Fecal Sludge Management: Diagnostics for Service Delivery in Urban Areas

Case study in Santa Cruz, Bolivia

Ana Mujica and Zael Sanz Uriarte

Supporting document

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List of abbreviations

AAPS	Autoridad de Fiscalización y Control Social de Agua Potable y Saneamiento Básico
ATP	Ability to Pay
CSDA	City Service Delivery Assessment
EPSA	Empresa Prestadora de Servicios de Agua Potable y Alcantarillado
ERTL	Empresa de Recolección y Transporte de Lodos
ESI	Economics of Sanitation Initiative
FGD	Focus Group Discussion
FS	Fecal Sludge
FSM	Fecal Sludge Management
FWFD	Fecal Waste Flow Diagram
JMP	WHO / UNICEF Joint Monitoring Programme
KII	Key Informant Interview
NGO	Non-Governmental Organisation
OD	Open Defecation
ODI	Overseas Development Institute
OPM	Oxford Policy Management
OSS	On-site Sanitation
O&M	Operation and maintenance
PCA	Principal Component Analysis
PFC	Prognosis for Change
PHRA	Public Health Risk Assessment
PSU	Primary Sampling Unit
RF	Research Framework
SAGUAPAC	Servicio de Agua Potable y Alcantarillado de Santa Cruz
SFD	Shit-Flow Diagram
SNI	Servicio Nacional de Impuestos
SSU	Secondary Sampling Unit
TOR	Terms of Reference
UNICEF	United Nations Children's Fund
WB	World Bank
WEDC	Water, Engineering and Development Centre, Loughborough University
WHO	World Health Organisation
WSP	Water and Sanitation Programme
WSS	Water Supply and Sanitation
WTP	Willingness to Pay

1 Introduction and research framework

1.1 About this report

This report summarises the main findings of a case study on fecal sludge management in Santa Cruz, Bolivia. It is part of 'Fecal Sludge Management: Diagnostics for Service Delivery in Poor Urban Areas', hereafter "the FSM research project". This work is funded by the World Bank Water and Sanitation Programme (WSP). There are five city case studies as part of this project (Balikpapan, Dhaka, Hawassa, Lima and Santa Cruz). The overall objective of this assignment is to "work with the WSP urban sanitation team to develop the methodology, design and survey instruments, undertake analysis of data collected from five field case studies (linked to World Bank operations projects), refine the diagnostic tools, and develop decision-making tools and guidelines for the development of improved FSM services." Specific objectives of the Santa Cruz case study are listed in the next section.

This document is part of a project deliverable designed to be internal at this stage. Therefore, it does not contain much background information, and the assumed audience is the WSP project team and other stakeholders familiar with the Santa Cruz FSM context.

The report's structure is detailed below. It begins with a background to the research and the city, moving into several sections analysing the urban sanitation context, which are not specific to FSM. Thereafter, the report's focus is FSM services in particular.

1.2 Study rationale and objectives

It is very common for poor people living in urban areas of most low-income countries to either use on-site sanitation facilities or defecate in the open. Even when improved on-site options are used to contain feces, there generally exist few services for collection, transport and disposal or treatment of the resulting fecal sludge. Fewer opportunities for resource recovery through end-use of fecal sludge exist. The service delivery gaps within and between stages of the sanitation service chain become more apparent as sanitation coverage increases in poor urban areas. Failure to ensure strong links throughout the fecal sludge management (FSM) service chain results in untreated fecal sludge (FS) contaminating the environment, with serious implications for human health.

Despite increasing demands for FSM services, there are few tools and guidelines to help city planners navigate complex FSM situations. This study aims to build on existing frameworks and tools, in particular the City Service Delivery Assessment (CSDA) scorecard and the Fecal Waste Flow Diagram (FWFD). The aim is to produce diagnostic and decision-making tools that are based in tried-and-tested strategic planning approaches and frameworks, with a focus on practicality. Critically, updates to the tools and guidelines will be based on primary data collection in five cities. In most of the cities, this is supported by interaction with city stakeholders involved in ongoing World Bank lending. Acknowledging the difficulty of reforming FSM services in cities, political economy questions around FSM are explicitly included as part of the overall analysis.

The specific objectives of the study are:

- To provide quantitative and qualitative data on the sanitation situation in Santa Cruz from a socio-economic perspective, specifically as it relates to FSM;

- To do the above in such a way that the data is representative of non-sewered areas of Santa Cruz, which are also the lowest-income sectors of the city; and
- To inform the development of analytical tools and guidelines, by "road-testing" draft tools using primary data collection.

The study was therefore primarily socio-economic rather than technical. It did not aim to carry out technical inspections of infrastructure or produce detailed maps with neighbourhood-level analysis and recommendations. For those who have previously worked in the sanitation sector in Santa Cruz, there may be few surprises, but the report does offer representative data to back-up what has previously been reported in smaller or more general studies.

1.3 Research framework

During the inception stage, the OPM/WEDC team developed a Research Framework (RF), based on the overarching research questions implicit in the TOR and draft research protocol. From these questions, a logical set of project components was developed. These became the basis for the design of data collection instruments that would enable information to be collected for the indicators making up each component.

The approach is to place all components – as well as ensuing results – of the study within the context of the FSM service chain, to optimise its relevance and effectiveness. The Tools and Guidelines document provides the data and analytical framework used to produce the outputs, and how to apply them.

This report is sub-divided into three groups of chapters. The initial chapter describes the city background and there are three chapters which cover the urban sanitation context without a specific focus on FSM. The rest of the report considers FSM services and service delivery.

Background

- Section 2 provides a background to the city

Urban sanitation context

- Section 0 describes the Fecal Waste Flow Diagrams

Analysis of FSM services

- Section 4 assesses the demand and supply for FSM services
- Section 5 contains a City Service Delivery Assessment
- Section 6 provides a Prognosis for Change based on the current situation
- Section 7 concludes

Annexes

- Annex A summarises the study methodology
- Annex B contains the detailed Fecal Waste Flow matrices
- Annex C provides the full CSDA scoring table

2 Background to Santa Cruz city

2.1 Santa Cruz overview

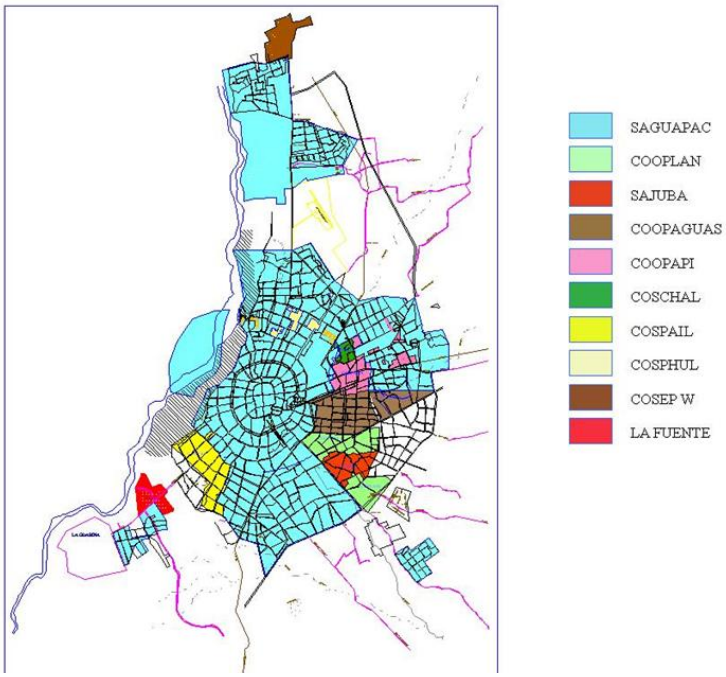
The Santa Cruz Metropolitan Area (referred to Santa Cruz hereinafter) is the second largest urban area in Bolivia, encompassing six municipalities (Santa Cruz de la Sierra, Cotoca, Porongo, La Guardia, El Torno and Warnes) and having around 1.9 million inhabitants. Santa Cruz is located in eastern Bolivia at an altitude of 416 m above sea level, experiencing a subtropical climate with an average humidity of 68% and an annual average temperature of 25°C. Maximum temperatures of up to 38°C can be reached in the summer months (December to March), while minimum temperatures of around 6°C can be experienced in the winter months (June to August) (Cáceres Magnus, 2015; WSP, 2010).

As a major economic centre in Bolivia, Santa Cruz has faced high population growth since the 1980s, mainly driven by rural-urban migration, with growth averaging around 5% between 1996 and 2001 and 4% between 2001 and 2012 (Caceres Magnus, 2015; Rivera, 2010). Most of these new urban inhabitants have settled in the suburbs or peri-urban areas of the city, where growth has been reported to almost double that observed in the "core" area – population growth in peri-urban areas of Santa Cruz was estimated at 7% between 1992 and 2012 (WSP, 2016).

As has been observed in other Latin American countries, urbanisation trends have not been coupled with equal access to basic services, mainly electricity, water and sanitation. For the country as a whole, access to piped water on premises in urban areas increased from 80 to 96% between 1990 and 2015. However, access to improved sanitation (excluding shared facilities) was just 61% by 2015, with 4% of urban dwellers still practising open defecation (WHO/UNICEF JMP, 2015). Moreover, 2013 estimates suggest that only 30% of all urban wastewater in Bolivia is effectively treated, with only 74% of municipalities across the country having a wastewater treatment plant (WSP, 2016).

Water supply and sewerage services in Santa Cruz are provided by 10 different cooperatives, as shown in Figure 1 below. Altogether they provide drinkable water to over 96% of the population (both piped into premises and through public taps). SAGUAPAC (*Cooperativa de Servicios Públicos de Santa Cruz Ltda.*) is the main and largest service provider.

Figure 1 Service areas of the cooperatives operating in Santa Cruz



Source: SAGUAPAC (2014) referenced in Cáceres Magnus (2015).

2012 Census data suggests that around 92% of households have water piped into dwelling, while 5% rely on public taps and the remaining 2% on wells (protected and unprotected), rainwater or springs, and other unimproved sources. Porongo and Cotoca have the lowest piped into dwelling coverage, reaching 61% and 72% respectively (Table 1).

Table 1 Drinking water coverage by municipalities in Santa Cruz

Type of water source	Municipalities (%)						Total
	Santa Cruz de la Sierra	Cotoca	Porongo	La Guardia	El Torno	Warnes	
Piped into dwelling	94%	72%	61%	84%	80%	86%	**92%**
Public tap	5%	10%	7%	8%	6%	8%	**5%**
Tanker truck	0%	0%	0%	1%	1%	0%	**0%**
Well	1%	17%	21%	6%	3%	6%	**2%**
Rainwater, springs, river	0%	0%	10%	0%	10%	0%	**0%**
Other (lakes or similar)	0%	0%	1%	0%	1%	0%	**0%**
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Source: 2012 National Census.

2.2 Santa Cruz sanitation context

As described in the previous section, while access to improved drinking water sources is almost universal in urban areas in Bolivia, sanitation coverage is still a challenge, with only 61% of the urban population having access to an improved facility. In particular, 2012 Census data for Santa Cruz suggests that around 47% of the population was connected to sewerage, with 21% and 26% of facilities emptying into a septic tank or a lined pit respectively, and 6% of households having no

sanitation facility, i.e. practising open defecation[1]. Porongo, Cotoca and El Torno have the highest proportions of households without a sanitation facility, with 26%, 21% and 21% respectively.

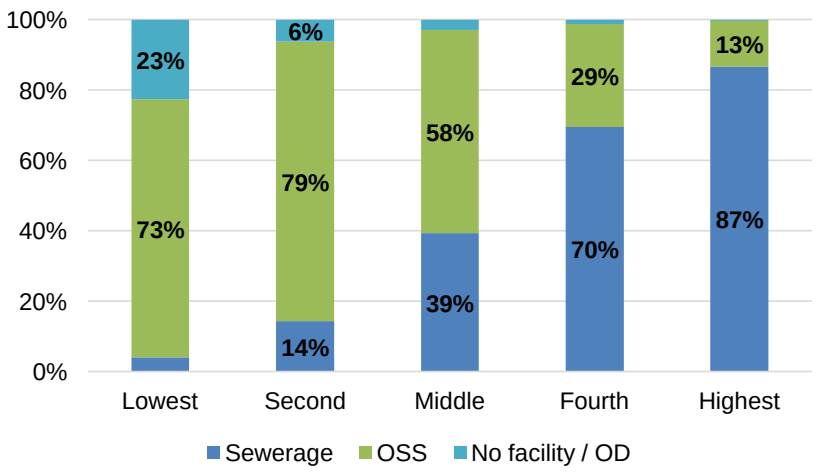
Table 2 Sanitation coverage by municipalities in Santa Cruz

Type of containment	Municipalities (%)						Total
	Santa Cruz de la Sierra	Cotoca	Porongo	La Guardia	El Torno	Warnes	
Sewerage	53%	17%	12%	2%	21%	21%	**47%**
Septic tank	21%	16%	21%	38%	10%	22%	**21%**
Lined pit	23%	46%	40%	52%	48%	40%	**26%**
Onto road / street	0%	0%	0%	0%	0%	0%	**0%**
Into spring / river	0%	0%	0%	0%	0%	0%	**0%**
Into lake	0%	0%	0%	0%	0%	0%	**0%**
No facility / OD	3%	21%	26%	8%	21%	17%	**6%**
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Source: 2012 National Census.

Figure 2 further shows the distribution of sanitation coverage by wealth quintiles[2]. As expected, access to sewerage increases with wealth, with only 4% of households in the lowest quintile having access as compared to 87% in the highest quintile. Meanwhile, the proportion of households without a facility or practising OD decreases with wealth: while 23% of households in the lowest quintile have no facility, all households in the highest quintile have access to sewerage or on-site sanitation.

Figure 2 Sanitation coverage by wealth quintiles in Santa Cruz



Source: SNV (2015) based on 2012 National Census data.

Although it would be ideal to have more information on the type of user-interface (i.e. the type of sanitation facility used), the focus of this study is primarily the management of fecal sludge from on-site sanitation (OSS) facilities (i.e. the containment stage) and, to an extent, all forms of fecal waste flows, including sewerage, through to end-use / disposal (see Figure 3 below).

[1] Census data does not allow for a classification of these facilities into improved / unimproved as per WHO / UNICEF JMP definitions.
[2] Wealth quintiles were estimated by principal component analysis (PCA) using average household assets at the block (i.e. *manzana*) level.

