right designated site in the city. The results show some private operators will face risk of financial loss in their business, especially for the ones who have currently high expenditures and number of trips per is close to the maximum values (break-even number of trips per truck per year). In compare with previous scenarios, there are more enterprises which can find capital

recovery within 5 years: HN.08 (after 1 year), HN.03, HN.05 (after 2 years), HN.04 (after 3 years) and HN.07 (after 4 years).

4.4.1.2. Access to finance and analysis of scenarios where private enterprises are getting bank loans to run business

For the small and medium enterprises, it is not easy to get loans from the commercial banks due complexity in administrative procedures and difficulties in mobilizing of legal properties for mortgage. Besides, high interest rates of the bank loans due to hot growth of the real estate market create significant pressure on any business proposal in getting loans.

In the successful cases, banks often provide as much as 70% of the value of the business at the Interest rates around 18%/year. The rest 30% has to be paid from the own capital of the enterprises.

3 scenarios 1a, 2a and 3a have been analyzed for Hanoi private enterprises where they borrow the loans from the bank to run the business keeping the same FSM model as in scenarios 1, 2, and 3 respectively.

Scenario 1a (borrowing loan from the bank for 70% of capital invest of the enterprise, keeping the same FSM model, 5 year projection of finance):

Payment for the bank loan interest (18%/year) becomes a significant payment in the firm's expenditures. Even though the model of FSM is assumed to be kept as presence, i.e. sludge is still not brought to the right landfill, most of enterprises will face the risk of financial loss in their business (HN.02, HN.05, HN.07, HN.09). There only HN.06 and HN.08 will find their capital recovery within 5 years.

Scenario 2a (borrowing loan from the bank, plus increase of desludging fee by household, or equal payment from city budget for sludge brought into legal dumping sites):

Different levels of desludging fee increase (equal to different payments from the city budget) were tried. VND 107,500/m^3 (USD 5.22/m^3) is average acceptable rate where enterprises can keep the same level of profits in FSM business, going further (for 20 km per trip in average), paying more expenditures, brining sludge to the city's treatment site under the condition that enterprises have to get loans from the bank to run their business. There only 3 private enterprises can find their capital recovery within 5 years period: HN.04, HN.08 (after 3 years) and HN.09 (after 5 years).

Scenario 3a (borrowing loan from the bank, maximizing number of trips per truck):

Sludge is brought into designated dumping or treatment sites. In order to keep profit, private enterprises should utilize their maximum truck capacity. There private enterprises HN.03, HN.04, HN.05 and HN.08 still can find capital recovery within 5 years, where HN.02, HN.06 will face the financial losses.

4.4.1.3. Role of public sector in business sustainability

Currently business of FSM private enterprises does not cross cut any public activity. Their own run marketing, desludging and illegal dumping of emptied sludge does not get any support from the city authorities.

Hanoi has been conducting the 3R (reduction, reuse, recycle) project since 2006, with at source separation of solid waste campaigns and capacity building activities for the Hanoi URENCO. The project is funded by Japanese budget and technically supported by JICA. Separated organic waste from 4 pilot wards in Hanoi urban area is being transported to the Cau Dzien composting plant for making compost fertilizer. Brought to Cau Dzien fecal sludge is also being co-composted. Expansion of the 3R project and implementation of appropriate marketing strategy for the compost product may bring a better business situation for the Cau Dzien composting plant which should receive emptied sludge from the toilets. Further, the capacity of the composting plant should be increased. Hanoi is currently considering to invest in a new module of a fecal sludge treatment station in Cau Dzien.

Awareness raising for frequent desludging of household and public septic tanks can be made with efforts not only of private service providers, but also by players from public sector such as public utilities (Sewerage and Drainage company, Urban Environment company), local authorities at ward, district and city levels, schools and universities, NGOs, etc. Good experiences in awareness rising for septic tank emptying have been recognized in some urban environmental sanitation projects such as World Bank 1B project in Hai Phong (2000 – 2009), Danida project in Buon Ma Thuot (2001 – 2009), etc. With prevailing percentage of septic tank number among on-site sanitation facilities in the Vietnamese cities, frequent desludging of septic tanks will assure sustainable market for the desludging, transportation, treatment and reuse business (see results of Scenario 3 in the company level business analysis).

Strict control in fecal sludge dumping by the city authorities and the public will also certainly impact on the business behaving of the private FSM enterprises. Strong penalties applied to illegal dumping cases will force enterprises reconsider their sludge transportation and dumping. As shown in Scenario 2 analysis, additional charges for emptied and delivered sludge volume should be applied in order to keep private FSM business profitable.

4.4.1.4. Business analysis of Treatment Plants in Hanoi city

Business of treatment plant Cau Dzien in Hanoi city has been analyzed as it is Hanoi URENCO 11 (numbered HN.01 in this study).

Actual capacity of the Cau Dzien composting plant is from 2,000 to 5,000 tons of compost per year. About 70% of fertiliser used in Vietnam is imported. Price of organic fertilisers, made locally from agricultural waste, organic solid waste, animal and human wastes, etc. is much lower. However, there is only small portion of the market use from that type of fertiliser. Besides Cau Dzien composting plant in Hanoi, with design capacity of 50,000-100,000 tons of organic waste input per year and 13,600 tons of compost product output per year, there are 4 other large composting plants contributing to the total design capacity of compost product 22,000 tons per year, which is equal to 8.2% of the total organic fertilizer needs in the Red river delta. The actual capacity of compost fertilizer in the North of Vietnam is 12,500-15,000 tons per year. There are also some private firms such as Song Gianh, Humix,

Thien Nong producing organic fertilizers from other sources and supplying around 15,000 tons of organic fertilizer per year to the northern provinces.

The reasons of low sale of Cau Dzien compost in compare with others are:

- Not competitive price;
- Low product quality;
- Limited effective marketing and after sale service.

Compost made by Cau Dzien has a good quality in terms of nutrients compared with Vietnamese standard foor fertiliser, issued under Decision No. 100:2008/QD-BNN of the MARD on October 15th, 2008. However, Cau Dzien compost exceed standards for Arsen and Coliforms. High standard in term of Arsen (<2 mg/kg dry weight) and mixed up composition of poorly separated are main causes. Presence of sand and other substances are also limitation of Cau Dzien compost.

Current after tax loss of HN.01 FSM business is USD 93,045 per year. This loss is currently cross-subsidized by the mother public utility of Hanoi URENCO who relies on the major budget sources of household environmental sanitation fees, for the solid waste collection, and compensated by the city budget.

4.4.1.5. Recommendations for sustainable FSM business models in Hanoi city

Current business model of FSM in Hanoi is not sustainable. Private enterprises are mostly applying illegal dumping method. Advocacy and enforcement efforts by the city authorities to control the FSM activities are limited. Composting plant is running with low capacity, and producing product with low quality. Awareness raising campaigns on FSM and resource recovery are not conducted, or conducted with limited results in the city.

State own enterprise is also running FSM activity, but not considering it as a business. Cross-subsidy by other enterprise under the public utility of Hanoi URENCO is being made in order to keep the FSM activities within the enterprise.

Private enterprises are competing, practicing illegal dumping of the emptied sludge to minimize expenditures and maximize business profits.

As shown in Scenario 1a of the financial analysis, in case of borrowing money from the bank with the current interest rates, number of private enterprises may face debt in their business profile in the 5 year run.

In order to control illegal dumping of fecal sludge in Hanoi, more enforcement from the city authorities should be applied. All private enterprises who are dealing with fecal sludge emptying should bring sludge into the legal sites for treatment and resource recovery. Strict inspection of the firm registration, truck regular check, tax payment and report, certification upon sludge delivery to the treatment or dumping sites, etc. should be applied. Besides, public supervision on illegal dumping is another efficient FSM control measure which is currently applied in some cities like Ho Chi Minh, Binh Dzuong, etc.

Out of the growth of desludging fee due to inflation, in order to keep profit, additional charge from septic tank owners or, from the city budget should be made. VND 107,500/m^3, or USD 5.22/m^3 should be applied, making total desludging fee of USD 17.52/m^3 instead of current USD 12.3/m^3 (added up 42%) in case all sludge is brought into city's treatment or dumping sites.

Further, city authorities should build up more fecal sludge receiving and treatment stations. Appropriate allocation of the stations would reduce running costs for the sludge transportation. Since there is still very high demand of the market in the compost fertiliser product, appropriate marketing and sales strategy should be taken besides application of large scale source separation and improvement of composting technology.

Besides composting, or co-composting with organic waste, Hanoi should look for other fecal sludge treatment technologies which may be more appropriate. Co-digestion of fecal sludge with organic waste from restaurants, markets, agriculture waste, etc. for biogas recovery and composting of digested sludge for making fertiliser; sludge drying and incineration as fuel source, etc. are among potential technologies to be considered.

4.4.2. City level – Hai Phong city

4.4.2.1. *Company level financial analysis:*

4.4.2.1.1. Income statements

Income statements of 4 surveyed enterprises are presented in (Table 4-21). The analysis has been made for the state own enterprise of HP SADCO (HP.01), for 2 medium enterprises HP.03 and HP.04 (with 3 trucks each) and 1 large enterprise HP.02 (with 12 trucks).

HP SADCO income statement shows the company has a loss of USD 43,232 per year. This amount is being compensated by the revenue from other activities at the company. The reasons of loss of HP SADCO in FSM business are:

- High capital costs, leading to high depreciation costs for fixed assets of HP SADCO, including Trang Cat sludge treatment plant.
- The enterprise serves limited number of households, industries and other customers under the servce base. The Company focuses on free-of-charge desludging for the houholds according to the schedulded program. As an order from the city, the expenditures for scheduled desludging are paid by a part of wastewater fees (around 4 – 8% of total wastewater fee revenue). This activity does not bring ''benefit'' in the company financial balance.
- Trang Cat sludge treatment plant is now operating, but it receives only dredged sludge from city sewers, canals, and scheduled sludge collected by HP SADCO. Due to limited capacity, lack of enforcement and clear guidance, no one private enterprise delivers sludge to Trang Cat. This might also increase expenditures of the FS emptiers.
- Trang Cat treatment plant has good infrastructure and equipment base. However, due to low technology of compost production and unseparated feeding materials, quality of compost is not high and it has very limited commercial value for the

market. So far, over last 5 years, Trang Cat just has sold the first portion of compost product to the public utility company who is taking care of green spaces in the city. The value of contract was small (VND 15 million or USD 728). Trang Cat compost has to compete with other types of organic fertilisers in the market.

All surveyed private enterprises in Hai Phong do have benefit in their FSM business. With number of trucks 3 per company, annualized capital costs from USD 4,659 to USD 4,756 (average USD 4,707) and running cost from USD 20,815 to USD 23,182 (average USD 21,998), the medium enterprises can make net (after tax) profit from USD 9,397 to USD 21,962 (average USD 15,679).

A large private enterprise in Hai Phong (HP.02) has 12 trucks. With annualized capital costs of USD 15,916 and running cost of USD 57,655, the enterprise makes a net (after tax) profit of USD 26,000 per year (data from 2010).

Money fluxes in a public enterprise HP.01, and average values of money fluxes in private enterprises HP.02 .HP.04 are illustrated in Figure 4-80 and Figure 4-80.

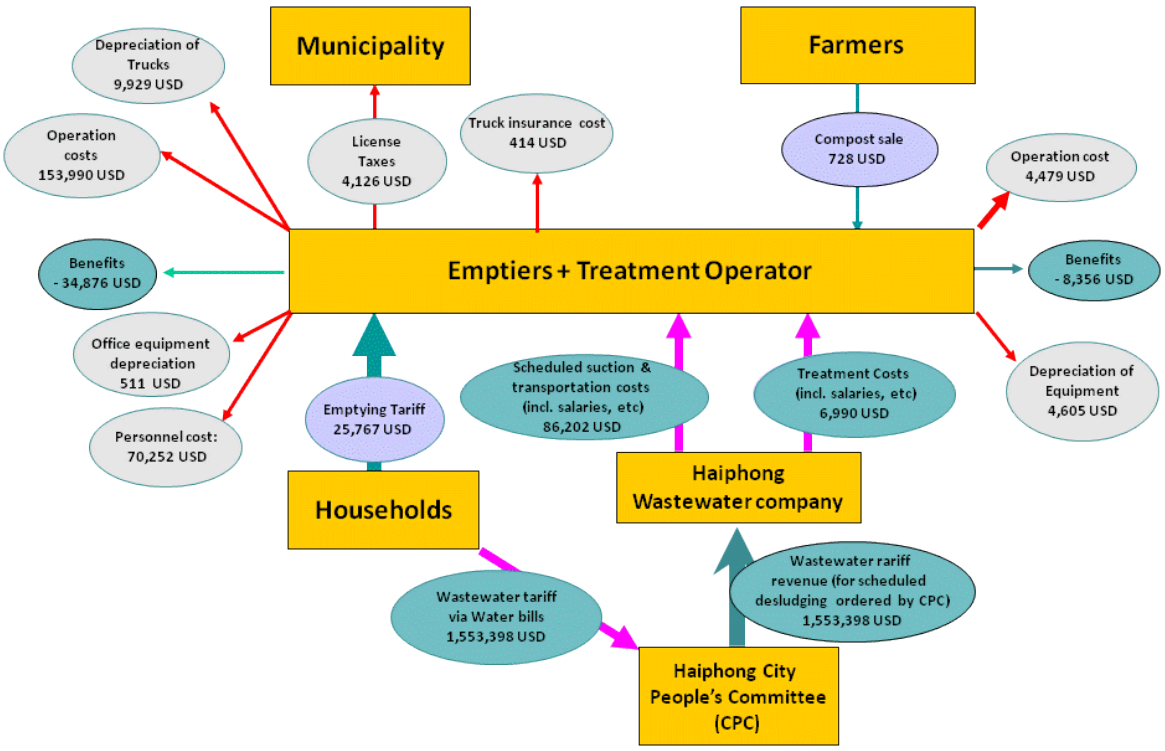


Figure 4-82. Money fluxes in a public utility HP.01

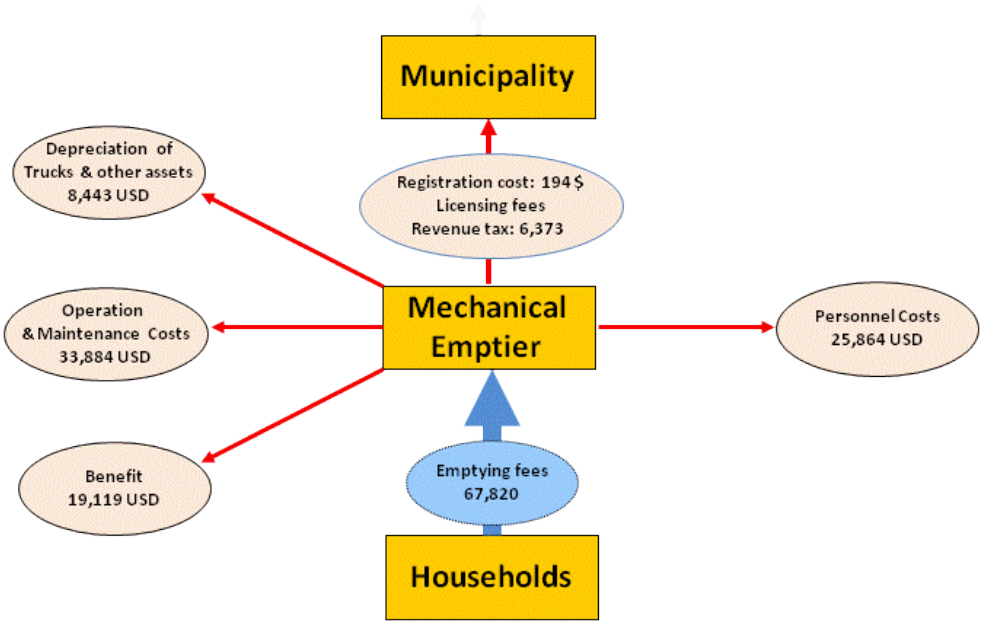


Figure 4-83. Average values of money fluxes in Hai Phong private enterprises HP.02 … HN.04

Table 4-20. Income statement of FSM enterprises in Hai Phong city (USD)

Item	State Co.	Medium private Co.			Large private Co.	Private Co.
	HP01	HP03	HP04	Average	HP02	Average
Number of trucks	13	3	3	3	12	**6**
Average tank volume, m3	2.8	2.5	2.0	2.3	2.8	**2.4**
Average cost of new truck	53,058	12,427		12,427		**12,427**
Average cost of second hand truck		7,767	7,605	7,686	6,472	**7,281**
Average return trip distance, km	35.0	15.0	15.0	15.0	15.0	**15.0**
Typical emptying fee, USD/m3	12.3	14.3	10.7	12.5	13.6	**12.9**
Typical emptying fee, USD/trip	34.2	36.3	21.4	28.85	35.8	**31.2**
Personnel Costs	**70,252**	**16,078**	**14,680**	**15,379**	**46,835**	**25,864**
Registration fees of company and licensing fees for truck	4,126	194	194	194	194	194
Operating costs - Fixed	**48,626**	**1,273**	**4,220**	**2,747**	**4,086**	**3,193**
Office building rent	-	-	2,330	1,165	2,330	1,553
Telephone	5,894	583	583	583	699	621
Electricity	20,629	408	583	495	408	466
Water	17,682	117	175	146	117	136
Other costs		55	183	119	178	139
Annual maintenance	4,421	111	367	239	355	278
Operating costs - Variables	**17,465**	**3,270**	**4,087**	**3,679**	**6,540**	**4,632**
Fuel (pumping & transportation)	15,877	2,973	3,716	3,344	5,945	4,211
Sludge dumping			-	-		-
Others	1,588	297	372	334	595	421
Total Operating Costs	**140,469**	**20,815**	**23,182**	**21,998**	**57,655**	**33,884**
Equipment Capital costs						
Insurance costs for trucks, vehicles	413.98	95.53	95.53	96	382.14	191
Truck Depreciation Cost	9,929	4,660	4,563	4,612	15,534	8,252
Office equipment depreciation costs	511					
(Trang Cat landfill) Fixed asset depreciation	4,605					
Sub-total	**15,460**	**4,756**	**4,659**	**4,707**	**15,916**	**8,443**
Revenue Sources						
Emptying (all customers)	86,202	54,853	40,369	47,611	108,238	67,820
Service revenue	25,767					
Compost sale	728					
Sub-total	**112,697**	**54,853**	**40,369**	**47,611**	**108,238**	**67,820**
Profit /Loss						
Revenue before Tax	**(43,232)**	**29,283**	**12,529**	**20,906**	**34,666**	**25,493**
Revenue Tax	**-**	**7,321**	**3,132**	**5,226**	**8,667**	**6,373**
Profit (loss) after Tax	**(43,232)**	**21,962**	**9,397**	**15,679**	**26,000**	**19,119**

Table 4-21. Break-even analysis, Hai Phong city

Item	State company	Medium private Co.			Large private Co.	Private Co.
	HP01	HP03	HP04	Average	HP02	Average
Number of truck	13	3	3	3.0	12	**6.0**
Truck volume	2.79	2.53	2	2.3	2.63	**2.5**
Trips/year (2010)	13,104	1,512	1,890	1,701	3,024	**2,142**
Breakeven (trip/year)	18,485	648	1,227	938	1,987	**1,288**
Breakeven (trip/truck/year)	1,422	216	409	313	166	**264**

Table 4-22. Scenario 1, 5 years financial analysis with existing FSM model, Hai Phong city

Item	State company	Medium private Co.			Large private Co.	Private Co.
	HP01	HP03	HP04	Average	HP02	Average
NPV @18% discount rate	(207,566)	69,081	31,734	50,408	83,554	**61,456**
After Tax IRR - 5 years	N/A	144%	158%	151%	112%	**138%**
Pre-tax IRR - 5 years	N/A	287%	301%	294%	183%	**257%**
Avg 5 yr monthly cash to operator	(4,305)	1954	872	1413	2404	**1743**
Average annual 5 year ROE	219%	23%	21%	22%	19%	**21%**
Year of capital recovery within 5 years	No	III	III		III	

Table 4-23. Scenario 2, additional payment for all sludge to landfill, 5 years analysis, Hanoi city

Item	State company	Medium private Co.			Large private Co.	Private Co.
	HP01	HP03	HP04	Average	HP02	Average
NPV @18% discount rate		63,216	31,516	47,366	265,484	**120,072**
After Tax IRR - 5 years		89%	116%	103%	121%	**109%**
Pre-tax IRR - 5 years		132%	182%	157%	144%	**153%**
Avg 5 yr monthly cash to operator		2031	951	1491	8608	**3863**
Average annual 5 year ROE		19%	14%	17%	14%	**16%**
Subsidy from city budget (USD/m3)		No need	1.94	1.94	0.97	**1.46**
Year of capital recovery within 5 years	No	III	IV		V	