Figure 3 The sanitation service chain

This study is not focusing on the structural conditions or the OSS facilities themselves, so much as the extent to which they contain / do not contain fecal sludge and what happens to the fecal sludge from this stage onwards. For this reason, the household survey, and later sections of this report, refer to different categories for household sanitation facilities and assesses fecal sludge management in relation to the service chain above.

2.3 FSM in Santa Cruz

Later sections of this report will identify the scale of FSM services and its implications, based on primary and secondary qualitative and quantitative data. Here, the roles legally assigned to the key actors that currently are and could be involved in FSM are briefly presented, based on previous WSP studies, key informant interviews and field experience gathered by the World Bank consultant. The list is not exhaustive. How this plays out in reality is covered in Section 6.

Table 3 Roles assigned to key FSM stakeholders

Categories	Stakeholder	Assigned roles in FSM
National government	Ministry of Environment and Water (MMAyA) – in particular, the Vice Ministry for Water Supply and Sanitation	• Policy design and establishment • Ensure financial resources are allocated to the sanitation sector
	Water Supply and Basic Sanitation Supervision and Societal Oversight Authority (AAPS)	• Regulate and monitor the provision of emptying, transport and treatment services • Approve tariffs and fees for emptying, transport and treatment of FS
	National Tax Service (SNI)	• Activity registration and designation of tax identification number to water supply and sanitation service providers (EPSAs) and FS emptying and transport service providers (ERTLs)
Departmental government	Santa Cruz Government	• Ensure the adequate provision of FS emptying, transport and treatment services (only if municipal governments do not have the capacity)
	Santa Cruz Environmental Authority	• Approve and classify adequate practices and remedial actions with regards to FSM activities • Environmental monitoring for FS management and final disposal

Municipal government	Municipal Governments	• Ensure the adequate provision of FS emptying, transport and treatment services, directly or through public, communal or mixed service providers or cooperatives • Establish the fees for FS emptying, transport and treatment (if services are directly provided) • Grant operative licenses to ERTLs
	Water supply and sanitation service providers (EPSAs)	• Provide FS emptying, transport and treatment services directly or through a third party (when this responsibility is delegated by municipal governments) • Estimate and propose fees (to be considered by the AAPS) for FS emptying, transport and treatment services
	FS emptying and transport service providers (ERTLs)	• Supply and provide FS emptying and transport services
Private sector	Households	• Ensure adequate FS containment, and demand and use FS emptying and transport services
	Commercial establishments	• Ensure adequate FS containment, and demand and use FS emptying and transport services
	Industry and oil businesses	• Ensure adequate FS containment, and demand and use FS emptying and transport services

Source: Cáceres Magnus (2012).

3 Fecal waste flow diagrams

3.1 Introduction

Fecal Waste Flow Diagrams (also known as 'shit flow' diagrams or SFDs) are an innovation arising from WSP's 12-city study of FSM (Peal & Evans, 2013). In short, an SFD is a visualisation of how fecal waste (fecal sludge or wastewater) flows along the sanitation service chain. At each stage of the chain, the proportion of fecal waste that is or is not effectively managed to the next stage of the chain is indicated.[3]

This means that where fecal waste is deemed to be:

- Effectively managed from one stage of the chain to the next (for example, where wastewater from cistern flush toilets is effectively transported through sewers to a designated treatment site, or fecal sludge is transported by a tanker to a designated disposal site), the SFD shows the flow of fecal waste continuing along the chain – and the arrow representing that flow of fecal waste to the next stage remains green;

- Not effectively managed from one stage of the chain to the next (for example, where wastewater leaks from sewers before reaching a designated treatment site, or fecal sludge is dumped into the environment or drainage channels), then the SFD shows the fecal waste "dropping out" of the service chain – and the arrow representing that flow of fecal waste turns brown.

The proportion of fecal waste that is effectively managed all the way to the end of the service chain is indicated as "safely managed", with the remaining proportion that has dropped-out of the chain deemed "unsafely managed". The primary destination of that "unsafe" fecal waste is indicated (e.g. receiving waters, general environment, drains, etc.).[4] Thus far, SFDs in different cities have been undertaken using different methodologies, as is often necessary in the context of poor data availability. Furthermore, most SFDs so far (including those in the 12-city study) were undertaken using secondary data and expert estimates. This study is amongst the first to use primary household survey data and field-based observations to construct SFDs. A group of urban sanitation experts is currently discussing the 'roll-out' of the use of SFDs, for which other methodologies will be developed.[5]

For this study, SFDs are being developed which are indicative of (i) the city-wide situation, and (ii) the situation in low-income settlements (see Annex A for more information). For Santa Cruz, the former is based on both primary and secondary data, whereas the latter is based solely on primary data collection in non-sewered areas (which are generally low-income areas), as part of sub-sample A.

[3] Previous iterations of SFDs distinguished between safe and unsafe practices, but here we refer to effective / ineffective management. This progression has been made because it is difficult be sure of the safety of the process, but if the fecal waste is managed to the next stage of the sanitation service chain, we can say it is considered an effective process.
[4] It is acknowledged that FS may pass from irrigation channels into other water bodies, e.g. rivers, but the diagram focuses on the *primary* destination. It was beyond the scope of this study to be able to track the pathways of sludge beyond the household, e.g. which canals did it pass through and where was its eventual destination.
[5] See website for the SFD promotion initiative here.

3.2 Methodology

The city-wide SFD is based on both primary and secondary data as neither sub-sample in the household survey was representative of Santa Cruz as a whole.[6] The 2012 Census was used as a reference to estimate the proportions of different types of sanitation and containment technologies used, with primary household data projected to match the Census proportions. Estimates for the proportions of FS that are effectively emptied and transported were also based on primary household survey data.[7]

For the SFD in non-sewered areas, data from the following household survey question was used:

- *What type of sanitation facility does this dwelling have?*[8]

For Santa Cruz, this question encompasses both sanitation and containment technologies. It should be noted that the household's response is taken as given, as it was not possible to confirm responses by observation.

To analyse this data, an SFD matrix was created – a blank matrix is shown in Table 4 below. It shows which data sources are used and how they are analysed into categories of effective and ineffective management of fecal waste through the stages of the service chain. Results for Santa Cruz are shown in the next section.

Firstly, household survey data on use of infrastructure (question above) is used to allocate households to five categories shown in the column marked (1) in the figure below:

(i) **Sewered (off-site centralised or decentralised):** toilets connected to sewers (not on-site sanitation).

(ii) **On-site storage – emptiable:** on-site sanitation (OSS) toilets (involving pits or septic tanks) that can be emptied. However, they can also be connected to drains through an overflow, to avoid the need for emptying. These toilets are emptiable but may or may not be emptied.

(iii) **On-site storage – single-use / pit covered:** OSS toilets where pits or tanks are covered and / or abandoned once full. These toilets may be emptiable but are never emptied.

(iv) **On-site non-storage – straight to drain / similar:** OSS toilets which connect directly to drains, water bodies or open ground. These toilets are therefore non-emptiable.

(v) **Open defecation (OD):** self-explanatory.

The question of emptiability is key. Category (ii) above is denoted as emptiable, meaning that this containment option involves a pit or a tank which fills with FS. Between the two extremes of a closed system and a system which never fills up, there is a spectrum of scenarios. For example, some tanks may have an overflow to the drain but may still require emptying if they become blocked. These categories were designed to be applicable around the world. As it happens, the

[6] In other cities in this five-city study, sub-sample A was designed to be representative of the whole city. However, given that data collection in Santa Cruz was mainly carried out to assess the viability of a call centre for FS services, sub-sample A is representative of non-sewered areas of the city. For more information on sampling, please refer to Annex A.

[7] The only containment facilities that are formally emptied are septic tanks, septic tanks and soakaways and cement-lined pits. Among households with these types of facilities, the household survey suggests that only 27% are emptied. Secondary data about the total number of discharges at the SAGUAPAC treatment plant shows that there were 15,974 discharges in 2014, of which 80% correspond to domestic FS. Assuming that each discharge is the equivalent of 1.5 households, then 19,169 households were served in 2014. This is equal to 33% of households having their FS effectively transported and treated.

[8] This question encompasses both characteristics of the sanitation facility as well as the type of containment. Responses include (i) latrine to unlined pit, (ii) latrine to lined pit, (iii) pour-flush to off-set lined pit, (iv) flush to soakaway, (v) flush to septic tank, (vi) flush to septic tank and soakaway, and (vii) no facility.

vast majority of households in Santa Cruz fall into category (i), as there is 49% sewerage. In non-sewered areas, most households fall into category (ii), as most households have a septic tank.

Data collected through the household survey are allocated in column (2) below (a key shows the meaning of the colour-coding of cells by data source). Next, the proportions for each of the stages of the chain are allocated. As can be seen from the emptying column, marked (3), a certain proportion of the population's FS which is collected is emptied by a service provider, with the remaining FS not emptied (e.g. overflows to drains).

The rest of the matrix follows a similar logic. Full SFD matrices for Santa Cruz (city-wide) and non-sewered areas (sub-sample A) are presented in Annex B, along with further methodological notes. This section has given a brief overview of where the data underlying the SFDs comes from. The SFDs themselves are more intuitively appealing and are presented in the next section.

It should be noted that since data comes from a household survey and the Census, the proportions in the matrices are proportions of households rather than FS volumes.[9]

[9] The impression given by the SFD therefore involves assumptions that (i) each person produces the same amount of FS, and (ii) pit accumulation rates are constant across the city. This is an approximation but the most pragmatic approach in the context of uncertainty around FS volumes. FS volume only really becomes an issue when considering the extent of change in service levels needed to deal with the amounts. This study is primarily about identifying the broader picture of *where* the management of FS is or is not effective, not what volumes are being managed or mismanaged.

Table 4 Fecal Waste Flow Matrix template

1	2			3						4
		Containment		**Emptying**		**Transport**		**Treatment**		**Overall**
Type of system	*Population using: (%)*	*Of which: (%)*		*Of which: (%)*		*Of which: (%)*		*Of which: (%)*		**Safe**
		Contained	*Not contained*	*Emptied*	*Not emptied*	*Transported*	*Not transported*	*Treated*	*Not treated*	**0%**
Sewered (off site centralised or decentralised)		100%	0%	100%	0%		100%		100%	
		0%	0%	0%	0%	0%	0%	0%	0%	**0%**
On-site storage – emptiable		100%	0%		100%		100%		100%	
		0%	0%	0%	0%	0%	0%	0%	0%	**0%**
On-site storage – single-use / pit sealed		100%	0%							
		0%	0%							
On-site non-storage – straight to drain/similar		0%	100%							
		0%	0%							
Open defecation		0%	100%							
		0%	0%							
		Containment	0%	Emptying	0%	Transport	0%	Treatment	0%	
Unsafe	**0%**		**0%**		**0%**		**0%**		**0%**	
Affected zones (you can adapt the terms to suit the context)		*Local area and beyond via drains (amount direct to groundwater not identified)*		*Local area (via overflowing latrines or dumped FS)*		*Neighbourhood (via leakage / overflow from sewers or drains)*		*Receiving waters (via sewer outfall/discharge)*		

From household survey
From secondary data
De facto value

3.3 Results

Firstly, the secondary data and household survey results, which are inputs to the SFD, are shown in the tables below. They are reported separately for the whole city of Santa Cruz and non-sewered areas (sub-sample A). After that, a separate SFD matrix and diagram for each area are presented.

3.3.1 Census and household survey results as an input to the SFD

In most countries, national household surveys usually collect data on the type of sanitation facility (e.g. cistern flush, pour/manual flush, pit latrine, hanging toilet, etc.). However, in Bolivia only the type of containment/facility discharge is inquired about in the Census and other similar surveys. Nonetheless, the household survey asks about both sanitation and containment technologies, allowing for projections to be made to estimate city-wide coverage. Figure 4 below depicts the definitions used for primary data collection. The household survey also provides information about the emptying rate for septic tanks, septic tanks with soakaways, and cement-lined pits (all other technologies are deemed to be non-emptiable). Finally, the proportion of households for which FS is effectively transported was estimated using the number of discharges recorded at SAGUAPAC treatment plants, assuming that (i) 80% of total discharges are domestic; and (ii) each discharge is equivalent to 1.5 households.

The SFD for non-sewered areas only relies on household survey data (i.e. type of sanitation and containment technologies, and proportion of households that empty their tanks) and estimations for the proportion of households for which FS is effectively transported, as described above.

Table 5 shows the type of sanitation and containment systems for Santa Cruz city-wide (based on the 2012 Census and the household survey) and non-sewered areas of the city (only household survey data). City-wide, 41% of households have a facility that discharges into a septic tank, as compared to 70% in non-sewered areas. Surprisingly, while 5% of households city-wide have no sanitation facility, only 1% of households in non-sewered areas reported not having a facility – this is likely due to sampling issues.

Figure 4 Definitions of sanitation facilities and containment

a. Latrine to unlined pit

b. Latrine to lined pit

c. Pour-flush to off-set lined pit

d. Flush to cement-lined pit

e. Flush to septic tank

f. Flush to septic tank and soakaway

Source: SNV (2015).

Table 5 Type of sanitation facility / containment

Sanitation and containment type	City-wide	Non-sewered areas
Sewerage	49%	-
Flush to septic tank and soakaway	35%	60%
Flush to septic tank	6%	10%
Flush to cement-lined pit	3%	17%
Pour-flush to off-set lined pit	0%	3%
Latrine to lined pit	0%	3%
Latrine to unlined pit	1%	5%
Directly to drain or similar	0.2%	0%
No facility / OD	5%	1%
Total	**100%**	**100%**

Source: 2012 National Census and Household Survey.

The table above shows the basic categories, but it is also important to consider the proportion of these which are shared. This is relevant, not just in terms of developing the standardised indicators of the WHO / UNICEF JMP, but also because the FSM arrangements for shared latrines are likely to be different from those of 'private' latrines from a management perspective. This is because accountability for dealing with full or blocked pits or tanks, as well as payment for FSM services, may be less clear-cut in a 'shared' situation, recognising that this label could refer to a large number of scenarios. The technology and service used would be as for private facilities, while noting that shared pits/tanks would be likely to fill more quickly, depending on the number of users.

As can be seen from Table 6 below, 69% of households in non-sewered areas used a facility considered improved under JMP definitions (see footnotes below). However, this value should be read with some caution as, even if the facility is classified as improved by standard definitions, its quality and maintenance may not always be adequate. Nearly a quarter of households (24%) reported sharing their facility (improved or unimproved).