Table 4-24. Scenario 3, maximum trips per truck and all sludge to landfill, 5 years analysis, Hanoi city

Item	State company	Medium private Co.			Large private Co.	Private Co.
	HP01	HP03	HP04	Average	HP02	Average
NPV @18% discount rate		196,469	49,511	122,990	1,049,316	**431,766**
After Tax IRR - 5 years		N/A	232%		N/A	**232%**
Pre-tax IRR - 5 years		N/A	606%		N/A	**606%**
Avg 5 yr monthly cash to operator		5,130	1383	3256	26855	**11,123**
Average annual 5 year ROE		31%	23%	27%	39%	**31%**
Year of capital recovery within 5 years	No	I	II		I	

Table 4-25. Scenario 1.a, with existing FSM model and bank loan, 5 years financial analysis, Hai Phong city

Item	State company	Medium private Co.			Large private Co.	Private Co.
	HP01	HP03	HP04	Average	HP02	Average
NPV @18% discount rate		(6,615)	18,265		40,554	**17,401**
After Tax IRR - 5 years		13%	79%		50%	**48%**
Pre-tax IRR - 5 years		21%	116%		76%	**71%**
Avg 5 yr monthly cash to operator		463	567		1,531	**854**
Average annual 5 year ROE		23%	17%		16%	**19%**
Year of capital recovery within 5 years		No	IV		IV	

Table 4-26. Scenario 2a, additional payment for all sludge to landfill and bank loan, 5 years analysis, Hanoi city

Item	State company	Medium private Co.			Large private Co.	Private Co.
	HP01	HP03	HP04	Average	HP02	Average
NPV @18% discount rate		(28,675)	11,003		17,830	**53**
After Tax IRR - 5 years		-2%	57%		32%	**29%**
Pre-tax IRR - 5 years		1%	83%		49%	**44%**
Avg 5 yr monthly cash to operator		(54)	380		980	**436**
Average annual 5 year ROE			13%		13%	**13%**
Subsidy from city budget (USD/m3)	-	No need	1.94		0.97	**1.46**
Year of capital recovery within 5 years		No	V		V	

Table 4-27. Scenario 3a, maximum trips per truck and all sludge to landfill, with bank loan, 5 years analysis, Hanoi city

Item	State company	Medium private Co.			Large private Co.	Private Co.
	HP01	HP03	HP04	Average	HP02	Average
NPV @18% discount rate	692,501	1	3	2	N/A	**2**
After Tax IRR - 5 years	N/A	129%	2503%	1316%	N/A	**1316%**
Pre-tax IRR - 5 years	N/A	163168%	60621%	111895%	15,127	**5,788**
Avg 5 yr monthly cash to operator	16,759	3,357	1,189	2,273	20,626	**8,391**
Average annual 5 year ROE	41%	23%	24%	24%	40%	**29%**
Year of capital recovery within 5 years	No	III	II		I	

4.4.2.1.2. Breakeven analysis

Break-even analysis (Table 4-21) confirms the findings from Income statement. Due to high capital and running costs, HP.01 (Hai Phong SADCO) can not cover its expenditures. All private enterprises run business where all have actual number of trips is more than break-even points and do have profit.

4.4.2.1.3. IRR, NPV, Cash Flow and ROE

Scenario 1 (keeping the same FSM model, financial analysis for 5 year projection):

In Scenario 1, wastewater fee will be increased from current 15% surcharge to water bill, up to 20% surcharge in 2012, and 25% surcharge in 2015. This wastewater fee increase follows Hai Phong commitment as agreed in the World Bank project 1B (2000 – 2009). Besides amount of fecal sludge desludged by the HP.01 under schedule for free of charge, HP.01 and all private enterprises are providing fecal sludge emptying service for other households, and for all commercial, industrial and public buildings. No one private enterprise brings sludge to Trang Cat landfill.

Results of Scenario 1 analysis show that: keeping the same model of FSM, in the coming 5 years, the average Rate of Return on Equity (ROE) at all private enterprises is ranging from 21 to 23% (in average 21%).

NPV after 5 years at all small and medium enterprises (HP.02 ... HN.04) > 0; IRR > 18% (18% is a bank interest rate over last years in Vietnam).

All private enterprises in Hai Phong can find full capital recovery within 3 years period.

For HP SADCO (HP.01), after 5 years projection, under the same working environment in the FSM, all financial indicators are still negative. Enterprise needs a cross-subsidy from other activities of the HP SADCO which are paid by the city or by other sources of budget.

Scenario 2 (all sludge to the Trang Cat landfill, with additional fee, 5 year financial projection):

Scenario 2 is made with assumptions all sludge will be delivered to the landfill and composting plant in Trang Cat. In order to bring sludge for a longer distance for a proper treatment and reuse, the companies need additional payment to cover their running expenditures. The amount of additional fee required for each m^3 of sludge delivered to the landfill will be ranging from 0 (in case of HP.03) to VND 40,000 (USD 1.94, in case of HP.04). HP.02 and HP.04 will find capital recovery in the year 5 and year 4, respectively, while HP.03 will find capital recovery in the year 3.

Scenario 3 (all sludge to the Trang Cat landfill, no additional fee, maximum number of trips per truck, 5 year financial projection):

Scenario 3 is made with assumptions all sludge will be delivered to the landfill and composting plant in Trang Cat. In order to bring sludge for a longer distance for a proper treatment and reuse, the companies need to maximize their marketing and service

performance so that maximum number of trucks, and maximum number of trips per truck would be utilized to keep their benefit. With increased revenue, HP.02 and HP.03 will find capital recovery right in the year 1, while HP.04 will find capital recovery in the year 2.

4.4.2.2. Access to finance and analysis of scenarios with bank loans

There is a very similar situation for private enterprises in Hai Phong city to get loans from the bank as in Hanoi (see paragraph 4.4.1.2). The 3 scenarios are analyzed for private enterprises in Hai Phong city as follows.

Scenario 1.a (borrowing loans from the bank for 70% of capital invest of the private enterprise, keeping the same FSM model, 5 year financial projection):

Scenario 1.a is made with assumptions the private enterprises have to get a loan from the bank to run their business. Among 3 analyzed private enterprises, HP.03 will face the risk of financial loss in its business, where HP.02 and HP.04 still make benefits and find capital recovery in the year 4.

Scenario 2.a (borrowing loans from the bank for 70% of capital invest of the private enterprise, all sludge to the Trang Cat landfill, with additional fee, 5 year financial projection):

Scenario 2.a is made with assumptions the private enterprises have to get a loan from the bank to run their business, but, in order to bring sludge for a longer distance to the Trang Cat landfill for proper treatment and reuse, the companies need additional payment to cover their running expenditures. The amount of additional fee required for each m^3 of sludge delivered to the landfill will be ranging from 0 (in case of HP.03) to VND 40,000 (USD 1.94, in case of HP.04). HP.02 and HP.04 will find capital recovery in the year 5.

Scenario 3.a (borrowing loans from the bank for investment, all sludge to the Trang Cat landfill, maximum trips instead of fee increase, 5 year financial projection):

Scenario 3.a is made with assumptions the market will be available while private enterprises, in order to keep business profitable with bank loans, will exploit maximum number of trips per truck, and all trucks in business.

All private enterprises will make profit without additional fees paid for the sludge delivery to landfill. HP.02 will find capital recovery right in the year 1, HP.02 – in the year 3, and HP.04 in the year 2. From the point of view of FSM business, this scenario seems most appropriate for the case of Hai Phong city.

4.4.2.3. Role of public sector in business sustainability

Hai Phong is a first city in Vietnam who has increased wastewater tariff higher than 10%, and planning to increase wastewater tariff gradually to meet commitment stated in the sanitation project 1B (WB). From 2005 the city has changed the FSM structure in the city while considering septic tank is one component of the city's sewerage and drainage system. Authorization for Hai Phong Sewerage and Drainage Company to run the FSM business, providing budget from wastewater fee collection for the scheduled desludging are valuable efforts by the Hai Phong city authorities.

Awareness raising campaigns started since 1B project are now being conducted by Hai Phong Sewerage and Drainage Company. The Company has created a special Unit taking care of customers' relations and delivery of FSM service. For scheduled desludging, the Company cooperates closely with the local authorities who have contact and access to every household. Awareness rising for households is conducted by the Company, and also by the local Women's Union who was under the 1B project in charge of running the Revolving Fund for the low income households to borrow money for upgrading the toilet and septic tank.

So far in Vietnam there is only Hai Phong city applying FSM model with key acting role of the Sewerage and Drainage Company. With built up capacity from the World Bank project the Company can handle with the FSM component even though this component is still not considered as business as it does not have any profit. Keeping going schedule desludging, further increase of wastewater tariff, and improvement of treatment system for compost sale are the issues to be realized by Hai Phong Sewerage and Drainage Company in order to make their FSM business more sustainable.

4.4.2.4. Business analysis of Treatment Plants in Hai Phong city

Business analysis of a single Trang Cat waste treatment plant in Hai Phong city has been done and provided as one component of the Hai Phong Sewerage and Drainage Company (HP.01, see paragraph 4.4.2.1.). The loss of USD 43,232 per year is being compensated by the revenue from other activities at the company. As mentioned above, the reasons of financial loss of HP.01 in FSM component are high capital costs of vacuum trucks and other fixed assets at the Trang Cat sludge treatment plant purchased from the WB 1B project; running expenses for the scheduled desludging for the households is covered by the city, not by the households; compost product from Trang Cat has a limited commercial value for the market and cannot be sold.

4.4.2.5. Recommendations for sustainable FSM business models in Hai Phong city

In Hai Phong city, the amount of fecal sludge emptied under scheduled program (free-of-charge) is 7,618 m^3, while the volume of sludge emptied under service basis (household pays) by HP SADCO is 1,980 m^3 (HP SADCO 2010 data). The sludge amount emptied by HP SADCO makes 12% of the estimated total volume of fecal sludge emptied in the city (reported 9,598 m^3 out of estimated 80,569 m^3). Only HP SADCO's sludge is brought into Trang Cat waste treatment plant for composting and dumping. The rest amount of fecal sludge is emptied by 10 private enterprises and dumped, in most of cases, illegally. Even though Hai Phong FSM model seems more advancing in compare with badly controlled situation in Hanoi and Ho Chi Minh cities, but there are still some negative points in Hai Phong as follows:

- 4 to 6% of budget coming from collected wastewater fee is paid for the scheduled desludging. Wastewater fee is still low. Expenditures are more than revenues, and HP SADCO now should have a cross-subsidy for the FSM part from its other activities.

- Capacity of FSM equipment and infrastructure of HP SADCO is not fully utilized yet. Very small income is collected from composting sale, while company's expenditures are huge due to depreciation.
- Private sector takes part in FSM but they are not bringing sludge to the right place. Enterprises still can not utilize trucks at their maximum capacity because of competition. At presence, enterprises are still making profits. However, if they have to get a loan from the bank to start and to run their business, loss may occur.
- If all septic tanks and pits are emptied regularly as required (at least one per two years for septic tanks, once per year for pit latrines), the total volume of sludge to be emptied from Hai Phong urban area market is estimated as 166,466 m^3 (see Table in paragraph 4.4.4.1). The current volume of sludge emptied by all enterprises is 80,569 m^3 or 48%. There is big market potential for enterprises to increase their activities and revenues.

From above described analyses, possible solutions for Hai Phong to improve FSM model will be made as follows:

- To keep a major role for FSM in the city of the HP SADCO. Wastewater fee will be increased as comitted with WB and to cover running costs of the HP SADCO.
- To improve marketing activities for regular septic tank and pit desludging.
- To improve organization of works so that all trucks can make a maximum number of trips per day. Besides household awareness rising and marketing enhancement, maximum explotation of trucks in business will help enterprises to increase their revenue and keep business profitable even when bank loans and long distance delivery of sludge are applied.
- To set up legal framework for FSM activities including control for sludge emptying, transportation and dumping activities. Emptied sludge should be brought into treatment sites.
- To improve treatment process and to enhance marketing for increase of compost production and sale.

4.4.3. City level – Ho Chi Minh City

4.4.3.1. *Company level financial analysis:*

4.4.3.1.1. Income statements

Income statements of 6 surveyed enterprises are presented in Table 4-28. The analysis has been made for State own enterprise of CITENCO, for small enterprises (with 1 truck each), medium enterprises (with 2 to 4 trucks each), and large enterprises (5 trucks each and more).

A public utility CITENCO (HCM.01) income statement shows the company has a net (after tax) profit of USD 182,101 per year. The company has very important revenue from lease of public toilet cabins (including lease of cabins and desludging for cabins) which is even more than revenue from its major activity in FSM (USD 260,971 vs. USD 198,240).

All surveyed private enterprises in Ho Chi Minh City do have benefit in their FSM business. A small private enterprise HCM.06 has annualized capital costs USD 16,480 and running costs USD 17,169, after tax benefit USD 6,220. With number of trucks from 2 to 5 per company, annualized capital costs from USD 6,160 to USD 24,982 (average USD 14,706) and

running cost from USD 40,658 to USD 60,202 (average USD 50,757), the medium enterprises can make net (after tax) profit from USD 17,768 to USD 87,103 (average USD 42,519).

A large private enterprise in Ho Chi Minh City (HCM.03) has 6 trucks. With annualized capital costs of USD 14,803 and running cost of USD 72,895, the enterprise makes a net (after tax) profit of USD 38,269 per year (data from 2010).

Money fluxes in a public enterprise HCM.01, and average values of money fluxes in private enterprises HCM.02 .HCM.06 are illustrated in Figure 4-80 and Figure 4-80.

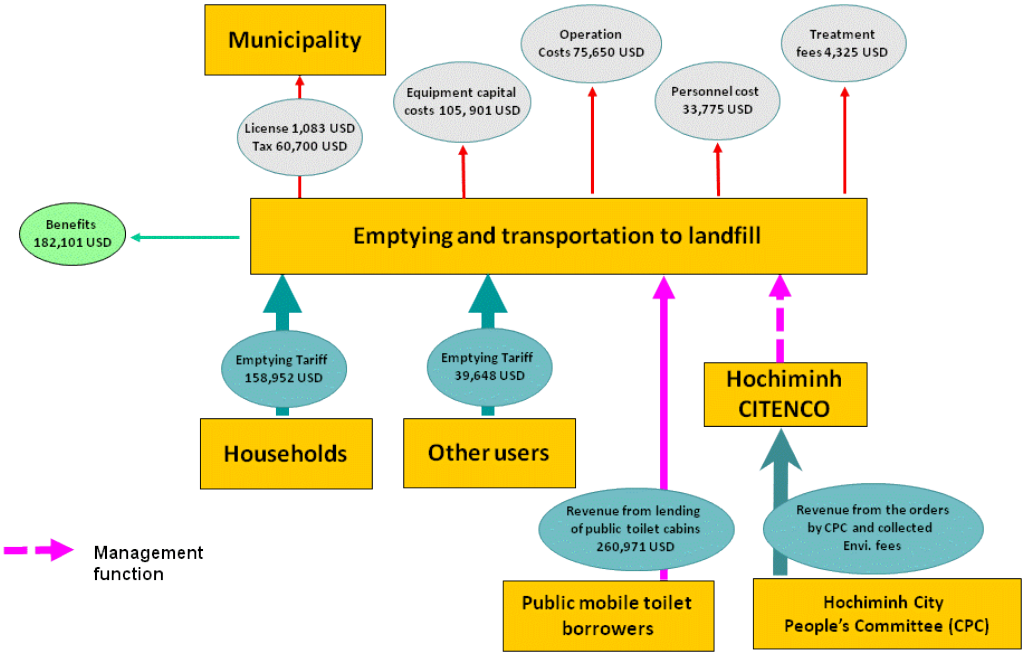


Figure 4-84. Money fluxes in a Ho Chi Minh City public utility HCM.01

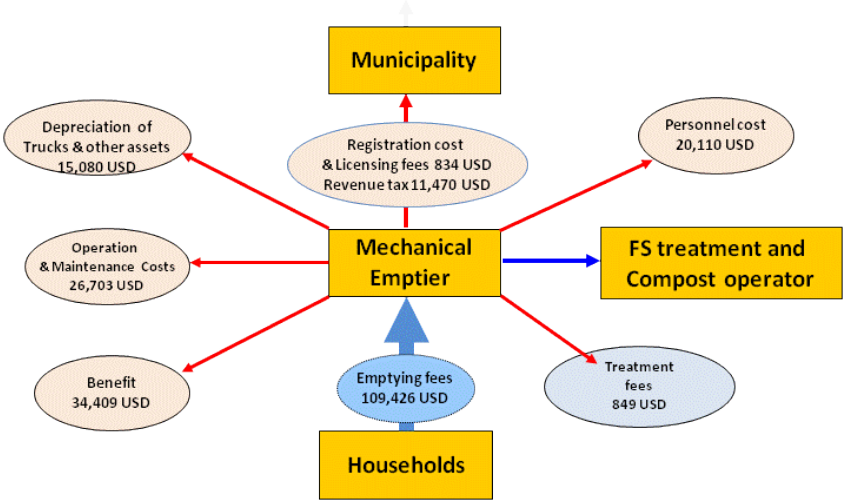


Figure 4-85. Average values of money fluxes in Ho Chi Minh City private enterprises HCM.02 … HCM.06

Table 4-28. Income statement of FSM enterprises in Ho Chi Minh City

Item	Public Co.	Small private co.	Medium private co.				Large private co.	Private co.
	HCM.01	HCM06	HCM02	HCM04	HCM05	Average	HCM03	Average
Input data								
Number of trucks	7	1	4	3	3	3	6	3
Average tank volume, m3	5.5	6	2	3	4	3	3	4
Average cost of new truck		21,883						21,883
Average cost of second hand truck	19,515		10,223	14,592	14,660	13,158	7,311	11,697
Average return trip distance, km	35.0	15.0	20.0	30.0	40.0	40.0	25.0	26.0
Typical emptying fee, USD/m3	12.1	19.4	21.8	17.0	17.3		17.0	**18.5**
Typical emptying fee, USD/trip	46.7	81.6	43.7	51.0	48.3		51.0	**55.1**
Personnel Costs	**33,775**	**8,665**	**22,893**	**20,831**	**16,183**	**19,969**	**31,981**	**20,110**
Registration fees of company and licensing fees for truck	**1,083**	**280**	**536**	**402**	**2,150**	1,029	**804**	**834**
Registration fees of company	146	146	-	-	1,748	583	-	379
Licensing fees for trucks	938	134	536	402	402	447	804	456
Operating costs - Fixed	**44,854**	**5,913**	**13,573**	**6,874**	**15,117**	**11,854**	**17,650**	**11,825**
Office building rent	6,990	4,951	2,039	1,748	11,650	5,146	2,039	4,485
Telephone	2,330	117	1,165	874	175	738	1,165	699
Electricity	11,650	466	1,456	874	2,039	1,456	1,456	1,258
Water	1,631	58	291	291	87	223	291	204
Offices supplies, computer, etc	699	117	466	466	291	408	466	361
Trucks maintenance and repair	8,155	146	5,825	874	524	2,408	8,738	3,221
Safety equipment	1,748	58	2,330	1,748	350	1,476	3,495	1,596
Public toilets for lease	11,650							
Operating costs - Variable	**30,796**	**2,312**	**14,410**	**12,551**	**26,754**	**17,905**	**22,460**	**15,697**
Fuel (pumping & transportation)	26,470	2,202	13,529	11,890	25,480	16,966	21,139	14,848
Disposal fees	4,325	110	881	661	1,274	938	1,321	849
Equipment Capital costs								
Loan Interest paid to Bank		16,043			12,478	12,478		14,260
Insurance costs for trucks, vehicles	377.18		216	161.65	161.65	180	323.30	216
If used, costs to refurbish truck (one time upfront)			1,942			1,942	2,912.62	2,427
Truck Depreciation Cost	13,592	117	8,155	4,368.93	8,737.86	7,087	8,737.86	6,023
Tyres annual depreciation Cost	816	58	243	184.47	402.91	277	364.08	250
Suction pipes depreciation Cost	340	87	90	86.17	143.20	106	134.71	108
Tanks depreciation Cost	3,398	175	2,330	1,359.22	3,058.25	2,249	2,330.10	1,850
Public toilet depreciation	87,379							
Subtotal	**105,901**	**16,480**	**12,975**	**6,160**	**24,982**	**14,706**	**14,803**	**15,080**
Revenue Sources								
Household septic tanks	158,592	41,942	59,893	60,884	201,320	107,366	110,978	95,003
Septic tanks from other customers	39,648		28,185	16,184		22,185	27,744	24,038
Other revenues (public toilet for rent)	260,971							
Subtotal	**459,211**	**41,942**	**88,078**	**77,068**	**201,320**	**122,155**	**138,722**	**109,426**
Profit /Loss								
Revenue before Tax	**242,801**	**8,293**	**23,691**	**30,250**	**116,137**	**56,692**	**51,025**	**45,879**
Revenue Tax	60,700	2,073	5,923	7,562	29,034	14,173	12,756	**11,470**
Profit (loss) after Tax	**182,101**	**6,220**	**17,768**	**22,687**	**87,103**	**42,519**	**38,269**	**34,409**