Data on sharing was not available for in the 2012 Census and thus we were not able to estimate JMP categories for Santa Cruz city-wide.

Table 6 Type of sanitation facility use by JMP category – non-sewered areas

	%	No. of households
Improved	69%	251
Improved – shared[10]	22%	79
Unimproved	7%	27
Unimproved – shared[11]	2%	7
Total	**100%**	**364**

Source: Household Survey.

For completeness and consistency with other case study reports, it is important to explain that results were grouped into risk categories based on the relative risk to public health from a combination of the type of containment arrangement and where the FS and effluent empty to:

- **Low-risk** categories are those where the FS can be considered to be contained (in JMP terms), at least in relation to the first stage of the service chain.
- **High-risk** categories are those where the FS goes directly into the environment and so potentially poses a risk of exposure to the public, whether via drainage systems or water bodies with which people interact (especially children).
- **Medium-risk** categories are those where there is at least some containment in a pit or septic tank, but those pits / tanks either: (a) have outlets connected to drains that allow only partially digested effluent to flow through, or (b) are unlined / permeable, allowing FS to leach into the surrounding soil and groundwater that may be used for domestic purposes (e.g. washing clothes). These scenarios still represent a risk, but it is somewhat lower than contact with fresh FS as in the high-risk category above.

The results are shown in Table 7 below. At the city-wide level, 5.2% of households have high-risk blackwater management practices as compared to only 1% of households in non-sewered areas. The most common category was low risk for both city-wide (90%) and non-sewered areas (70%),

[10] The JMP definition of a shared facility is one which is used by 2 or more households (including a public facility). Improved facilities included all types of facilities listed in the household survey except latrines and no facilities / OD.
[11] "Unimproved shared" is not a category usually reported by the JMP, but it is useful to report for our purposes so we can see the full proportion of households sharing latrines.

with sewerage being the most common in the former and flush to a septic tank and soakaway in the latter.

Table 7 Management of blackwater – non-sewered areas

	City-wide (projected) %	Non-sewered areas	
		%	No. of households
Low risk	**92%**	**88%**	**257**
Sewerage	49%	-	-
Flush to septic tank and soakaway	35%	60%	219
Flush to septic tank	6%	10%	38
Flush to cement-lined pit	3%	17%	63
Medium risk	**2%**	**11%**	**42**
Latrine to unlined pit	1%	5%	20
Latrine to lined pit	0%	3%	12
Pour-flush to off-set and lined pit	0%	3%	10
High risk	**6%**	**1%**	**2**
Directly to drain	0.2%	-	-
No facility	5%	1%	2
Total	**100%**	**100%**	**364**

Source: 2012 Census and Household Survey.

Finally, it is worth considering the reported household behaviour in the context of septic tanks / pits filling up. This was assessed by asking about the action taken by the household when their tank or pit last filled up. As can be seen in Table 8, the majority of households did not empty their septic tanks or pits (73%). Households with a flush to cement-lined pit had a

Table 8 Action after pit or tank filled up – non-sewered areas

	Emptied (%)	Not emptied (%)	No. of households
Flush to septic tank and soakaway	17%	83%	63
Flush to septic tank	24%	76%	38
Flush to cement-lined pit	30%	70%	219
Total	**27%**	**73%**	**320**

Source: Household Survey.

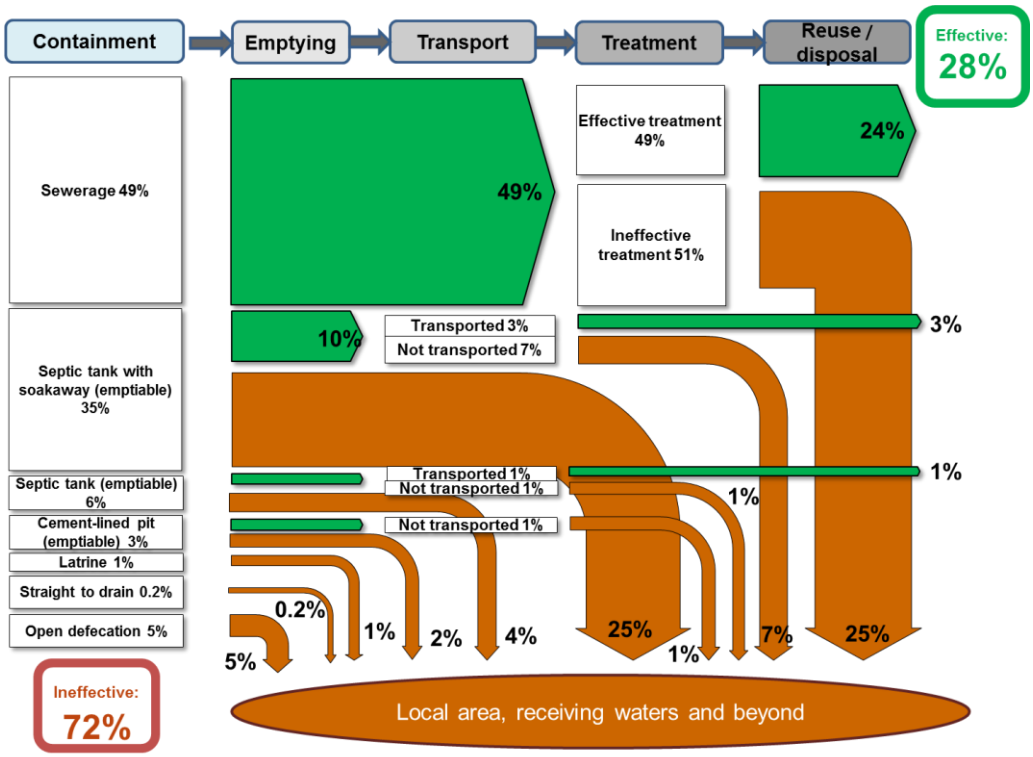
3.3.2 Presentation of SFDs

Using all these results, two sets of SFD matrices and diagrams were constructed: one giving a city-wide picture based on both primary and secondary data, and one focused on non-sewered areas and based mainly on sub-sample A of the household survey. These are presented as Figure 5 and Figure 6 below. SFDs work on the same principle as the matrix shown above. Household's toilet technology and associated containment method is shown on the left, with intermediate steps and primary destination of the FS shown along the sanitation service chain.

What is clear from the city-wide SFD is that the majority (72%) of FS in Santa Cruz is not effectively managed. While 49% of households have a sewer connection, about 25% of wastewater does not receive effective treatment – only SAGUAPAC's wastewater treatment plant provide adequate treatment. For households that have emptiable on-site storage (septic tanks with soakaways, septic tanks and cement-lined pits), data from the household survey suggest that between 17% to 30% of households empty their pit / tank depending on the type of containment. Furthermore, based on data for the number of FS discharges at the SAGUAPAC treatment plant in 2014, it is estimated that around a third of FS collected is actually transported to the SAGUAPAC

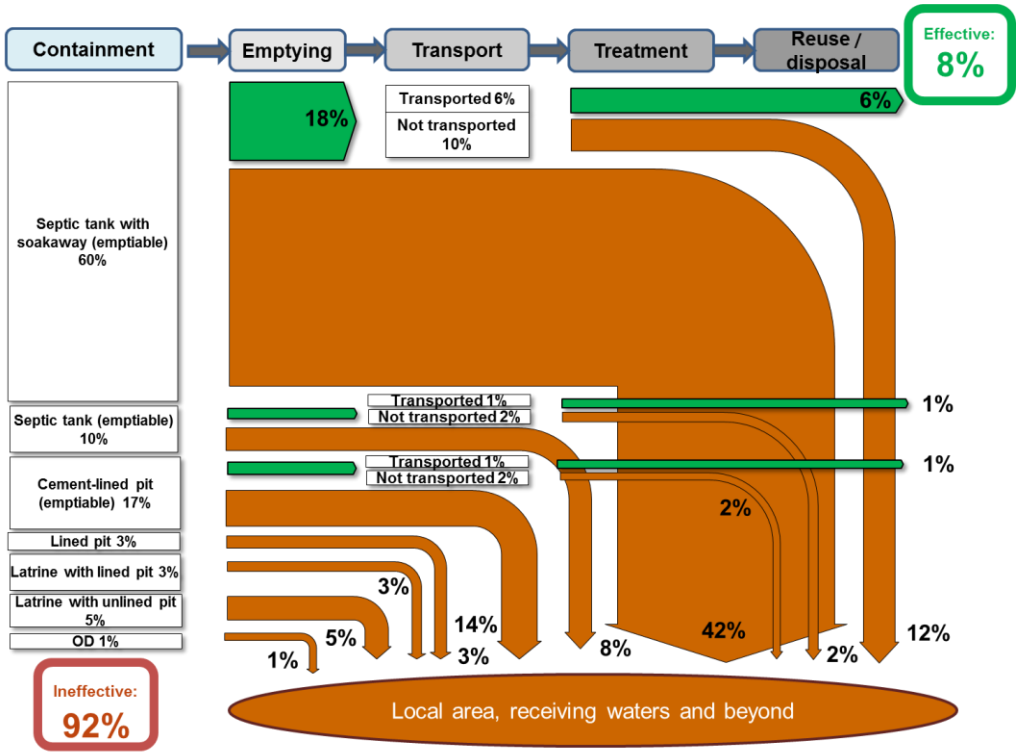
treatment facility. Thus, only 4% of households that use emptiable systems manage their FS effectively. Open defecation and facilities that empty straight to drains account for around 5% of households. Finally, single-use on-site storage (i.e. latrines with unlined pits), which eventually allow FS to leach into the surrounding environment, account for around 1% of households. Overall, 31% of emptiable OSS is deemed to be ineffectively managed, mainly driven by the lack of guidance and standards for their construction, but also by poor knowledge on adequate maintenance practices.

Figure 5 Faecal Waste Flow Diagram for Santa Cruz – city-wide, based on Census data and household survey



Considering next the SFD for the non-sewered sample (Figure 6), it is observed that the vast majority of households (70%) have a septic tank or a septic tank and a soakaway, with an additional 17% having a cement-lined pit, all of which are emptiable technologies. As is the case for the city-wide SFD, around 17% of cement-lined pits, 24% of septic tanks and 30% of septic tanks with soakaways are emptied. Assuming as well that the proportion of ERTLs that reach a SAGUAPAC treatment facility is the same across city-wide and non-sewered areas, then only 8% of the FS collected is effectively treated. Only 9% of households use single-use on-site storage (lined and unlined pits), for which none of the FS is effectively managed: these containment systems are reported to allow FS to seep into the surrounding environment. Overall, 92% of FS in non-sewered areas in Santa Cruz is ineffectively managed.

Figure 6 Faecal Waste Flow Diagram for Santa Cruz – non-sewered areas, based on household survey



3.4 Implications of the SFDs for FSM in Santa Cruz

The SFDs show that the majority of the FS in Santa Cruz is not effectively managed: at the city-wide level, 72% of all FS produced by households goes to the surrounding environment and receiving waters, while in non-sewered areas, 92% of all FS is not treated. Although almost half the city's population has access to sewerage, only 24% of waste collected is effectively treated, with the remaining FS not receiving adequate treatment (25%). The majority of households that are not connected to sewerage use emptiable on-site facilities that discharge into a septic tank with a soakaway, a septic tank or a cement-lined pit. However, many of these facilities are not properly built and maintained, with FS seeping into the surrounding environment. Even when emptied, not all FS reaches a treatment facility as not all service providers operate in the formal market and are thus not allowed to discharge the FS collected at SAGUAPAC's treatment plant. Single use on-site storage facilities (i.e. covered when full) are also used, but evidence from KIIs and FGDs also suggest that FS leaches into the surrounding environment in these cases.

From these SFDs, it is clear that the key challenges in Santa Cruz are (i) ensuring adequate FS containment and maintenance for on-site facilities; (ii) improving the effectiveness and capacity of treatment for FS collected through sewerage or by FS emptying and transport service providers; and (iii) eliminating open defecation.

4 FSM services: Potential Demand and Supply Management

4.1 Introduction

In economic theory, markets for goods and services operate on the basis of demand and supply. This chapter provides a brief assessment of demand and supply for FSM services in Santa Cruz. At this stage, it is important to note the difference between potential (or notional) demand and effective demand. The *potential demand* for FSM services is the quantity (and type) of services which would be demanded in the absence of any market failures or distortions. This is different from *effective demand*, which is the quantity (and type) of services actually purchased in the context of current supply and prices.

A simple way of illustrating this is to note that 45% of households city-wide use OSS (i.e. potential demand), of which only 12% are emptied, suggesting a relatively low effective demand. Reasons for a gap between potential demand and effective demand in Santa Cruz include: (i) poorly built infrastructure (pits or septic tanks) that either leach into the ground and have never filled up or do not allow for adequate maintenance activities to be carried out; (ii) practice of building a new pit when the one in use fills up; (iii) lack of knowledge about the required maintenance for emptiable facilities; (iv) lack of knowledge or disregard for environmental concerns; and (v) tariffs for FS emptying and transport services being higher than consumers' willingness and/or ability to pay (Cáceres Magnus, 2015; SNV, 2015; WSP, 2010).

There can be different definitions of potential demand in the context of FSM, with varying layers of complexity. The simplest definition is as per the above, i.e. services that would be demanded if all households with OSS used emptying services and were willing and able to pay. Qualifications could be added for different scenarios, for example given (i) emptying of pits/tanks every 10 years on average, (ii) regularly desludging once a year, (iii) 30% of households unable to pay the market price and a further 20% are unwilling, and so on. For this study, we have kept things simple.

Santa Cruz has a relatively developed FSM market, with the first emptying service providers appearing around 25 years ago. There are currently 27 registered FS emptying and transport service providers (ERTLs) – however, only 14 of them currently transport the collected FS to a SAGUAPAC wastewater treatment plant, the only cooperative that currently has an adequate treatment facility (WSP, 2016). Tariffs for services have been reported to be high by households – indeed, WSP studies suggest that ERTLs operate under oligopolistic competition (i.e. service providers make informal agreements about tariffs to guarantee some level of profit) (WSP, 2010).

Demand is mainly driven by the need for *corrective* (e.g. pit/tank is overflowing) rather than *preventive* measures (e.g. regular desludging). Poorly built infrastructure also reduces the demand for FS emptying and transport services, as few pits/tanks are reported to fill up. Moreover, in some cases, there is no hatch for emptying, forcing ERTLs to break through the floor to reach the pit/tank, leaving many households unsatisfied with the service provided. Households that rely on traditional latrines, where FS is contained in unlined pits, also have a tendency to build a new pit once the one in use fills up, further discouraging demand for FSM services.

4.2 Methodology

This sub-section sets out key dimensions of demand and supply, and the data collected that is related to these aspects. It was not intended to collect comprehensive data on demand and supply, given the broad scope of the research and the limitations of some of the instruments used.

4.2.1 Demand

The research framework (see Section 1.3) poses the following question: *What is the existing customer demand and preferences for FSM services?* i.e. the current effective demand. This is discussed in three parts: (a) physical and economic determinants of household demand, (b) household satisfaction with current services, and (c) barriers faced by households in obtaining FSM services[12]. This list is not meant to be exhaustive, but rather considers key elements for answering the questions in the research framework.

Physical and economic determinants of household demand

It is useful to separate the physical and economic determinants of household demand because the differences between them have implications for any potential interventions, either in stimulating or responding to demand. Physical determinants are related to geography and infrastructure, whereas economic determinants are more to do with markets and finance.

The main determinants are set out in Table 9 and Table 10 below, describing its relevance and the way they have been measured by the research instruments (if data is available).

Table 9 Physical determinants of demand for FSM services

Dimension	Relevance	Instrument used to collect quantitative data
1. Accessibility of location		
Equipment access	Likelihood of equipment of different sizes (manual emptier, tanker truck, etc.) being able to access the facility to empty it	Household survey questions about equipment access and emptying point.
Type of building	Whether single-storey or multi-storey, and privately owned or in shared ownership	Household survey question
2. Fill rate		
Volume of containment	The nature of the containment method (e.g. whether a pit, tank, or no real containment) and its volume	Household survey question on type of containment and dimensions of pits or septic tanks (which allow for volume estimations)
Number of users	The number of household members (i.e. the owner household plus any sharing households) determines the volume entering the pit	Household survey questions around household size and numbers of households sharing the sanitation facility
Climate, soil type and groundwater	Ambient temperature, soil type and groundwater table can all strongly influence the rate of filling and digestion of fecal sludge	Available secondary data

[12] Given our focus on household demand, the primary concern is demand for emptying and transport services rather than for the remaining components of the sanitation service chain.

Table 10 Economic determinants of demand for FSM services

Dimension	Relevance	Instrument used to collect quantitative data
1. Financial		
Ability to pay (ATP)	Poor people do not always have the financial resources to pay for FSM services	Willingness to pay data is available from the household survey
Willingness to pay (WTP)	People may have access to financial resources but are not willing to pay for the service at the market price for any number of reasons	
2. Fill rate		
Tenancy status	Households who rent property from a landlord may not have authority to deal with sanitation matters. Landlords may not want to pay for tenants' ongoing services. Tenancy status therefore influences the incentives and decision-making role of the likely service purchaser	Household survey question
Alternative sanitation options	If there is space, then households can dig a new pit and cover the old one. If there is not, the household may still abandon the latrine and use an alternative option (shared / public latrine or open defecation) rather than pay for an FSM service	Household survey asked about action after pit/tank last filled up

Other barriers which households face in obtaining FSM services

Some reasons for a gap between potential and effective demand for FSM services in Santa Cruz are already listed above (e.g. physical access to households and willingness to pay). However, there are many other potential barriers which households may face in securing FSM services.

Some of the barriers to accessing services have not been possible to predict *ex ante*. They were therefore explored in the qualitative research, particularly through FGDs with community members and an ethnographic study of OSS use in non-sewered areas. Several of the discussion questions focused around perceptions and opinions of existing services, and what participants would like to see in terms of improved services in the future. Discussions were semi-structured, with participants able to discuss questions more openly, so allowing for the identification of further determinants of demand not otherwise addressed in the household survey. The Generic Data Collection Instruments contain the full list of topics and questions addressed.

4.2.2 Supply

On the supply side, the research questions were around the current status and quality of FSM service delivery, with a focus on assessing current technical and institutional capacity (i.e. the scope and quality of services). This was assessed mainly through the report submitted by the WSP consultant as well as other key WSP studies in Santa Cruz.

4.3 Findings: household demand for services

The results in each key area are presented below, with an overall assessment provided in the concluding section, alongside implications for FSM in Santa Cruz.

4.3.1 Determinants of household demand

Accessibility

Whether a service provider can actually get to the facility requiring emptying (as well as the household's perception of this) will be a key determinant of demand for services. Data to assess accessibility focused on the characteristics of the dwelling as well as the facility itself.

On one hand, the type of building influences the extent and nature of the emptying required. Table 11 shows that the majority of households live in owned residences (65%), most of which are houses (likely to be single-storey). This is followed by rented (18%) or on loan (10%) arrangements of single rooms or huts. An aspect to note is that 2% of dwellings are "illegally owned", i.e. they are probably located in occupied plots of land, with no property rights. Although potentially accessible, these households usually have little incentive to invest in adequate sanitation facilities and maintaining them given the vulnerability of their tenancy status.

Table 11 Type of residence occupied and ownership status – non-sewered areas

Ownership status	House (n=309)	Hut (n=9)	Single room (n=44)	Improvised dwelling (n=2)	Total	No. of households
Rented	16%	22%	36%	0%	18%	67
Owned	69%	44%	48%	50%	65%	238
Land-pawn	3%	0%	2%	0%	2%	9
On loan	10%	33%	7%	0%	10%	37
Illegally owned	2%	0%	5%	50%	2%	8
Other	1%	0%	2%	0%	1%	5
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**364**

Source: Household Survey.

Focusing on the facility itself, Table 12 below shows the accessibility of the main pit/tank structure for households that have an emptiable structure (either septic tanks or soakaways). The majority of households have a purpose-built hatch, which will facilitate the provision of FS emptying services, with 17% of households requiring the removal of the squatting plate or lid. Although not captured by the household survey, some households also require their lids or tanks to be perforated to allow for FS extraction (SNV, 2015).

Table 12 Access point for emptying equipment – non-sewered areas

	Total	No. of households
Yes, purpose-built hatch	83%	222
Yes, squatting plate must be removed	17%	44
Total	**100%**	**266**

Source: Household Survey.

Overall, from the perspective of accessibility it is clear that there do not seem to be any significant difficulties in accessing neither the dwelling nor the facilities themselves. However, there is no evidence related to the quality of the roads and other geographical characteristics (e.g. hilly areas) that may hinder ease of access for ERTLs.

Fill rate

Data on the type of containment was already shown in Table 5 above. The household survey also collected information on the dimensions of the pit/tank as reported by the household, as well as the time taken between the previous and the last emptying, which allow for an estimation of the average fill rate for on-site facilities.

Table 13 shows the average estimated volume for soakaways and septic tanks in non-sewered areas. Soakaways are commonly deeper and are thus able to contain a larger volume of FS (i.e. 20.0m^3) as compared to septic tanks, which on average contain around 6.0m^3.

Table 13 Average estimated volume for soakaways and septic tanks – non-sewered areas

Type of containment	Average dimensions and volume		No. of households
Soakaway	Diameter	2.36m	137
	Depth	4.56m	116
	Volume	**20.00m^3**	
Septic tank	Length	1.78m	169
	Width	1.51m	170
	Depth	2.22m	136
	Volume	**5.96m^3**	

Source: Household Survey.

Households were also asked how long it usually took for their pit to fill up, which is considered more relevant and also a more reliable indicator for households to estimate. The results are shown in Table 14 below for soakaways and septic tanks separately. The data shows that among the 11 households using soakaways, the majority take between 7 to 12 months to fill up (36%). For the 71 households using septic tanks, a fifth reported their tank filling in less than 6 months, followed by 18% of households who said their tank took between 2 to 3 years to fill up. Long fill-up rates for septic tanks may be associated with poor construction or installation, with some reported to have leakages and punctures to delay the need for emptying (Herreira Patiño *et al*, 2015).

Despite differences in the time ranges between the two types of containment systems, the average time does not seem to differ as widely, with soakaways taking, on average, 2.6 years (standard deviation of 1.04) to fill up as compared to 2.4 years (standard deviation of 0.27) for septic tanks.

Table 14 Average time taken for soakaways and septic tanks to fill up – non-sewered areas

	Soakaways		Septic tanks	
	%	No. of households	%	No. of households
Less than 6 months	18%	2	20%	14
7 – 12 months	36%	4	15%	11
13 – 18 months	9%	1	8%	6
19 – 24 months	18%	2	17%	12
2 – 3 years	0%	0	18%	13
3 – 4 years	0%	0	10%	7
4 – 5 years	0%	0	3%	2
5 – 10 years	18%	2	7%	5
More than 10 years	0%	0	1%	1
Total	**100%**	**11**	**100%**	**71**

Source: Household Survey.

Moving on to data on shared facilities, the average number of households per sanitation facility in non-sewered areas was 1.2.[13] It is also worth considering the number of *people* which were sharing facilities in more detail, as shown in Table 15 below.[14] This comes directly from data reported by households. It should be noted that the average household size in non-sewered areas was 5.8 people.

As shown below, the majority of sanitation facilities were shared with fewer than 6 people (56%). This also holds for all types of facilities, with the exception of latrines to lined pits, of which 50% are shared with 6-10 people. Flush to septic tanks are generally more private, with 71% of them being shared with less than 6 people. About a quarter of facilities are shared between 6 to 10 people.

Table 15 Number of people using the same sanitation facility by type – non-sewered areas

	Latrine to unlined pit	Latrine to lined pit	Pour-flush to off-set lined pit	Flush to cement-lined pit	Flush to septic tank	Flush to septic tank & soakaway	Total
1 to 5 people	45%	42%	60%	48%	71%	57%	56%
6 to 10 people	30%	50%	20%	29%	24%	25%	26%
11 to 15 people	0%	0%	0%	3%	0%	5%	4%
16 to 20 people	15%	0%	10%	6%	3%	5%	5%
21 to 25 people	5%	0%	10%	5%	0%	3%	3%
More than 25 people	5%	8%	0%	10%	3%	5%	6%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
No. of households	20	12	10	63	38	219	362

Source: Household Survey.

[13] For this estimate, households with private facilities (not sharing with other households) are included and coded as 1. If these households are excluded, the average number of households per facility increases to 2.5.

[14] These data are drawn from the following household survey questions: "*How many households share this dwelling or plot?*", "*How many people live in this dwelling or plot?*" and "*How many sanitation facilities are functioning in this dwelling or plot?*"

Financial aspects

As noted above, data on willingness to pay (WTP) was collected through the household survey. Data for the amount paid the last time the pit/septic tank was emptied is also available, with additional information collected through FGDs and available in other WSP studies.

First though, it is worth briefly considering finance for containment. Based on information gathered through FGDs, the estimated cost of a latrine to lined / unlined pit ranges between US $38 (250 Bs) and US $145 (1,000 Bs) as compared to US $2,177 ($15,000 Bs) for a flush to septic tank (including superstructure and labour). This is consistent with the information provided by different households in a parallel WSP ethnographic study: investments in containment range between US $62 ($430 Bs) for a latrine to an unlined pit to US $1,742 ($12,000 Bs) for a flush to a septic tank and soakaway, as shown in Table 16 below. Given that around 80% of household heads in Santa Cruz have a monthly income of less than US $435 ($3,000 Bs), which is usually the main source of income for households, it is clear that investing in adequate emptiable facilities requires significant efforts and planning, and may even be unaffordable to some households.[15]

Table 16 Costs of different sanitation facilities

Type of facility	Estimated cost in USD	Estimated cost in Bs
Latrine to unlined pit*	$62	$430
Latrine to lined pit*	$84	$580
Pour-flush to lined pit*	$96	$660
Flush to soakaway**	$1,016	$7,000
Flush to septic tank**	$1,451	$10,000
Flush to septic tank and soakaway***	$1,742	$12,000

*Facilities built by household members.
**Facilities built by household memebers or with hired labour.
***Facilities built with hired labour.

Source: Herreira Patiño et al (2015).

Table 17 shows household's maximum willingness to pay for emptying services.[16] The majority of households (72%) are concentrated in a range of between US $36 - $51 per emptying and transport service. Only 5% of households would be willing to pay more than US $87 per service.

Willingness to pay is below the average payment currently made by households for FS emptying and transport – on average, households have paid US $68 (470 Bs) in the past. This suggests that some households may not be considering FSM services as an affordable alternative – indeed, the minimum wage in Bolivia is around US $240 (1,656 Bs), which means that FS emptying services would amount to 28% of the monthly income.[17] Thus, there may be some scope to increase demand if prices for FSM services become are lowered, e.g. through increased competition between ERTLs.

[15] Based on household survey data.
[16] Households were probed for all the listed prices above, answering 'yes' in cases where they were willing to pay the cost given and 'no' in cases where the cost seemed too high.
[17] We may be over-estimating the proportion of costs for FS emptying and transport within household income as households, especially the poor, have several sources of income.

Table 17 Willingness to pay for emptying services – non-sewered areas

Maximum WTP (USD / Bs.)	%	No. of households
US $29 / 200 Bs.	7%	26
US $36 / 250 Bs.	27%	97
US $44 / 300 Bs.	25%	91
US $51 / 350 Bs.	20%	72
US $58 / 400 Bs.	5%	19
US $65 / 450 Bs.	6%	21
US $73 / 500 Bs.	2%	9
US $80 / 550 Bs.	3%	10
More than US $87 / 600 Bs.	5%	19
Total	**100%**	**364**

Source: Household Survey.

Incentives

The incentives that drive demand for improved FSM services are mainly influenced by ownership (of both the facility and the plot/dwelling itself), previous investments in constructing and maintaining the sanitation facility (as described above), and the current quality of the facility. Households may also be encouraged to use FS emptying and transport services if neighbourhood pressures for safe FS disposal increase or if they have limited space in their plots to build a new pit/tank.

4.4 Findings: supply of FSM services

As set put in Section 4.2.2, the supply side assessment is mainly related to the current status and quality of FSM service delivery. This was described in KIIs with service providers, but also relies on previous WSP studies and data on annual volumes and number of discharges by ERTLs.

4.4.1 Services effectively supplied

The first stage of the supply analysis should be to consider what services are supplied in the market, where effective supply intersects with effective demand. Some relevant context was already provided in Section 3.3.2 by the SFDs, especially Table 8 – this table shows that when pits/tanks fill up, around 27% of households in non-sewered areas use FS emptying and transport services, mainly due to overflow.