Table 4-29. Break-even analysis, FSM enterprises, Ho Chi Minh City

Item	Public Co.	Small private co.	Medium private co.				Large private co.	Private Co.
	HCM01	HCM06	HCM02	HCM04	HCM05	Average	HCM03	Average
Number of truck	7	1	4	3	3	3	6	**3**
Truck volume	5.5	6	2	3	4	3.0	3	**3.92**
Trips/year (2010)	2,970	252	1,512	1,512	2,916	1,980	2,268	**1,692**
Breakeven (trip/year)	1,723	197	1,015	794	940	916	1,257	**841**
Breakeven (trip/truck/year)	246	197	254	265	313	277	209	**248**

Table 4-30. Scenario 1, 5 years analysis with existing FSM model, Ho Chi Minh City

Item	Public Co.	Small private co.	Medium private co.				Large private co.	Private Co.
	HCM01	HCM06	HCM02	HCM04	HCM05	Average	HCM03	Average
NPV @18% discount rate	1,143,378	18,165	(191)	82,687	413,563	165,353	165,836	**136,012**
After Tax IRR - 5 years	N/A	60%	18%	189%	N/A	103%	N/A	**89%**
Pre-tax IRR - 5 years	N/A	93%	23%	434%	N/A	229%	N/A	**183%**
Avg 5 yr monthly cash to operator	30,681	643	266	2,280	9,898	4,148	4,175	**3,452**
Average annual 5 year ROE	31%	21%	6%	25%	38%	23%	31%	**24%**
Year of capital recovery within 5 years	IV	III	No	II	I		II	

Table 4-31. Scenario 2, additional payment for all sludge to landfill, 5 years analysis, Ho Chi Minh city

Item	Public Co.	Small private co.	Medium private co.				Large private co.	Private Co.
	HCM01	HCM06	HCM02	HCM04	HCM05	Average	HCM03	Average
NPV @18% discount rate		15,813	83	69,466	386,346	151,965	141,176	**122,577**
After Tax IRR - 5 years		54%	18%	144%	N/A	81%	1983%	**550%**
Pre-tax IRR - 5 years		82%	26%	273%	N/A	149%	N/A	**127%**
Avg 5 yr monthly cash to operator		588	212	1,970	9,261	3,814	3,597	**3,126**
Average annual 5 year ROE		20%	5%	24%	38%	22%	29%	**23%**
City subsidy or tariff increase USD/m3		0	8.50	0	0		0	**1.70**
Year of capital recovery within 5 years	IV	III	No	II	I		II	

Table 4-32. Scenario 3, maximum trips per truck and all sludge to landfill, 5 years analysis, Ho Chi Minh City

Item	Public Co.	Small private co.	Medium private co.				Large private co.	Private Co.
	HCM01	HCM06	HCM02	HCM04	HCM05	Average	HCM03	Average
NPV @18% discount rate	1,008,251	123,161	308,484	289,919		299,201	641,208	**340,693**
After Tax IRR - 5 years	N/A	N/A	N/A	N/A		N/A	N/A	**N/A**
Pre-tax IRR - 5 years	N/A	N/A	N/A	N/A		N/A	N/A	**N/A**
Avg 5 yr monthly cash to operator	27,516	3,086	7,496	7,134		7,315	15,310	**8,257**
Average annual 5 year ROE	28%	35%	37%	36%		37%	42%	**38%**
Year of capital recovery within 5 years		I	I	I			I	

Table 4-33. Scenario 1a, 5 years analysis with existing FSM model and bank loan, Ho Chi Minh City

Item	Public Co.	Small private co.	Medium private co.				Large private co.	Private Co.
	HCM01	HCM06	HCM02	HCM04	HCM05	Average	HCM03	Average
NPV @18% discount rate		Same as sc. 1	(14,570)	139,965	Same as sc. 1	62,698	153,214	**92,870**
After Tax IRR - 5 years			-4%	943%		470%	11966%	**4302%**
Pre-tax IRR - 5 years			-5%	N/A		-5%	N/A	**-5%**
Avg 5 yr monthly cash to operator			(59)	3,634		1,788	3,892	**2,489**
Average annual 5 year ROE			-2%	30%		14%	30%	**20%**
Year of capital recovery within 5 years			No	II			II	

Table 4-34. Scenario 2a, 5 years analysis, additional payment for all sludge to landfill and bank loan, Ho Chi Minh City

Item	Public Co.	Small private co.	Medium private co.				Large private co.	Private Co.
	HCM01	HCM06	HCM02	HCM04	HCM05	Average	HCM03	Average
NPV @18% discount rate		Same as sc. 2	40,443	122,337	Same as sc. 2	81,390	129,089	**97,290**
After Tax IRR - 5 years			106%	5		288%	754%	**443%**
Pre-tax IRR - 5 years			170%	N/A		170%	N/A	**170%**
Avg 5 yr monthly cash to operator			1,170	3,221		2,196	3,327	**2,573**
Average annual 5 year ROE			18%	29%		23%	29%	**25%**
City subsidy or tariff increase USD/m3	-	-	8.50	-	-		-	**1.70**
Year of capital recovery within 5 years			III	II			II	

Table 4-35. Scenario 3a, maximum trips per truck and all sludge to landfill, with bank loan, 5 years analysis, Ho Chi Minh City

Item	Public Co.	Small private co.	Medium private co.				Large private co.	Private Co.
	HCM01	HCM06	HCM02	HCM04	HCM05	Average	HCM03	Average
NPV @18% discount rate		Same as sc. 3	294,224	290,698	Same as sc. 3	292,461	631,260	**405,394**
After Tax IRR - 5 years			N/A	N/A		N/A	N/A	**N/A**
Pre-tax IRR - 5 years			N/A	N/A		N/A	N/A	**N/A**
Avg 5 yr monthly cash to operator			7,174	7,165		7,170	15,090	**9,810**
Average annual 5 year ROE			37%	36%		37%	42%	**38%**
Year of capital recovery within 5 years			I	I			I	

4.4.3.1.2. Break-even analysis

Break-even analysis (Table 4-29) confirms the findings from Income statement. All enterprises, including CITENCO and private enterprises are making benefits, since their current number of trips is more than break-even points from 1.3 to 3 times, and it brings safe revenue to the company.

4.4.3.1.3. IRR, NPV, Cash Flow and ROE

Scenario 1 (keeping the same FSM model, 5 year financial projection):

Results of Scenario 1 analysis show that: keeping the same model of FSM, in the coming 5 years, the average Rate of return on equity (ROE) at all private enterprises is ranging from 6 to 38%, average is 24%. Except for HCM.02, NPV after 5 years at all private enterprises are > 0. Very high IRR values, from 18 to 189%, were found.

Financial performance of the public utility CITENCO (HCM.01) is similar to the private enterprises. Along 5 years projection, all financial indicators are positive. Without heavy capital investment of composting plant like Hanoi and Hai Phong, in the area of FSM, CITENCO HCMC.01 is dealing with FS emptying and lease of public toilet cabins which require not high expenditures versus stable revenues, therefore, it can bring benefits to the company. No subsidy is provided to the HCM.01 activities.

Time of capital recovery of enterprises is 1 year (HCM.05), 2 years (HCM.03, HCM.04), 3 years (HCM.06) and 4 years (HCM.02). CITENCO will also find capital recovery in the year 4.

Scenario 2 (all sludge should be brought into legal dumping sites):

If all sludge will be brought into legal dumping sites, enterprises have to pay more in order to cover longer travel distances and associated expenditures. Except for HCM.02, all private enterprises are still making profit without additional charges. For HCM.02, the enterprise with 4 trucks per 2 m^3 tank volume, it needs additional charge VND 175,000 (USD 8.50) in order to keep business profitable which seems very high. The average Rate of return on equity (ROE) at all private enterprises is ranging from 5 to 38%, average is 23%.

Scenario 3 (maximizing number of trips per truck):

In this scenario, all sludge is brought into designated dumping or treatment sites. Private enterprises utilize maximum capacity of available trucks, thanks to ''still available'' market size, increase of business marketing and legal enforcement in frequent desludging by the city. Maximum number of trips per day is 4. The results show all private operators will make more profits thanks to revenues are increased. Capital recovery will be found in all enterprises right in the year 1. The analysis was not conducted for HCM.05 since the current number of trips per day of all trucks at the enterprise is already close to a maximum value. For the case of HCM.01, analysis of Scenario 3 was not also conducted since the enterprise is already bring sludge to the right place for the treatment or dumping.

4.4.3.2. Access to finance and analysis of firm finance with bank loans

Currently there are two private enterprises in Ho Chi Minh City, HCM.05 and HCM.06, are running business with loans from the bank.

Scenario 1.a, 2.a and 3.a were calculated for 3 private enterprises (HCM.02 and HCM.04 as medium size enterprises, HCM.03 as a large enterprise). HCM.05 and HCM.06 will keep the same financial flows in the Scenarios a since they are already borrowing loans from the bank to run a business.

Scenario 1a (applying bank interest rates for 70% of capital invest of the enterprise, keeping the same FSM model, 5 year financial projection):

HCM.03 and HCM.03 are still making profits and both will find capital recovery in the year 2. With bank loans, HCM.02 will have negative profit.

Scenario 2a (applying bank interest rates, plus increase of desludging fee by household, or equal payment from city budget for sludge brought into legal dumping sites):

If all sludge will be brought into legal dumping sites, and enterprises have to get loan from the bank for running business, HCM.03 and HCM.04 are still making profit without additional charge. The average Rate of return on equity (ROE) at HCM.03 and HCM.04 is 29% (close to the value in the case without bank loan). In order to keep business profitable, HCM.02 needs additional payment of VND 175,000 (USD 8.50) for each m^3 of sludge brought to the landfill. In that case, HCM.02 will find capital recovery in the year 3, while HCM.03 and HCM.04 will find capital recovery in the year 2.