Table 18 shows the type of service provider used by households for emptying and transport. Given that the FSM market has been in place for around 25 years, 95% of households hire an ERTL with a vacuum truck (mechanical emptying) to empty their pits/tanks. Only 5% of households rely on their members or other relatives for emptying. Since some of the ERTLs are small firms, many of which are family-owned, it is unclear whether households who empty their pits/tanks use mechanical or manual emptying.

Table 18 Type of service provider – non-sewered areas

	%	No. of households
ERTL with vacuum truck	95%	80
Manual emptier	0%	0
Household members	5%	4
Total	**100%**	**84**

Source: Household Survey.

Households were also asked about their knowledge of where FS was discharged after emptying. Households were only asked at the initial discharge point, so they are not always in a position to know where service providers eventually discharge to – indeed, 96% do not know where the FS is transported to. However, among the households that knew, the majority reported contents being transported to a wastewater treatment plant.

Table 19 Discharge point of pit/tank contents after emptying – non-sewered areas

	%	No. of households
To river / drains	1%	1
To distant or vacant plots	1%	1
To agricultural fields	0%	0
WWTP	2%	2
Don't know	96%	82
Total	**100%**	**86**

Source: Household Survey.

As mentioned in the previous section, households paid an average of US $68 (470 Bs) for FS emptying and transport services. Table 20 shows the average price paid by type of service hired. The cost of cleaning a septic tank (US $61) or a septic tank and a soakaway (US $69) is lower than hiring an ERTL to clean a soakaway only (US $76). This is probably related to the fact that soakaways may be more difficult to access, with lids/covers having to be removed or broken, whereas septic tanks are more likely to have a hatch for emptying.

Table 20 Type of service and cost – non-sewered areas

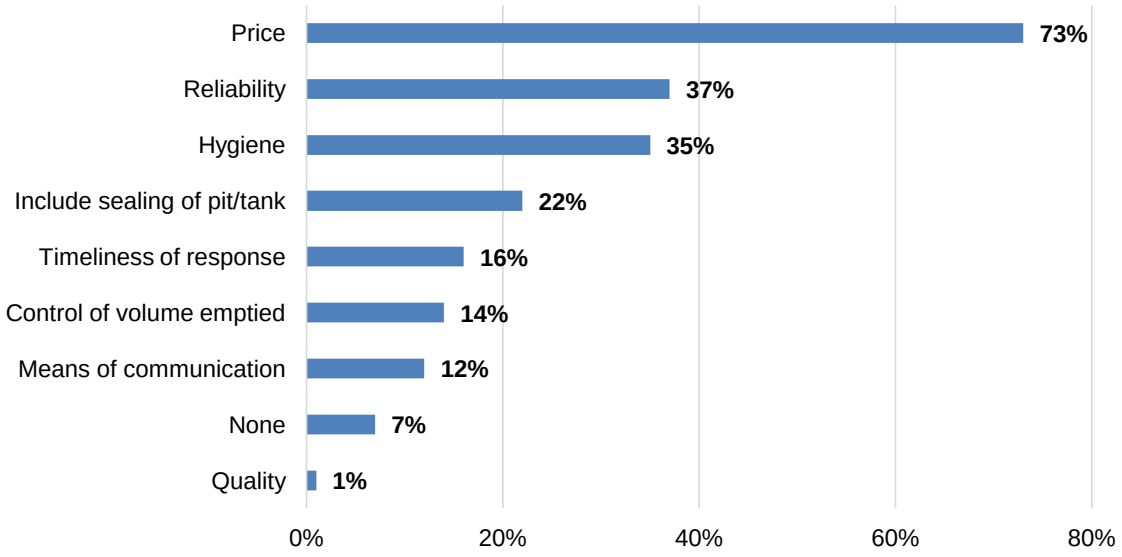
	Average price paid (USD / Bs)	No. of households
Only septic tank	US $61 (418 Bs)	17
Only soakaway	US $76 (522 Bs)	13
Septic tank & soakaway	US $69 (474 Bs)	50
Total	**100%**	**80**

Source: Household Survey.

Households were also asked about their views regarding some of the aspects of FS emptying and transport services that could be improved. Figure 7 shows that among households who have an emptiable facility, 73% of them think that the cost could be "improved", i.e. services could be cheaper. Both ERTLs' reliability (37%) and hygiene practices (35%) could also be improved – indeed, a diagnosis of ERTLs capacity, infrastructure and technology used suggests that workers

do not always use adequate protection equipment (e.g. gloves, masks, etc.), while some of the hoses and connections used for emptying have leakages (Pacheco Civera, 2014).

Figure 7 Elements of FS emptying services that could be improved – non-sewered areas



No. of households = 86.

Source: Household Survey.

4.4.2 Service provider capacity

Manual emptying

There are no legal/formal manual emptying services in Santa Cruz. Manual emptying is likely to be practiced by households who empty their pits/tanks themselves and potentially, some informal service providers.

Mechanical emptying

Mechanical emptying is provided by FS emptying and transport service providers (ERTLs), of which 27 are legally registered to the Water Supply and Basic Sanitation Supervision and Societal Oversight Authority (AAPS). However, given the constitutional ban on private-sector participation in the provision of water supply and sanitation services in Bolivia, there may be some private sector firms illegally operating in the Santa Cruz market – previous studies mentioned there were over 40 ERTLs (see Rivera, 2010); whether these firms have been forced out of the market because of increased competition or they have entered the informal market is unknown. It must also be noted that the registration and formalisation process for ERTLs has 14 different steps, some of which are not easy to comply, so some of the ERTLs that are currently operating in the market may actually be in the process of becoming formalised.

ERTLs are generally subcontracted by one of the ten utilities/cooperatives (EPSAs) that currently provide water supply and sanitation (WSS) services in Santa Cruz. Through this subcontract, ERTLs agree on a fee rate to use the EPSAs' treatment facilities for FS discharge after emptying. However, only SAGUAPAC, the main WSS cooperative has an adequate wastewater treatment facility. SAGUAPAC currently has contracts with only 14 of the 27 ERTLs, meaning that all other

FS collected is treated inadequately or dumped illegally to the surrounding environment. WSP (2016) estimates that around 24,000 m^3 of FS are illegally dumped every year.

Table 21 shows the capacity of ERTLs operating in Santa Cruz for which data is available and that serve household demand for FS emptying and transport. Total capacity in 2013 was equal to 778,591 litres, provided by 64 vacuum trucks and 21 different firms. Between 60 and 65% of trucks are refurbished (e.g. vacuums, container) in Santa Cruz. All of the ERTLs are small enterprises, having a total of between 2 and 6 employees – indeed, some of these firms are actually family-owned entrepreneurships.

Table 21 Capacity of ERTLs operating in Santa Cruz, 2013

Firm name	No. of employees	No. of vacuum trucks	Total capacity (Lts)
Bazan	4	1	14,000
Belén	4	1	4,850
Bolivia	6	4	43,420
La Económica	4	4	69,127
La Económica Uno	3	8	135,762
Mercado San Antonio		1	9,150
El Pauro		4	42,019
Pirai Económico	2	3	30,613
Playon	2	3	30,294
Santa Barbara	6	7	91,250
San Jorge	6	5	58,070
Santa Cruz	3	1	13,619
San Miguel		2	39,500
Servi Master	6	7	65,805
Socorro Camba	3	3	32,481
Soruco Oriental	5	2	14,046
Soruco Peto	3	2	16,674
El Tiluchi	2	2	21,965
La Veloz	2	2	15,446
Serv. Transporte Sanchez	4	1	17,500
Serv. Transporte Padilla		1	13,000
Total	**65**	**64**	**778,591**

Source: Cáceres Magnus (2015).

Table 22 shows the number of discharges and volume of FS transported by ERTLs between 2011 and 2013. For the majority of ERTLs, both the number of discharges and volume transported have increased across time, although some smaller firms seem to be shrinking or are being displaced (e.g. Belen) by larger competitors (e.g. San Jorge, Servi Master). Overall, the number of discharges has grown by 20% while the volume transported has grown by 31% between 2011 and 2013.

Table 22 Number of discharges and FS volume transported by ERTLs, 2011-2013

Firm name	2011		2012		2013	
	No. discharges	Volume (Lts)	No. discharges	Volume (Lts)	No. discharges	Volume (Lts)
Bazan	359	4,020,800	306	3,427,200		
Belén	35	135,800	20	77,600	16	62,080
Bolivia	111	872,070	135	1,533,150	394	3,327,250
La Económica	3,248	46,300,785	2,313	32,932,817	1,043	15,088,084
La Económica Uno	1,463	17,945,350	3,153	42,457,457		
El Pauro	195	1,571,702	173	1,312,426	230	1,680,496
Pirai Económico	482	4,190,990	543	4,721,385	537	4,669,215
Playon	430	3,851,565	721	6,420,750	742	6,597,465
Santa Barbara	2,195	17,829,452	2,404	24,447,027	2,317	21,607,217
San Jorge	2,239	19,786,580	2,642	23,812,268	2,797	28,392,131
Santa Cruz	48	522,960				
San Miguel	270	3,520,549	722	9,933,608	915	14,660,000
Servi Master	1,287	11,050,798	1,144	11,606,454	1,517	19,869,903
Socorro Camba	317	2,000,163	324	3,264,685		
Soruco Oriental	220	1,640,326	232	1,841,990	252	1,888,775
Soruco Peto	266	1,729,047	316	2,308,728	289	2,167,500
El Tiluchi	420	2,730,162	492	3,814,184	490	4,851,268
La Veloz	421	2,536,250	389	2,345,211	463	3,241,000
Serv. Transporte Sanchez	0	0	2	28,000	2	28,000
Serv. Transporte Padilla	359	4,020,800	306	3,427,200		
Total	**14,006**	**142,235,349**	**16,031**	**176,284,940**	**16,860**	**185,915,294***

*Some data for 2013 is missing, so the total reported volume does not match the addition of all volumes for all ERTLs.

Source: Cáceres Magnus (2015).

Based on these data and demand projections for FS emptying and transport services, it seems ERTLs have sufficient flexibility to cope with increasing demand in the medium-term (see SNV, 2015). However, in the extreme case in which all OSS facilities were to become emptiable (e.g. changing lined and unlined pits into cement-lined pits or other emptiable type of containment) and maintenance was carried out on a frequent basis (e.g. once per year), then current ERTLs capacity would be insufficient to meet demand, and investments would be needed to either increase the fleet number or its capacity.

5 City Service Delivery Assessment

5.1 Introduction

The FSM City Service Delivery Assessment (CSDA) is a crucial part of the analysis of FSM services. It answers an overarching question around the quality of the FSM enabling environment, the level of FSM service development and the level of commitment to FSM service sustainability. The aim of the CSDA is to allow an objective assessment of FSM service performance through all stages of the service chain, so as to identify priorities for reform. The Prognosis for Change (in the next section) then attempts to explain *why* the CSDA looks like it does.

The CSDA format builds on an approach developed under the 12-city study (Peal & Evans, 2013). In turn, the 12-city method was based on similar exercises in water and sanitation (e.g. Country Status Overviews produced by WSP).

The CSDA is arranged around three broad areas: (1) enabling services, (2) developing services, and (3) sustaining services. This is illustrated in Table 23 below, alongside the key question associated with each area, and the indicators used.

Table 23 CSDA framework for FSM

Area	Question in research framework	Indicator
Enabling	What are current policies, planning issues and budgetary arrangements?	Policy
		Planning
		Budget
Developing	What is the level of expenditure, degree of equity and level of output?	Expenditure
		Equity
		Output
Sustaining	What is the status of operation and maintenance, what provisions are made for service expansion and what are the current service outcomes?	Maintenance
		Expansion
		Service Outcomes

5.2 Methodology

The CSDA aims to be fully objective and transparent, so the analysis is clear and stakeholders can engage with it and update it over time as the situation improves. It is primarily a qualitative analysis, based on a review of key documents and interviews with stakeholders at the city level. WSP's overall study design was that the OPM/WEDC team designed the methodology, but did not do primary data collection (for more information, please refer to Annex A). For analyses such as the CSDA and PFC, it is very hard to separate data collection from analysis. Therefore, the collection and preliminary analysis was conducted by a short-term consultant contracted by WSP, Humberto Cáceres Magnus.

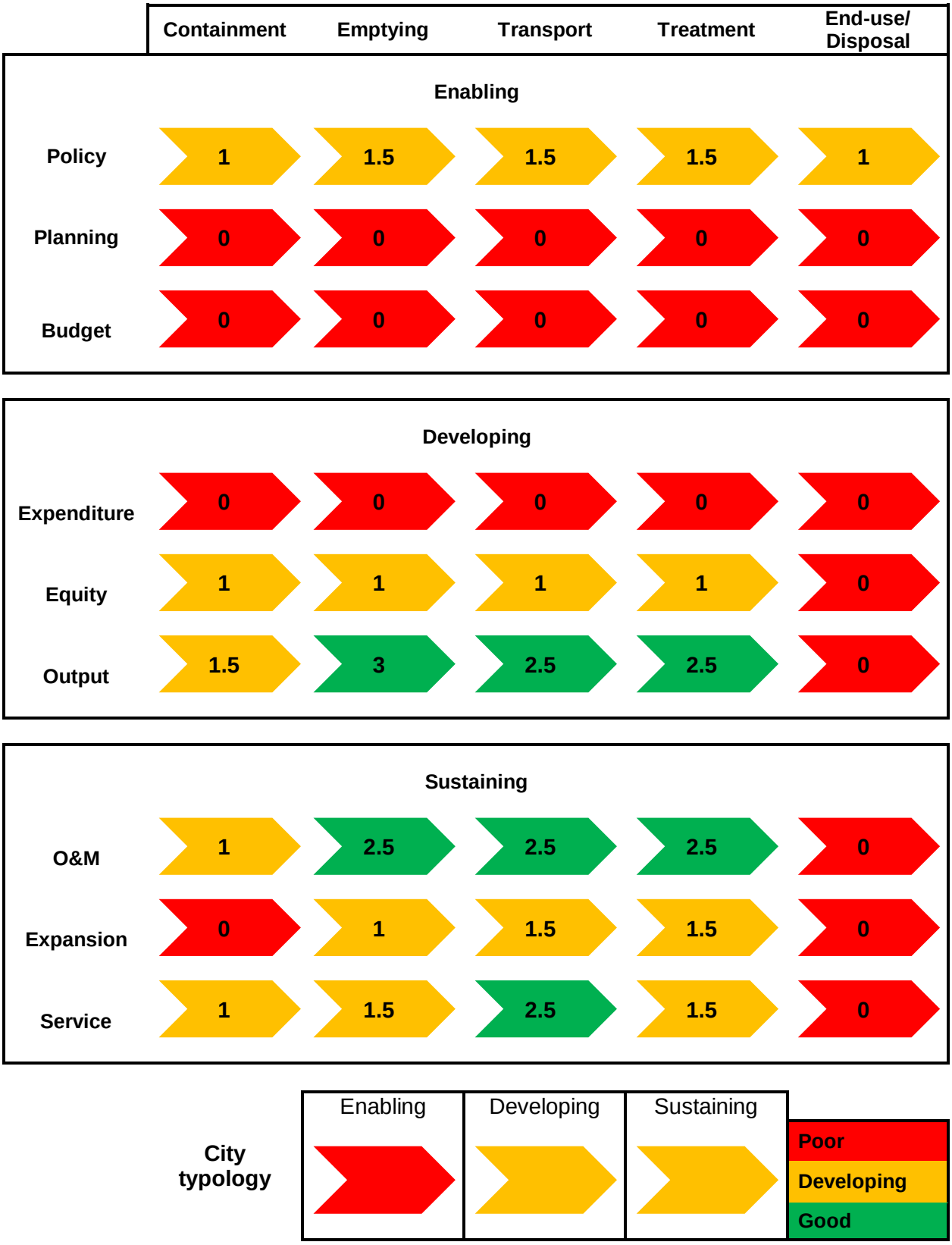
There are several questions beneath each of the nine overall indicators in Table 23 above, with 19 questions in total. For each question, there are objective criteria to enable a score to be given for the city, with 0 (poor), 0.5 (developing) or 1 (good) on that question. Each question is scored along the whole service chain from containment to disposal. An example is given in Table 24 below, for the first question under the "policy" indicator.