Scenario 3a (applying bank interest rates, maximizing number of trips per truck):

In case of all sludge will be brought to the legal dumping or treatment sites, and enterprises will have to get loan from the bank for running business, if number of trucks will be maximized, all private enterprises will be making profit without additional charges. The average Rate of return on equity (ROE) at enterprises is ranging from 36 to 42%, average is 38%. All analyzed enterprises will find full capital recovery right in the year 1.

4.4.3.3. Role of public sector in business sustainability

Similar to Hanoi and other Vietnamese cities, currently private enterprises in Ho Chi Minh City does not get any support from public sector in their FSM business. The situation would change if the city applies more control in the FSM activities, including firm and truck registration licensing, sludge dumping inspection, etc. Further, improvement of treatment and dumping stations, awareness raising and technical provision to households for frequent sludge emptying would enable enterprises to increase their revenue.

4.4.3.4. Business analysis of Treatment Plants in Ho Chi Minh City

There is big demand in compost fertiliser for agriculture and urban green spaces as well as domestic plantation. Acceptable quality of the compost product makes it sold in the market. Besides, low-cost fecal sludge treatment facilities allows enterprise minimize its expenditures and avoid high depreciation costs, what lead to more profits for the company. This is an

important difference between HCMC private fecal sludge treatment plants in compare with subsidized public enterprises in Hanoi and Hai Phong cities. All fecal sludge treatment sites in Ho Chi Minh City are running with profits.

It is to note that Hoa Binh Fertilizer enterprise is specializing in fecal sludge treatment and composting only. They are not dealing with fecal sludge emptying services. Hoa Binh Co. charges to the emptiers VND 30,000 (USD 1.46) for each truck bringing sludge to the site. This is important income for the company besides compost sale.

In case the city authorities will enforce the control on FSM, more sludge will be brought into the site and Hoa Binh will have more income. The issues raised here are available capacity of the enterprise to receive sludge, and, allocation of treatment site for minimizing travelling expenses for the emptiers. Since Hoa Binh enterprise did not agree to take part in the survey, no details information on their finance has been analyzed. There is only evidence for their benefit is the company is keeping running and trying to expand the business.

4.4.3.5. Recommendations for sustainable FSM business models in Ho Chi Minh City

As financial analyses above shows key factors influencing profitability of the FSM enterprise is sludge transportation distance and number of trips per truck. While distance is regulated by the city landfill location and city control on the FSM activities, number of trips of enterprises can be improved by more capital investment for the trucks, marketing activities, and awareness rising for households to empty their tanks regularly.

There should be strict control on the FSM activities especially by the private enterprises. Moreover, technical support could be given to Hoa Binh and other enterprises who are dealing with fecal sludge treatment and composting product selling. Higher treatment efficiency and quality of the compost would bring more revenues and benefits from compost selling and, let enterprise to consider an option to reduce disposal fee for each cubic meter of sludge brought into the site. That may encourage private emptiers to bring their sludge to the site instead of illegal dumping.

Special credit program could be developed for FS emptiers in the city so that they could access to the bank loans with more favor conditions. In that case, they can purchase new trucks, with higher efficiency (less energy consuming, less noisy and smelling, etc.) and expand the business.

4.4.4. Country level (across cities)

4.4.4.1. Difference in parameters across three cities

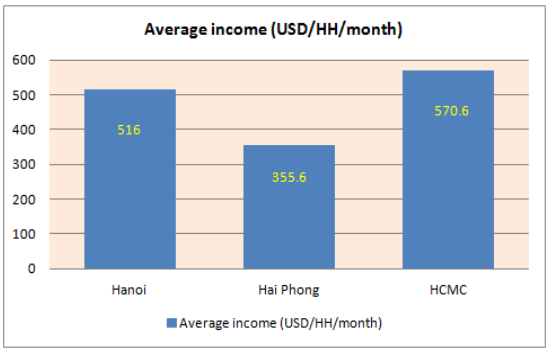


Figure 4-86. Average income per household in studied cities

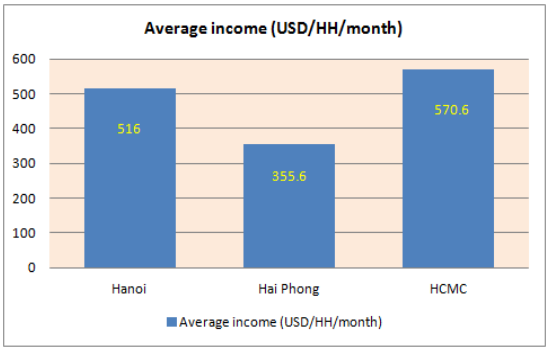


Figure *4-86* presents average income per household in Hanoi, Hai Phong and Ho Chi Minh City, based on the household survey data. Ho Chi Minh City has a highest income: USD 570.6 per HH per month vs. USD 516/HH/month in Hanoi and USD 355.6 in Hai Phong City. However, the coverage of on-site sanitation facilities in Ho Chi Minh City is lowest (79%, including 66% of HHs with septic tank and 13% of HHs with pits) vs. 96% in Hanoi and 96% in Hai Phong city. Total number of sanitation facilities is given in

Figure 4-87. Average number of toilet users is given in

Figure 4-87.

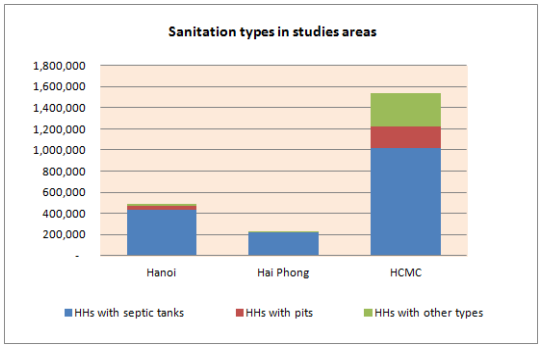


Figure 4-87. Number of sanitation types in studies areas

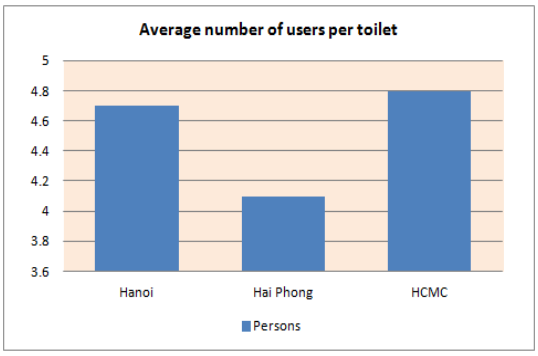


Figure 4-88. Number of toilet users in cities

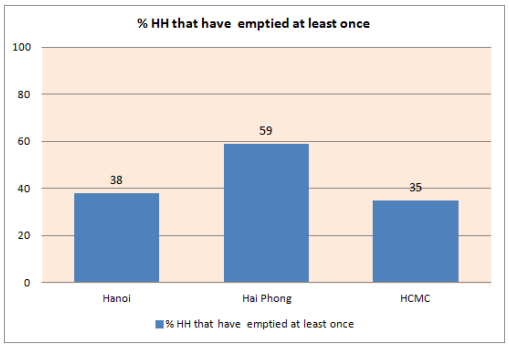


Figure 4-89. Percentage of HHs that have emptied at least once

Figure 4-89 shows importance of the city authorities' role in FSM. In Hai Phong, thanks to World Bank project, providing support in HH sanitation improvement, sewer connection and scheduled desludging, percentage of households that have emptied septic tanks is significantly increased compared to Hanoi and Ho Chi Minh Cities (59% vs. 38% and 35%, respectively). However, since WB project just has completed, and Hai Phong has not pass the first round of the scheduled desludging, there is still high percentage (41%) of HHs that have never emptied their tanks.

Frequency of desludging interval in Hai Phong is also shorter than in Hanoi (Figure 4-90). Average desludging interval in Hai Phong is 4.4 years vs. 6.2 years in Hanoi. For Ho Chi Minh City, average desludging interval is also 4.4 years, what relates to the sewer connection rate, and to the size of septic tanks built in surveyed households.

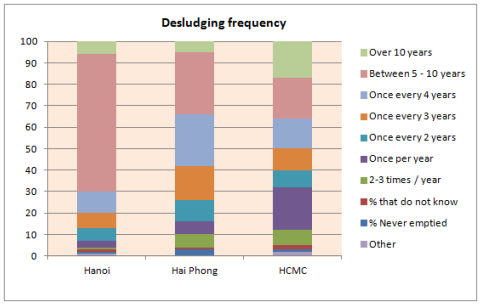


Figure 4-90. Desludging frequency in studied areas

In terms of current capacity of the FSM enterprises, Hanoi has a highest percentage of sludge volume collected vs. actual sludge volume production in the city. Highest demand is still available in Ho Chi Minh City whereas current volume of sludge collected is only 38% of the market demand. Those parameters C1 and P1 are presented in Table 4-35.

The mentioned market demand P1 (Table 4-36) is calculated based on the current desludging interval in each city. With intervention of the city authorities, for example, issuing requirement to desludge tank at least once per two years, demand for desludging might rise significantly up in all markets.

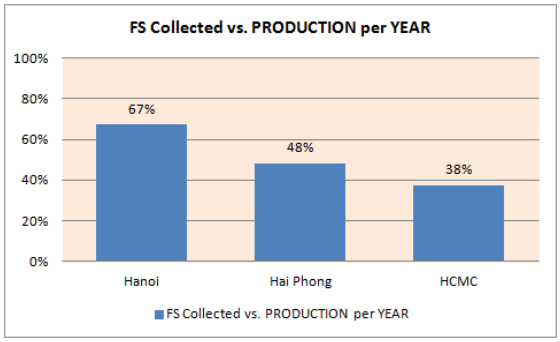


Figure 4-91. FSM market demand vs. supply in studied cities

Table 4-36. Compare of key parameters of FSM market among cities

Parameters	Hanoi	Hai Phong	HCMC
Number of HHs in city	430,638	218,795	1,017,019
FS volume, based on HH survey data = P1, m^3	280,376	166,466	894,087
FS volume, if desludging interval will be 2 years for septic tanks and 1 year for pits = P3, m^3	604,616	212,689	1,102,957
FS Collected per year = C1, m^3	189,000	80,569	335,756
FS Collected vs. production per year, m^3	67%	48%	38%
# of trucks run by private businesses*	112	63	150
Desludging interval, from HH survey, years	6.2	4.4	4.4
# of HHs served per truck per year	418	382	579
# of HHs served per truck per day, from HH survey	1.7	1.5	2.3
# of HHs served per truck per day, from enterprise survey	2.7	1.4	2.0

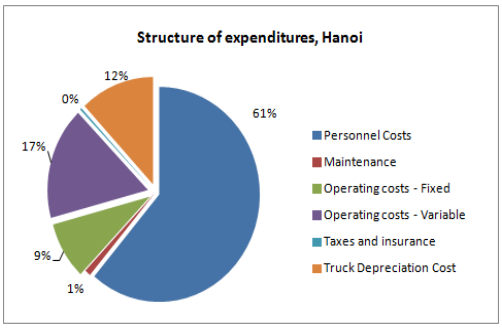
**Hai Phong city: Scheduled desludging by HP.01 is included.*

From the Table 4-36 some other discussions can also be made as follows:

- In Hanoi, number of HHs served by truck per day, from HH survey, is 1.7, while from enterprises survey the number is 2.7. Difference (2.7 - 1.7)/2.7 = 37% shows there is amount of sludge emptied from commercial points and offices, schools and other public places, as well as from construction sites in Hanoi is more then assumed 10% of the HH sludge volume.