Table 24 Example of an CSDA question, criteria and scoring

Question	Containment	Emptying	Transport	Treatment	End-use/ disposal	Indicator/ Score
Policy: Is FSM included in an appropriate, acknowledged and available policy document (national / local or both)?	0.5	0	0	0	0	• **1:** policy is appropriate, approved (or in draft form), acknowledged and available • **0.5:** policy is appropriate, approved (or in draft form), but not clearly acknowledged / available • **0:** policy not available, or inappropriate to the context

Once all 19 questions are scored, the next step is to aggregate those scores into a city scorecard, by summing together the scores for each indicator (policy, planning, etc.). Because there are different numbers of questions for each indicator, a final step is required, which is to normalise the scores to a total out of 3 for each indicator. This is achieved by dividing the city score for that indicator by the maximum possible city score, multiplying by 3, and finally rounding to the nearest 0.5. This process delivers the overall CSDA scorecard. The output for Santa Cruz is shown in Figure 8 below.

Figure 8 CSDA scorecard for Santa Cruz



5.3 Findings

The overall CSDA scorecard for Santa Cruz is shown above in Figure 8. An explanation for each score allocated to the full set of 19 questions is shown in Annex C, while the following sub-sections summarise the implications of those results.

5.3.1 Enabling

The enabling environment refers to the current policy, planning and budgetary arrangements made for FS services. The city of Santa Cruz currently has a poor enabling environment – while all FSM components are considered in water, sanitation or environmental policies, there is no planning and thus, no budget allocated for FSM activities. In particular, the Municipal Ordinance No. 031 of 2001 enacts the Municipal Regulation for Wastewater and Sludge Management in Santa Cruz, explicitly indicating that households without access to sewerage must rely on alternative systems or services for containment, emptying and transport of wastewater and sludge. Standards for emptying and transport services are set out (e.g. types of trucks to be used, health and safety equipment for workers), while Articles 53, 55 and 57 forbid the disposal of wastewater or sludge in public roads, natural water bodies or any other unauthorised area. Article 45 also ordains that the wastewater / sludge producer is “under the obligation of cleaning its septic tank at least once per year”.

In addition, the AAPS Administrative Regulatory Resolution No. 227 of 2010 (i) recognises the existence of septic tanks, latrines and ecological sanitation in areas where there is no access to sewerage; (ii) allows EPSAs (i.e. water supply and sanitation service providers) to provide low-cost FS emptying and transport services (directly or via a third-party) in areas where no sewerage expansion is planned in the short-run; and (iii) regulates ERTLs (i.e. FS emptying and transport service providers) to ensure FS is discharged at treatment facilities and they comply with all legal and environmental standards. Furthermore, the AAPS Administrative Regulatory Resolution No. 546 of 2014 establishes the operational and technical standards under which ERTLs must operate, and the 2016-20 National Sanitation Plan sets out a wastewater reuse policy.

Despite the existence of a relatively comprehensive policy framework, the roles and responsibilities of municipal and national institutions remains unclear – indeed, there is limited engagement from municipal authorities in the provision of water supply and sanitation services, and hence FSM (WSP, 2016). This lack of designated responsibilities directly hinders the operationalisation of the regulatory mechanisms stipulated in the AAPS resolutions above; the AAPS itself is also known to have limited capacity to enforce regulations. Another issue with the current regulatory framework are the rules for formal registration and certification of ERTLs: many of these service providers are family or micro businesses that are unable to comply with all the requirements, e.g. social security for all employees, having a designated office space, etc.

The main deficiencies in the enabling environment are related to planning and budgetary allocations: on one hand, the 2011-2015 Sector Development Plan for Basic Sanitation only considered access to sewerage for people in urban and peri-urban areas, and although FSM is encompassed in the policy and legislation described above, there are no specific targets. On the other hand, given the current limitations for ERTLs to formalise, there are little incentives for FSM investments. Most resources in urban areas are currently being directed towards the expansion of the sewerage network and the construction of new wastewater treatment plants, with SAGUAPAC allocating some resources to increase FS discharge capacity at treatment plants and the AAPS working on improving regulatory mechanisms.

5.3.2 Developing

The developing environment has to do with the level of expenditure or investments, the degree of equity, and the quality and quantity of services provided across the FSM chain. Santa Cruz is currently at a developing stage, with a good range of FS emptying and transport services of decent quality and with enough capacity to meet current demand.

Despite the existence of several ERTLs, the FS emptying and transport services are offered under oligopolistic competition (as described in Section 4.2.2), where there is a tacit agreement between service providers on the price for emptying and transport that allows for higher profits to be made as compared to purely competitive markets. With these prices, services remain largely unaffordable to the poorest households, amounting to almost a third of the current minimum wage. The costs for containment are more aligned with households' ability to pay – however, the type of OSS facilities built by the poorest are rarely deemed as effective containment.

Given the above, as well as the prioritisation of investments in sewerage and treatment facilities, services cannot be deemed equitable, which is one of the areas where Santa Cruz significantly under-performs. Although the city has made significant investments in improving FS services, especially with the support of WSP, most of the focus so far has been on the supply side, i. e. standardising and formalising EPSAs and ERTLs activities. Recent initiatives aimed at increasing competitiveness across ERTLs (e.g. a call centre for FSM services) may reduce prices and allow for increased access among the urban poor. However, more emphasis needs to be placed on these populations, especially with increasing rural-urban migration and urbanisation trends.

Regarding the quantity and quality of the services provided, FSM emptying, transport and treatment services are generally good, but there are still improvements to be made with regards to the availability of treatment facilities for FS discharge (currently, ERTLs can only discharge at the main SAGUAPAC treatment facility), ensuring that all FS emptied is actually transported to a treatment plant, and also guaranteeing that ERTLs comply with all administrative and technical standards (e.g. AAPS registration, provision of health and safety equipment, use of adequate trucks and emptying tools, etc.). There are still no formal services for FS reuse in Santa Cruz, so this is also an area that requires prioritisation.

5.3.3 Sustaining

The sustaining environment captures the status of operation and maintenance (O&M), the provisions made for service expansion and the current outcomes with regards to public health and the percentage of FS that is effectively managed. Overall, the city of Santa Cruz is at a developing stage.

Regarding O&M, although ERTLs do not systematically keep financial records, especially the smallest firms, both Caceres Magnus (2015) and SNV (2015) show that the majority of ERTLs are currently making profits after discounting O&M costs. As mentioned in the enabling and developing sections above, the Municipal Ordinance No. 031 of 2011, all other AAPS regulations, and the documents drafted with WSP support have set out the norms, standards and sanctions for FS emptying, transport and treatment services. Although the local environmental authority is in charge of defining the norms and standards for OSS facilities (i.e. containment), these do not seem to be available, except for septic tanks and soakaways. There are no specific standards and sanctions for FS reuse either.

Moreover, reporting for FS emptying, transport and treatment is currently being undertaken for registered ERTLs, but there is no data for firms that operate in the informal market, nor is there

adequate monitoring of how much FS is effectively contained and the frequency of maintenance of OSS facilities. The AAPS Administrative Regulatory Resolution No. 546 of 2014 provides some guidance on the frequency of reporting on to the AAPS, but this is yet to be fully operationalised.

In what concerns FS services expansion, so far no policies and procedures have been developed to stimulate demand. Although the creation of a call centre for FS emptying and transport services may encourage demand, especially among low-income households, investments also need to be made to ensure that containment facilities are adequately built and maintained to ensure the sustainability of demand. However, government measures for sector development have been taken forwards through the Technical Assistance provide by WSP for emptying, transport and treatment. Further efforts are required to ensure these measures are sustainable, e.g. by including specific targets in national or city-level sanitation plans, and also to strengthen FS containment and reuse sub-sectors.

Finally, performance with regards to service outcomes is relatively good: the percentage of total FS generated by the city that is managed effectively at containment, emptying and transport stages is above 50% (as shown in Figure 5), and thus the public health risks at these stages are between low and medium. Health risks at containment are deemed to be high as some of the OSS facilities are not built properly, leaching into the surrounding environment, while many other overflow due to poor maintenance. Risk is deemed at a medium level for emptying as some ERTLs use faulty equipment and not all personnel is adequately protected.

5.3.4 Implications of the CSDA scorecard

The resulting CSDA scorecard for Santa Cruz suggests that service delivery is poor for the enabling environment, but developing across the developing and sustaining environments. Indeed, Santa Cruz has a relatively developed FSM context for Latin America with a comprehensive regulatory framework for emptying, transport and treatment, as well as 27 operational and formal FS emptying and transport service providers that seem to be financially sustainable (i.e. current demand allows firms to cover their O&M expenses and in some cases, make some profit).

Nonetheless, there are several issues that need to be improved. On one hand, although there are containment standards for rural areas, where OSS is more predominant, there are limited standards or regulations for containment, which are only existent for septic tanks and soakaways, and are not necessarily acknowledged. These are key to ensure that FS does not end-up in the surrounding environment or receiving waters, but also to encourage household demand for FS emptying and transport services. Efforts should also be made to ensure containment standards are disseminated across non-sewered areas to increase compliance, especially given the limited capacity for monitoring and enforcement. A regulatory framework is also required for FS reuse – although there have been some initiatives directed at regulating wastewater reuse in other cities of Bolivia, there are no frameworks for FS reuse in urban areas. On the other hand, more capacity (both financially and with human resources) needs to be given to the AAPS and other local authorities to improve the enforcement of regulations, especially regarding ERTL formalisation and adequate FS treatment.

Another issue that needs to be addressed is the lack of equity of the current FSM market – the average cost of a FS emptying and transport service is US $68, which amounts to almost a third of the Bolivian minimum wage and thus remains unaffordable to the poorest households. Indeed, there have been reports of some households puncturing their septic tanks to delay fill-up rates. Costs could be reduced by increasing market competition or providing some sort of cross-subsidy for the poorest households. Service provision could also be improved by enforcing technical

standards for FS emptying and transport as to minimise health risks for both consumers and suppliers.

Finally, although significant efforts have been made since 2009 with WSP's support, ways to maintain political buy-in need to be explored to ensure the FSM sector is also prioritised and focus is not solely directed towards expanding the sewerage network or building new treatment plants. Planning and budget allocations need to include FSM to ensure services are sustainable in the medium- to long-term – this cannot be achieved without a full commitment all relevant stakeholders (including government, private sector, civil society, etc).

6 Prognosis for Change

6.1 Introduction

This chapter provides a Prognosis for Change (PFC), by considering the positions of various stakeholders, in particular the institutions and incentives at play. In the sanitation sector, key studies considering these questions include a multi-country study carried out by WSP with OPM (WSP, 2010) and a series of papers by the Overseas Development Institute (ODI, 2013). In addition, SANDEC's recent FSM book includes a chapter on stakeholder analysis, which is a key methodology for this kind of analysis (Strande *et al*, 2014). Through this prognosis for change, it is intended to understand three elements, which are briefly outlined below and in Figure 9.

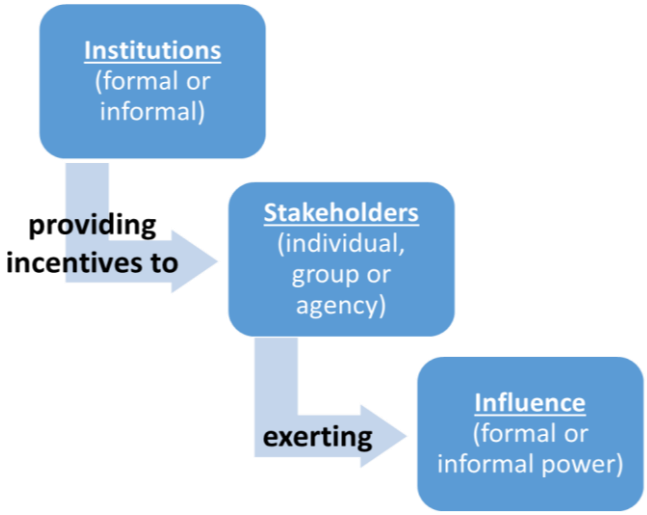
Firstly, a PFC considers *how institutions function*. Here, institutions are defined as "the rules and norms governing human interaction", rather than a narrower definition of organisations. Institutions can be formal – such as codified laws, e.g. a by-law about where FS can be legally dumped – and informal, as is the case of social norms, such as prevailing attitudes towards reusing FS in agriculture.

Secondly, a PFC considers the *incentives* which institutions provide to different stakeholders. A stakeholder is any individual or group with an interest in the outcomes of a policy. In FSM, stakeholders may include sludge truck companies, the municipality, or poor households. Stakeholders can be defined broadly or narrowly defined as required by the breadth and depth of the analysis. For example, the former stakeholders could be narrowed to recent entrants to the sludge truck market, the planning department of the municipality, or poor female dwellers. This allows for a more nuanced analysis rather than taking all organisations as homogeneous.

Third, a PFC considers how stakeholders exert *influence*. Here, influence is defined as the formal or informal power to cause something or to prevent it from occurring. In FSM, it might be worth considering municipality by-laws on fecal sludge. A municipality may have formal legal power, but if all their by-laws are openly flouted by service providers without fear of punishment, then their influence is very low by that measure. They may however have informal power to influence the FSM market in other ways, such as the actions undertaken by employees when they identify a blocked sewer pipe.

Finally, for a PFC to be practically useful, it should also consider the implications of the findings for effective engagement in a reform or change process. This involves the assessment of the options for engagement, and weighing them up in the context of the prevalent power dynamics and likely response of stakeholders.

Figure 9 Key concepts in PFC assessment



6.2 Methodology

In this study, developing a PFC was only one concern alongside a large number of other research components. There was therefore a balance to be struck. The approach was to link a focussed PFC closely to the service delivery assessment, presented in the previous section (Section 5). The aim is therefore to explain *why* the CSDA is as it is – in other words, to explore why service delivery blockages exist and what entry points are available to stakeholders to try and resolve them.

Undertaking a PFC is primarily a qualitative exercise. It relies mainly on Key Informant Interviews (KIIs) with relevant stakeholders and focus group discussions, alongside secondary data in the form of key sector documents, reports and studies. As noted in Section 5.2 for the CSDA methodology, the OPM/WEDC team did not conduct the primary data collection and preliminary analysis, which was carried out by other consultants contracted by the World Bank. Reports from these consultants were the primary inputs for the construction of this PFC.

Developing a PFC requires a structure in order to be clearly analysed and communicated. There are a bewildering number of tools available, which can be applied to particular questions as to explore some of the issues described in Section 5. Many tools which are commonly used, including in this study, are contained in a sourcebook which OPM produced for the World Bank (Holland, 2007). The main tools used include institutional responsibility analysis, stakeholder analysis and process mapping.

6.3 Findings

As noted above, the main objective is to explore why the CSDA results are as they are. For Santa Cruz, the CSDA is broadly yellow (i.e. “developing” scores), with red (i.e. “poor” scores) for planning, budget and expenditure, and the reuse stage of the FS chain. Scores for the areas of the chain across the developing and sustaining environments are between 1 and 3 (“developing” to “good”), with generally good performance for emptying, transport and treatment stages, especially regarding outputs, O&M and service outcomes. Thus, the job of the PFC in the Santa Cruz context is to try and explain “why is this the status of FSM” and what the prognosis for change is.

At this stage, it is worth reconsidering Santa Cruz’ context and the responsibility of key actors, which were briefly set out in Section 2.3.

6.3.1 Santa Cruz' FSM context

Overall, 49% of households in Santa Cruz are connected to the sewerage network, with the remaining households using on-site sanitation (46%) or practising open defecation (5%). In addition, household survey data suggests that, among households using OSS or practising OD, around 69% have an improved sanitation facility, 22% have a shared facility, and the remaining 9% have an unimproved facility.

Focussing exclusively on the demand for FSM services, among households using OSS, 27% claim to empty their tanks / pits, with 95% of them using FS emptying and transport services provided by ERTLs. Services seem to be mainly used for facilities discharging into a septic tank with soakaway or a septic tank, with a frequency of 6 months for the majority of septic tanks and between 7 to 12 months for most soakaways – however, the average reported fill-up rate is around 2.5 years for all types of OSS facilities. Although around 83% of containment facilities have an access point for emptying, the majority are not properly built (e.g. some household perforate their septic tanks to reduce the fill-up rate, recent proliferation of lined but bottomless pits) with FS leaching into the surrounding environment. Considering that around two thirds of the FS collected does not reach a treatment facility, estimates suggest that in non-sewered areas of Santa Cruz only around 8% of total FS is effectively managed (see Figure 6).

Santa Cruz has a relatively developed FSM market, with 27 ERTLs formally (i.e. registered) operating. Previous studies suggest that the price setting occurs under oligopolistic competition, with ERTLs making higher profits than expected in a purely competitive market. On average, households pay US $68 per FS emptying and transport service, which amounts to almost a third of the current Bolivian minimum wage. When asked about FS service satisfaction, 73% of households consider that prices could be "improved", suggesting that the cost for FS emptying and transport is indeed too high for the average household in non-sewered areas.

Although the developing and sustaining environments are both at a developing stage, the enabling environment remains poor – despite the existence of FSM policy, there are very limited planning and budgetary arrangements. FSM services remain inequitable (i.e. unaffordable to the very poor) and without clear governmental support – most of the focus is still on sewerage expansion and the construction of wastewater treatment plants. Another area that requires further attention is FS reuse: there is some policy development happening with the support of WSP, but it mainly refers to wastewater reuse for irrigation with no explicit mention of FS reuse in urban or peri-urban areas.

6.3.2 Mapping institutional responsibilities

The focus of the PFC is on how institutions function, the incentives which those institutions provide to stakeholders, and how those stakeholders exert influence. It is therefore important to understand who those stakeholders are, alongside their formal and informal roles. A useful tool to do this is institutional responsibility mapping, as set out in Table 25 below. Stakeholders have been categorised by sector (e.g. national or local government, private, etc.), and both their formal responsibilities ('what should be happening') and the reality ('what actually happens') in FSM in Santa Cruz are described. A final column summarises some of the main challenges faced.

The main messages are the following:

- Roles and responsibilities across national, departmental and municipal governments may be clearly defined but are not clearly understood / practiced, with the Ministry of Environment and Water having limited participation in the design of FSM policies, the Santa Cruz department also remaining relatively inactive given that services seem to be

adequately provided by the municipalities, and the municipalities subsequently remaining on the margin and trusting EPSAs to be adequately managing and monitoring ERTLs.

- The lack of defined roles and responsibilities for FSM impacts on the availability and allocation of financial and human resources for FSM both regarding budget and planning but also for the effective implementation of the regulatory framework. For instance, the AAPS has limited capacity to support ERTLs in fulfilling all registration and certification requirements and also ensure that services are adequately provided. The focus on ERTL registration and certification (which pertains more to the AAPS and the SNI) may also be distracting national, departmental and municipal governments from broader FSM issues.

- Regarding the supply of FSM services, EPSAs have contracted ERTLs for the provision of FS emptying and transport services, but only SAGUAPAC has adequate facilities for FS discharge and treatment. This reduces competition among EPSAs and does not allow ERTLs to comply with environmental standards. Moreover, given the nature of some of the ERTLs (i.e. small or family-businesses), almost half of them remain unregistered and thus operate partially or fully in the informal market. Given the limited capacity of the AAPS and SNI to do effective monitoring, ERTLs sometimes also engage in tax evasion.

- On the demand side, households, commercial establishments and the industry / oil businesses all seem to be paying higher prices than they would otherwise pay in a competitive market. There are also issues regarding the quality of construction of OSS facilities (not all of them are emptiable or leach into the surrounding environment) and awareness of the required frequency of maintenance activities.

Table 25 Institutional responsibility mapping for FSM

Categories	Stakeholder	Formal role	The reality	Core challenge
National government	Ministry of Environment and Water (MMAyA) – in particular, the Vice Ministry for Water Supply and Sanitation	• Policy design and establishment • Ensure financial resources are allocated to the sanitation sector	• Policies and regulations for the design of wastewater treatment plants and the construction of OSS facilities (i.e. septic tanks) for areas with less than 10,000 inhabitants are available. However, the implementation of these regulations has been limited and there are no specific provisions for FS services across the whole chain at a national level • They have had very limited active participation in the design of FSM policy	• Limited financial and human capacity • FSM considered a short- to medium term sanitation alternative
	Water Supply and Basic Sanitation Supervision and Societal Oversight Authority (AAPS)	• Regulate and monitor the provision of emptying, transport and treatment services • Approve tariffs and fees for emptying, transport and treatment of FS	• The registration of all ERTLs is currently underway (with 14 out of 27 already registered) but no official monitoring and enforcement of regulations has been implemented	• Limited capacity to carry out monitoring and enforcement of regulatory framework
	National Tax Service (SNI)	• Activity registration and designation of tax identification number to water supply and sanitation service providers (EPSAs) and FS emptying and transport service providers (ERTLs)	• Generally, ERTLs that are formally registered comply with tax regulations. However, small, family-businesses and informal firms do not provide receipts / proof of purchase to costumers to avoid taxes. There is limited monitoring from SNI to prevent this from occurring	• Limited financial and human resources to carry out proper vigilance
Departmental government	Santa Cruz Government	• Ensure the adequate provision of FS emptying, transport and treatment services (only if municipal governments do not have the capacity)	• Limited involvement from the departmental government as FSM services seem to be adequately provided by the municipality	• Limited financial and human capacity • Prioritisation of other sectors with a focus on expanding the sewerage network vs.

	Santa Cruz Environmental Authority	• Approval and classification of adequate practices and remedial actions with regards to FSM activities • Environmental monitoring for FS management and final disposal	• The Authority assumes that all FS discharges to SAGUAPAC treatment plants are disposed of correctly and carries out limited monitoring of discharges for other ERTLs	provision of adequate FSM services
Municipal government	Municipal Governments	• Ensure the adequate provision of FS emptying, transport and treatment services, directly or through public, communal or mixed service providers or cooperatives • Establish the fees for FS emptying, transport and treatment (if services are directly provided) • Grant operative licenses to ERTLs	• Municipal governments have remained on the margin of coordination and service provision on behalf of EPSAs and ERTL, focussing exclusively on granting licenses and occasional environmental monitoring	• Allocation of responsibilities remains unclear, esp. with decentralisation • Reliance on other authorities to guarantee the adequate provision of FS services • No specific budget allocated for water and sanitation
	Water supply and sanitation service providers (EPSAs)	• Provide FS emptying, transport and treatment services directly or through a third party (when this responsibility is delegated by the municipal governments) • Estimate and propose fees (to be considered by the AAPS) for FS emptying, transport and treatment services	• SAGUAPAC is the only service provider that is fully complying with all FS regulations • Not all EPSAs have records of the quantity of FS emptied and transported, limiting their ability to improve services	• Not all EPSAs have wastewater / sludge treatment plants to ensure ERTLs properly discharge FS • Limited financial resources to build new wastewater / sludge treatment plant and guarantee their O&M in the long-run
	FS emptying and transport service providers (ERTLs)	• Supply and provide FS emptying and transport services	• ERTLs generally provide adequate FS emptying services but around 33% of FS collected is not transported and discharged to a SAGUAPAC treatment plant. In addition, not all ERTLs operate in the formal market	• Family-based and small firms do not comply with all requirements to become formal • Subjected to EPSA capacity and contractual arrangements

Private sector	Households	• Ensure adequate FS containment and demand and use FS emptying and transport services	• FS containment is not always effective and there is limited knowledge about OSS standards and required maintenance (e.g. frequency of emptying)	• Low-income households have a limited ability to pay for FS emptying and transport services • No measures / initiatives to educate households on proper FSM • Limited knowledge of what happens with FS after it is collected • Potentially, paying higher prices for FS services
	Commercial establishments	• Ensure adequate FS containment and demand and use FS emptying and transport services	• Not all OSS facilities are adequately built	• Limited knowledge of what happens with FS after it is collected • Potentially, paying higher prices for FS services
	Industry and oil businesses	• Ensure adequate FS containment and demand and use FS emptying and transport services	• These businesses usually comply with FS containment requirements and ensure that FS is transported to an adequate treatment facility	• Potentially, paying higher prices for FS services

Source: Cáceres Magnus (2012, 2015).

6.3.3 Influence and interests of stakeholders

When considering reform options, as would be the case with the introduction of a call centre for FS emptying and transport services, it is crucial to consider how stakeholders might respond, e.g. who would be supportive and who would oppose – in other words, their interest or whether they stand to gain or lose from any change to the *status quo*. With a limited amount of time and effort to put into preparing the ground and working with different stakeholders, it would be wise to use that time efficiently and target it at the right people. Therefore, information about stakeholders' interests is not enough. It must be used in combination with an analysis of their relative influence. This will allow to identify who potentially opposes the reform and, among them who has enough decisive power to prevent it from being implemented. We will use the introduction of the call centre for the provision of FS services as an illustrative example, but this analysis can be carried out for any other initiative considered for the improvement of FSM services in Santa Cruz.

Interest and influence can be scored and mapped onto a stakeholder matrix, as in Figure 10 below. Although stakeholder matrices can help start a conversation about stakeholder engagement in reform processes, they have inherent limitations, e.g. it is not possible to be certain about how different stakeholders would respond, stakeholders are not homogeneous, etc. In the matrix shown below, the question of whether each stakeholder would support or oppose the creation of a call centre to enhance competition for the provision of FS emptying and transport services is considered. Their relative interest and influence to cause or prevent such a change is assessed and scored on a scale from -10 to 10. Thus, a score of (-10,-10) represents a stakeholder that strongly opposes the reform but has minimal influence, while a score of (10, 10) is representative of a stakeholder that shows strong support and is also decisive for the reform to be implemented.