- In Hai Phong and Ho Chi Minh city, the number of HHs served per truck per day from HH survey is more than the value from the business survey (7 – 13%). Arithmetically this difference is acceptable.

a)



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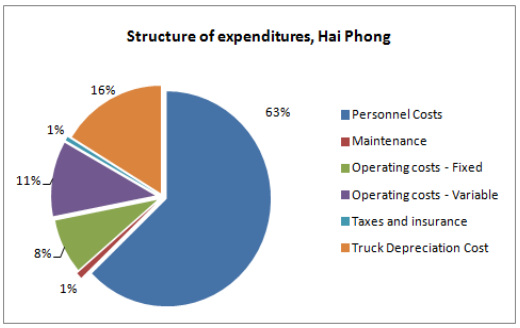

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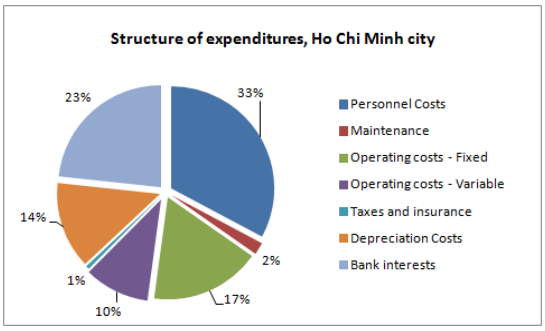

Figure 4-92. Structure of expenditures of private enterprises in cities

Figure 4-92 shows structure of expenditures representing average value among surveyed private enterprises. Salaries are largest part in expenditures in all enterprises, where most of trucks are second hand ones, and offices are rented. In Ho Chi Minh city, operating costs are at larger portion than in Hanoi and Hai Phong city, since enterprises have to pay more for payment for the office rent (if any) and for other office expenses such as electricity, water, telephone, sanitation and hygiene fees, etc.

In case of enterprise has to get loan from the bank to purchase trucks, significant ratio from expenditures is paid for bank loan interest, since purchase of trucks is a major investment of the enterprise.

Financial analysis for all surveyed enterprises has been made based on the income statements. Key results are presented in Table 4-37. All private enterprises are making profits. Average annual profit made by Hanoi private enterprises is USD 2,835/truck, by Hai Phong enterprises: USD 3,187/truck, by Ho Chi Minh enterprises: USD 10,727/truck. Average profit of HCMC enterprises is much higher than other cities. Correlation is found when actual number of trips made by private enterprises is compared with calculated break-even point or number of trips from where the enterprise starts to have profit. The actual number of trips is more than calculated break-even point for 125% in Hanoi, for 166% in Hai Phong, and for 201% in Ho

Chi Minh City. Period of return is therefore ranging among enterprises 3 – 4 years in Hanoi, 3 years in Hai Phong, and 1 – 4 years in Ho Chi Minh City.

Regarding public utilities in 3 surveyed cities, there is only Ho Chi Minh Urban Environment Company CITENCO (HCM.01) is making profit. The main source of revenue and profit for HCM.01 is not coming from desludging service, but from leasing public toilet cabins (57% vs. 43% of revenue). HCM.01 is also having revenue from FS emptying of the rent cabins. Unlike Hanoi and Hai Phong public utilities HN.01 and HP.01, the enterprise HCM.01 does not run activity in FS treatment, therefore, high depreciation costs for the waste treatment plant are not included in the company financial statement. Correlation is also found in break-even point calculation. For HN.01, 2016 trips have been made actually in 2010, while the enterprise should make as much as 9,826 trips, due to significant annualized depreciation costs of investment capital, in order to have profit in FSM business. In average, instead of current number of trips 403 per year, each truck should make 1,965 trips (see Table 4-37), which seems impossible for them.

Table 4-37. Financial analysis across cities

Parameters	Hanoi		Hai Phong		HCMC	
	Public utility	Private	Public utility	Private	Public utility	Private
Average desludging fee, USD/trip		34.3		31.3		55.1
Net profit (after tax), USD/truck/year	Lost	2,835	Lost	3,187	26,014	10,727
Number of trips made in 2010	2,016	1,890	13,104	2,142	2,970	1,692
Break-even point (trip/truck/year)	1,965	570	1,422	264	246	248
Percentage of revenue from break-even point, %	20	125	71	166	172	201
Return period, years	N/A	3 to 4	N/A	3		1 to 4

A similar picture is seen in the case of Hai Phong public utility HP.01. The enterprise should increase number of trips per truck per year up to 1,422 instead of current number of 1008 trips, in order to have business profitable. Those numbers are much more than break-even point of Hai Phong private enterprises (264 trips per truck per year).

For the Ho Chi Minh City public enterprise HCM.01, as above discussed, there is not an issue of big investment like HN.01 and HP.01. Value of break-even point of HCM.01 is at the same range of the private ones.

4.4.4.2. Recommendations of sustainable business models across the common parameters

- Market demand is one of deciding factors for the company's revenue and associated benefits. When market is available, direct influencing factors for the enterprises benefits, and capital recovery period, are travel distance and number of trips. Enterprises can increase number of trips for making more benefit, if they have well organized business and proper marketing activities. Concerning FSM fees, marketing effects, negotiation skills, and competition among enterprises in the same service territory are key influencing factors.

- High investment capital, mostly accured for specialized truck purchase, leads to high annualized capital depreciation costs and lowers benefit for the enterprise. Most of private enterprises, therefore, are trying to purchase second hand trucks at reasonable costs instead of new trucks. Number of trucks at enterprises are built from reliable, less fuel consuminng chassi, and mounted, locally made tank and pumping system. High annualized depreciation costs are among main reasons for being lost of public enterprises working in the field of FSM in Hanoi and Ho Chi Minh cities.

- FSM fees should be high enough to fully cover expenditures. If environmental sanitation regulation framework is weak, and competitive fees for FSM are low, FSM operators will try to find ways to break through for making more benefits, such as careless pumping, illegal dumping and other unqualified manners. Besides administrative control, there are different financial tools can be applied, such as:

    - Additional payment is charged to the service users to cover additional expenditures for delivery of sludge to the designated treatment site;

    - Bill is paid from the city's budget to the emptiers for each m^3 of sludge brought into designated site;

    - Special program is created where FSM enterprises will have access to get the loans from banks under favor conditions provided they will run FSM business with respect to the regulations. Appropriate monitoring and evaluation program, including public participation, is set up to follow the enterprises performances.

    - Increase of wastewater fee is applied, from where scheduled desludging is provided to the users.

- FSM business should be operated by the market driven principles, but, at the same time, coordination role of central government and local authorities is needed. In FSM, a role of central and local government to set up appropriate FSM regulation and provide strict control on its implementation is very important.

- Sludge emptying and transportaion service can be alone profitable, but, fecal sludge treatment and reuse, such as making compost for sale, is under high risk of failure. High investment and running costs of the composting plant, low quality of

compost product and high expenditures required for marketing, transportation of compost are main reasons of the failure.

- Even though all private FSM enterprises in all 3 studied cities are currently making benefits, but almost all of them are dumping fecal sludge illegally. Further travel distance to the right dumping or treatment sites makes them under situation of less profit or loss, especially when the enterprise has to get loans from the bank to invest in and to run business. For public enterprises, current FSM business requires either subsidy by the local authority, or cross-subsidy by other activities of the enterprise. Some solutions to improve sustainability of FSM business in Vietnamese cities are suggested as follows:

    - FSM fees should be increased, or, cross-subsidized by other activities within the enterprise;

    - Wastewater or solid waste management fees charged to the households which subjects also to adequate increase is among appropriate budget sources to cover FSM activities. Those budget sources could be used to cover scheduled emptying of fecal sludge for free (like HP.01 has been doing), or to pay to each m^3 of sludge brought into the designated dumping or treatment sites. Appropriate awareness raising for the public and FSM enterprises, strict control in FSM activities in the city should be conducted;

    - Using the same infrastructure for solid waste or wastewater management in the city for the FSM is a most feasible and sustainable solution in Vietnamese cities. The integrated waste management system may include at-source separation of wastes, co-treatment of sludge, organic waste and sewage treatment plant sludge for resources recovery through biogas recovery, wastewater reclamation, digested sludge utilization, etc. Utilization of the same infrastructure helps to economize investment and operation costs significantly where resource recovery brings more benefits.

4.5. Details and recommendation of at least one business ready for investment and growth

4.5.1. Current service levels

Hanoi city has been selected for FSM business improvement. FSM business, if it stays alone, has limited chance for sustainability. Potential factors leading to financial loss of the business are:

- More expenditures required when travel distance is more for bringing sludge into the legal sites;

- High investment capital and associated expenditures for operation and maintenance, as well as depreciation costs occur, when new trucks are purchased.

Access to the bank loans is limited, and contains also a high risk because of very high inflation rates in Vietnam;

- More and more strict regulation in compost quality, and significant expenditures are required for compost marketing as well as for after-sale services. Before hand, appropriate treatment technology for getting high quality compost requires appropriate resources.

- Design, construction and use of septic tank, desludging interval, collection of wastewtaer fees etc. are FSM related issues but they are out of control of the FS emptiers. The public utility like Hanoi URENCO should take over the responsibility for the FSM in the city while presence of private sector might fulfill the gaps in the market, and, keeps competition in the market. This condition is neccesary in order to have a good quality of the service from the providers.

High demand from the market shows possibilities for enterprise to grow their business (see Table 4-37). From above described analyses, possible actions for Hanoi to improve FSM model are recommended as follows:

- FSM service in the city will be provided by both public, and private types of enterprises.

- Marketing activities for septic tank design, construction and, use, as well as regular septic tank and pit desludging will be designed and piloted.

- Technical assistance to enterprises will be provided for improvement of organization of works so that all trucks could make a maximum number of trips per day.

- Technical assistance to local authority of Hanoi will be provided to develop a planning framework, and to set up a legal documentation managing FSM activities in the city. The planning framework should include market analysis, management model setting, task distribution and coordination among involved players, mechanisms for control for sludge emptying, transportation and dumping activities. Emptied sludge should be brought into treatment sites. A routemap for increase of wastewater and solid waste management fees will be set up. A legal regulation on FSM in the city will be issued. Technical support will be also provided for Hanoi authority to ensure monitoring and evaluation program for the issued regulation.

- Technical assistance to Cau Dzien composting plant will be provided in order to improve separation and treament technology as well as marketing capacity of the composting plant for getting better quality and sale volume of the compost.

- A pilot study on integrated waste management model in the city of Hanoi will be conducted, aiming at co-treatment of fecal sludge and organic fractions of solid waste from the city, industries and agriculture with sludge from the newly built Gamuda wastewater treatment plant (design capacity of 200,000 m^3/day), utilizing

the plant facilities for recovery of resources (biogas, nutrients, reclaimed water, etc.). Economic analysis of the model will be conducted.

4.5.2. Investment required

The activities proposed in the projects include soft interventions and hardware interventions. The soft interventions activities include support the city authority to develop a comprehensive FS management program for the city, capacity building activities for the involved staff of government management, research and education institutions, enterprises as service providers, and public as service users. Special awareness raising programs are also suggested to be conducted.

Concerning FS management program, project applicant is looking at hiring a consulting team who should be able to develop a planning framework of FSM in the cities. It might include the following components:

- Analysis of current and projected status of FSM for the city in the connection with other infrastructure components such as water supply, wastewater and solid waste management;

- Development of FS collection, transportation and treatment, as well as resource recovery models. Analysis and recommendation for the technology selection.

- Preparation of Feasibility Study (FS) for the FSM improvement infrastructure project.

The research on co-digestion and integrated waste management includes:

- Setting up the research sub-project on co-digestion of FS and organic waste with sludge from wastewater treatment plants, aiming at biogas recovery for heat and electricity generation.

- Study on improvement of compost fertilizer quality through improved waste collection and compost production as well as marketing and sales lines.

- The anaerobic digestions system can accepts amounts of organic solids and human waste from the cities. Mesophilic digestion by anaerobic microorganisms (at 35 – 37^{o}C) and thermophilic digestion (at 55^{o}C) will be compared with the feeding by different organic waste and septic tank sludge materials, which are still not well studied in the worldwide practice, in order to find out most appropriate operation parameters, gas producing and fertilizer quality influencing factors, as well as technical, economical analyses for the Vietnamese conditions.

- The produced biogas caters for an energy self-sufficient operation of the plants. The digested sludge (residue) is further treated and utilized for hygienically safe fertilizer to improve the soil quality, because it contains rich nutrients and organic fibers ideal for plants.

- In this way integrated solution of sanitation in urbanised area for sludge and organic waste treatment becomes feasible. Furthermore, when farming energy crops in the peri-urban areas, farmers can earn benefit in the new scheme.

- Once sewage network is established in future in the area, the operation scheme of the anaerobic digestion system is changed to accept sludge produced from the wastewater treatment plants.

- Thus the existing infrastructure can be continuously used without major additional modification, which saves significant expenditure of the municipality.

- To use the technical outcome for future investment projects, green-house gas and economical analysis are also conducted in the study.

Hard ware interventions are aiming at provision of support in construction of an integrated waste treatment system at the pilot scale whereas flows of collection, phase separation and treatment, resource recovery will be tested and demonstrated. Proposed scale for the pilot is around 1 ton of feeding waste per days. The pilot plant will be installed at the sludge treatment component, Gamuda wastewater treatment plant in Hanoi city.

Operation of the system would provide sufficient information for drafting of the FS and development of the stage 2 of the project proposal where private and international stakeholders will take part.

Human resource and capacity building is also being considered in the project. Staff will be trained. MSc and PhD students will be involved. University – Public utility – Private enterprise – Government will meet and agree upon the cooperation. Benefit/cost ratio will be analyzed for long-term and sustainable development.

This ‘’seeding project’’ will provide evidence for a long-term benefit and sustainable sludge management in particular, and waste management in the city in general. The principal scheme of integrated waste management concept proposed for the pilot project in Hanoi is given in Figure 4-93.

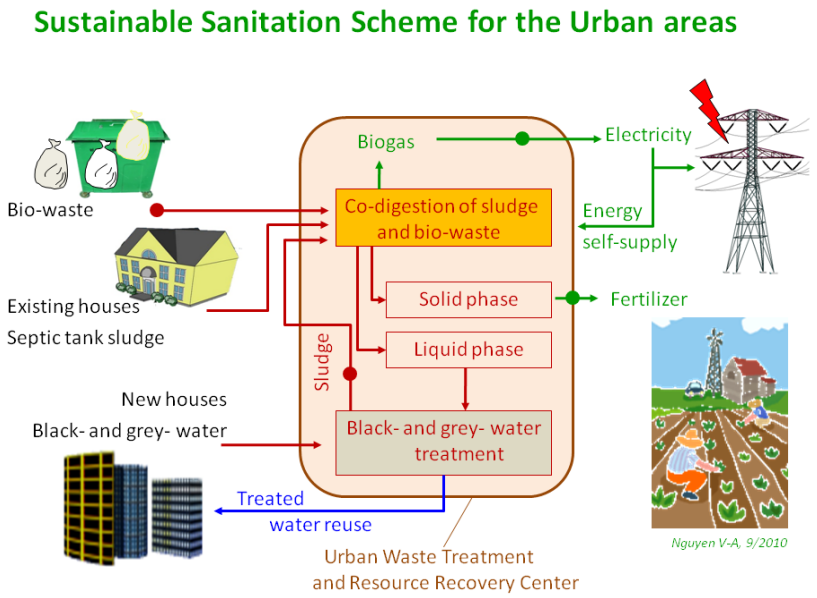

Figure 4-93. Scheme of the Sustainable Sanitation System

Results from this pilot could be used for development of sustainable waste management in other cities in Vietnam and in the region.

- Project duration: 3 year (36 months).
- Project budget estimation Table 4-38.

Table 4-38. Project budget estimation

No	Items	Unit	Unit price	Qty	Amount
A	**Soft interventions**				
1	Support in setting up FSM regulation and FSM framework	lump sum	100,000	1	100,000
2	Capacity building for FSM service providers	Persons	1,000	200	200,000
3	Research on co-digestion, compost production improvement, and integrated waste management	lump sum	300,000	1	300,000
4	Awareness raising programs	lump sum	100,000	1	100,000
B	**Hardware interventions**				
1	Composting plant improvement	System		1	2,000,000
2	Pilot plant for co-digestion and biogas recovery, 1 ton of waste/day	System		1	1,500,000
C	**Sum (A) + (B)**				**4,200,000**
D	Contingencies and overhead				840,000.0
E	**Total investment required**				**5,040,000**

5. Conclusions

(1) At the public enterprise, in most of cases, to run FSM business is not making a profit. The company is running FSM as a ‘‘must do‘‘activity, which is often cross-subsidized by other activities of the enterprise, or subsidized by the city’s budget.

(2) In the city of Hai Phong, scheduled fecal sludge emptying service for the communities is free of charge. Where wastewater fees is 15% surcharge on the top of the water bill, versus 10% of water bill in other cities, and all wastewater fee revenue is paid for the FSM management, the business does not make any benefit. The main reasons of loss are high annualized depreciation costs, and limited number of trips per truck per day which is much less than break-even point in the financial analysis.

(3) All private FSM enterprises are making profits. However, in order to reduce running costs, most of them are practicing illegal dumping of fecal sludge, which is contributing to a serious pollution of the city environment and public health.

(4) For emptying and delivery service, desludging expenditures, including running and depreciation ones, can be recovered by the competitive fees. However, fecal sludge treatment expenditures may not be recovered. Affecting factors here are selected technology for fecal sludge collection, treatment and reuse, and accepted market values of the compost product.

(5) There are some opportunities for the private FSM enterprises to increase benefit keeping legal, proper dumping of the faecal sludge. Those are: (a) To change the enterprise business model, expanding scope of activities and incomes; (b) To enforce regular desludging of septic tanks and pits with the support from the city authorities; (c) To increase desludging fee, or to provide city’s subsidy to cover costs paid for each m^3 of proper delivery of sludge. Increased wastewater and/or solid waste management fees are among apropriate budget sources to realize this city’s subsidy.

(6) One of solutions to improve situation of the FSM service in the city is to give the right to run this business to the local public utility. The service is controlled by the city, and paid by the users. Besides direct payment for each time of desludging service, indirect payment through water bills, as part of wastewater fee, could be realized given that an Urban public works company will provide scheduled desludging for the users. At the same time, service based desludging is still available in the city by the public or private utilities.

(7) Most sustainable management model for FSM is to apply an integrated waste management concept including centralized or semi-centralized waste collection and treatment systems. Faecal sludge, organic waste, wastewater will be co-treated for resource recovery. Public – private partnership (PPP) is considered to cope with big investments required.

(8) Market demand is one of deciding factors for the company's revenue and associated benefits. Cost for FSM service should be high enough to fully cover expenditures. If environmental sanitation regulation framework is weak, and competitive price for FSM is low, FSM operators will try to find ways to break through for making more benefits, such as careless pumping, illegal dumping and other unqualified manners. Besides administrative control, there are different financial tools can be applied.

(9) FSM business should be operated by the market driven principles, but, at the same time, coordination role of central government and local authorities should be highlighted. Public utility enterprise keeps an significant market share for the FSM in the studied cities in Vietnam.

(10) Some solutions to improve sustainability of FSM business in Vietnamese cities are suggested as follows:

- FSM fees should be increased, or, cross-subsidized by other activities within the enterprise;

- Wastewater or solid waste management fees charged to the households which subjects also to adequate increase is among appropriate budget sources to cover FSM activities. Those budget sources could be used to cover scheduled emptying of fecal sludge for free (like HP.01 has been doing), or to pay to each m^3 of sludge brought into the designated dumping or treatment sites. Appropriate awareness raising for the public and FSM enterprises, strict control in FSM activities in the city should be conducted;

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Annexes

1. List of people involved in the study
2. List of people interviewed
3. List of enterprises surveyed
4. Pictures taken from the study activities
5. Questionare – survey forms