Figure 10 Stakeholder matrix for creating a FSM services call centre

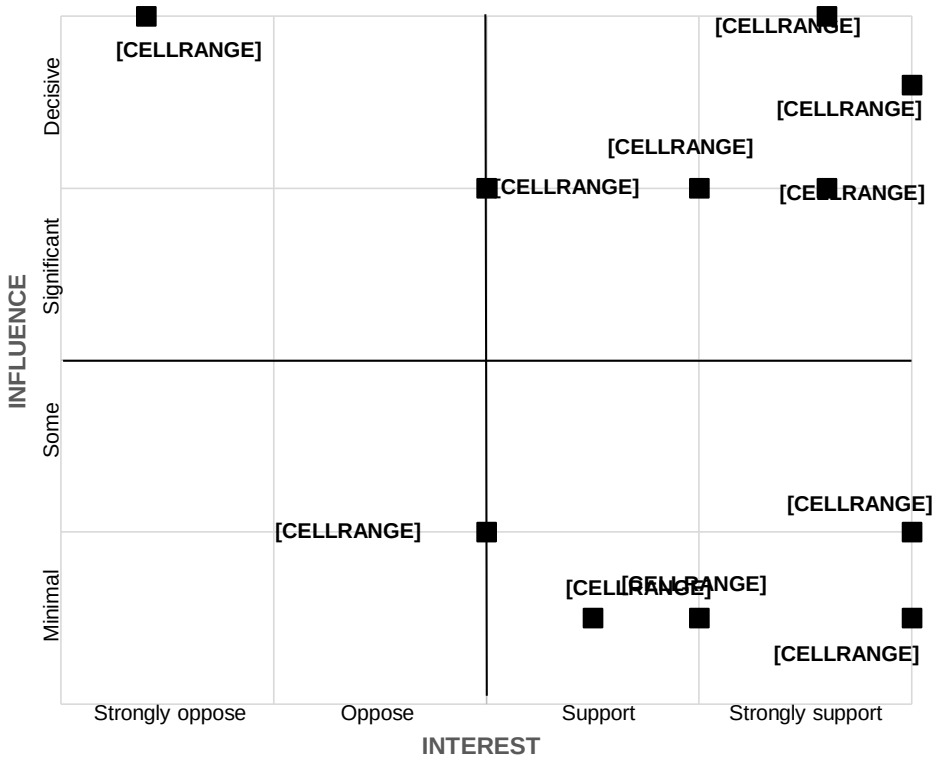


Figure 10 suggests that the majority of stakeholders would support or strongly support the creation of a call centre in Santa Cruz for the provision of FS emptying and transport services. This is partly based on KIIs carried out by SNV with different stakeholders to assess the viability of this initiative.

Starting with national level stakeholders, the Ministry of Environment and Water (MMAyA) was placed in a neutral position with significant influence, given its overview of all the water supply and sanitation sector, but also its limited involvement in the design and implementation of FSM policies in urban areas, especially with decentralisation of responsibilities to departmental and municipal levels. On the contrary, the National Tax Service (SNI) would potentially have minimal influence (as the call centre would only operate with registered ERTLs), but may display some support as the call centre would help enforce monitoring and thus reduce tax evasion. Finally, the AAPS, given its regulatory functions and vigilance over tariffs and prices, as well as its active involvement in the design and implementation of FSM policies, is deemed to be decisive and also highly supportive as the call centre would help it fulfil its monitoring obligations by providing key information on the number of discharges, FS volume treated, FS origin, etc. The AAPS also believes the call centre would improve the quality of FSM services and would guarantee a fair price to consumers (SNV, 2015).

At the departmental level, the Santa Cruz government could potentially have some significant influence, given its mandate over municipalities, and would likely support the call centre as it would contribute to its responsibility of guaranteeing adequate FS emptying, transport and treatment services. However, the Santa Cruz Environmental Authority is likely to have little influence and take a neutral position: although the call centre may increase demand and thus the proportion of FS that is effectively managed, it may also divert more active investments on treatment plants or other initiatives directly targeted at environmental management.

At the municipal level, local governments are decisive (given their direct mandate over the provision of water supply and sanitation services) and will strongly support the call centre given the potential benefits to consumers and also its possibility for enhancing monitoring and enforcement of FSM policy and regulations. Similarly, the EPSAs will strongly support the creation of the call centre, but have a lower level of influence. In particular, EPSAs believe that there is likely to be an increase in demand and thus increased competition and improved price-setting (SNV, 2015). Finally, the ERTLs will strongly oppose the initiative: they argue that firms are highly heterogeneous in terms of size, interests and market development capacity, which would difficult price-setting. They would also distrust the transparency of the call centre in monitoring and allocating FS emptying and transport services to the cheapest supplier. ERTLs are deemed to be decisive in this case because a call centre cannot be established or maintained without their full cooperation (Ibid, 2015).

Lastly, with regards to households, commercial establishments and industry, all of them have minimal or some influence – since households are likely to be the main beneficiaries, a higher level of influence has been allocated to them. Assuming prices for FS emptying and transport services are likely to decrease in a context of higher competition between ERTLs, then these stakeholders would also be supportive of the introduction of a call centre. However, the industry and oil businesses, given their higher ability to pay, would potentially express more indifference; thus, their lower level of support.

6.3.4 Illustrating the incentive problem

It is also helpful to consider the problem of poor FSM in Santa Cruz in two dimensions. The first dimension is *static*, that is, the way households, service providers and government stakeholders are currently dealing with OSS and FSM (partly described in Table 25 above). The second dimension is *dynamic* – the city is changing both spatially and demographically (e.g. increased migration from rural areas). In terms of policy, the static problem requires an action that could be implemented immediately but may have a slow response over time – for example, there may be ways of persuading households to improve their OSS facilities and carry out maintenance on a

frequent basis. However, the dynamic problem requires long-term involvement and engagement in areas that are more the domain of urban planning than sanitation policy and practice, e.g. ensuring that rural migrants settle in adequate areas that allow for the effective provision of water supply and sanitation services.

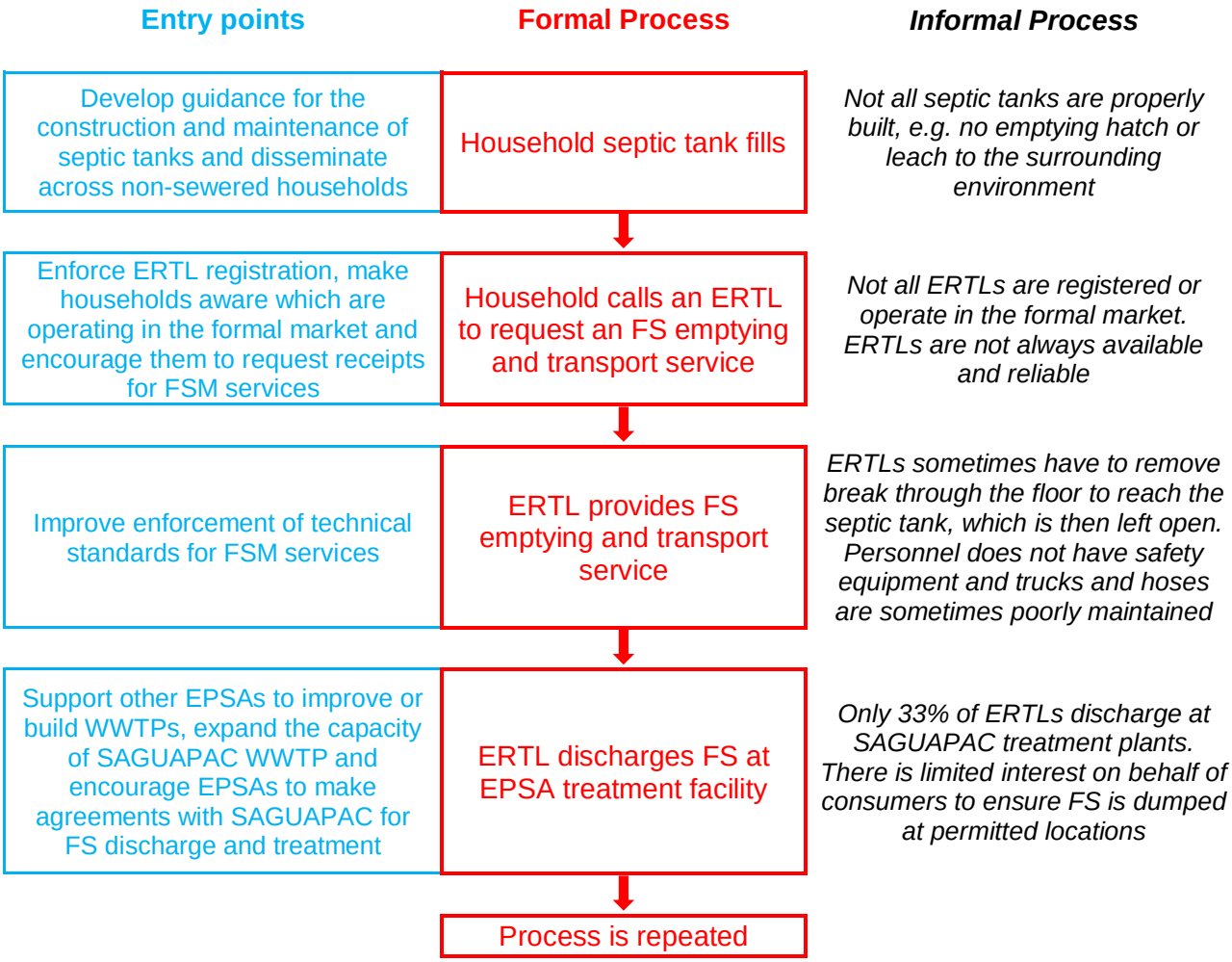
A useful tool to illustrate these problems is *process mapping*. This tool aims to understand the interaction between formal and informal "steps" in a process and identify entry points for engagement. Similarly to the stakeholder matrix, it is important to assess the roles of the key stakeholders in a process, how and where they exert influence, and the incentives they face in both formal and informal systems.

For this analysis, we have focussed on the process for requesting FS emptying and transport services when a septic tank fills up. This is shown in Figure 11 below. The central column shows the formal process that is supposed to be followed by the household, while the right column shows elements of the informal processes, i.e. what really happens.

Once a septic tank fills up, the household calls an ERTL to request an FS emptying and transport service. The ERTL should then provide the services, ideally within the day, and transport the FS to an EPSA treatment facility to ensure effective management. In reality, however, not all septic tanks are properly built or adequately maintained, making demand more unreliable and also making it more difficult for ERTLs to provide an adequate service. Once an ERTL is reached, they are not always readily available and may not be able to provide FSM services in a timely manner. Moreover, even if the services are provided, these are not necessarily of the highest quality, with some ERTLs not having adequate or properly maintained equipment. Only around half of ERTLs are currently registered, with the remaining ones operating in an informal environment and possibly, evading taxes. Finally, once FS is collected from the household, only 33% is effectively transported and discharged at a treatment plant, with the remaining FS being discharged in the surrounding environment or at treatment facility that does not provide effective treatment for FS.

The divergence between formal and informal processes gives rise to different entry points to improve FSM services. All of these entry points are aligned with some of the deficiencies identified in the enabling, developing and sustaining environments in the CSDA. First, it would be helpful for households if there were publicly available standards for the construction of OSS containment facilities and these were adequately disseminated – enforcement is likely to be more difficult given that many households are built by informal contractors or families themselves. Second, the AAPS and EPSAs should continue their efforts to encourage ERTLs formalisation, but efforts should also be directed towards consumers (e.g. households, commercial establishments, etc.) to encourage them to request receipts for the services received from ERTLs. Third, to ensure that services are adequately provided, the administrative and technical standards encompassed in the AAPS Administrative Regulatory Resolution No. 546 of 2014 should be enforced. Finally, to increase the proportion of FS that is effectively managed, it is necessary to either invest in the construction of new wastewater and FS treatment facilities to be managed by other EPSAs besides SAGUAPAC, or the latter's wastewater and FS treatment capacity needs to be increased. Flexibility in the contracts between ERTLs and EPSAs to ensure SAGUAPAC treatment facilities are always used in the meantime may also improve the effectiveness of FS management.

Figure 11 Process mapping for a septic tank filling up



6.3.5 Implications for FSM in Santa Cruz

This chapter has explained why the CSDA for Santa Cruz is poor for the enabling environment and at a developing stage across the developing and sustaining environments. As described in earlier sections, although the regulatory framework and services are relatively well developed across the emptying, transport and treatment stages of the FSM chain, a stakeholder mapping analysis reveals that the roles and responsibilities across different government levels are not clearly understood, with central/national and departmental governments remaining largely inactive in the design of FSM policy and provision of services. This is partly explained by the decentralisation of water and sanitation services in the 90s, which allocated responsibilities to the lowest levels of government in an attempt to increase government accountability to the electorate, among other concerns. However, for decentralisation to be effective, financial resources need to be allocated to the sector, and more specifically, to FSM. This requires more political buy-in for FSM, and subsequently, more active participation in the design of FSM policies and programmes.

Regarding the actual supply of FSM services, although the contractual arrangements between EPSAs and ERTLs seem to be operating relatively well, SAGUAPAC is currently the only WSS utility that can offer adequate treatment for FS. This may reduce competition between EPSAs and also limits the ability of ERTLs to comply with technical and environmental standards. ERTLs service provision is also hindered by the existence of very demanding requirements for formalisation as compared to their average size (e.g. number of employees, emptying trucks, etc.)

and nature (e.g. micro-firms or family businesses). On the demand side, households in non-sewered areas, especially the very poor, are not familiar or are unable to afford adequate containment options, with many pits, soakaways and septic tanks leaching into the surrounding environment. Although the law suggests that septic tanks should be emptied or checked once per year, households do not seem to be aware of this legislation nor is it enforced.

If a reform to develop or improve FSM was proposed, the stakeholder matrix analysis suggests that, given the limited involvement in FSM to date from central/national and departmental governments, they are likely to take a neutral or slightly supportive position, despite them being highly influential for the implementation of any initiative in the WSS sector. Both the AAPS and the SNI, given their direct role in the formalisation of ERTLs, are likely to be supportive and decisive/highly influential, with the likely exception of cases in which revenues collected through formalisation processes are reduced. At the departmental level, stakeholders are also likely to be supportive, mainly because reforms to improve FSM would contribute to their responsibility of guaranteeing adequate access to water and sanitation within the department of Santa Cruz, although potentially less influential than central-level government institutions. Finally, both municipal stakeholders and consumers (households, commercial establishments and industry) will likely support all measures to improve FSM, with the exception of reforms that increase competition among ERTLs, as this will lead to a reduction in profits and the exit of the most inefficient operators, which may deter some EPSAs and ERTLs to give their full support. However, all of these stakeholders, on their own, are less decisive, and they would only be able to drive a reform is some sort of “collective action” is undertaken.

Lastly, a process mapping analysis points to some of the interventions that could be carried out to improve FSM services. These include: (i) developing standards for OSS containment, which are publicly accessible and acknowledged by all citizens and government counterparts; (ii) support ERTL formalisation with consumer education or sanctions if formal service providers are not contracted; (iii) enforce ERTLs administrative and technical standards; and (iv) increase FS treatment capacity.

7 Conclusions and recommendations

The study has identified several key challenges in ensuring continued provision of safe sanitation services to all citizens in Santa Cruz. Besides inherent issues related to heightened rural-urban migration and thus, increased urbanisation, other concerns relate to:

- Lack of adequate containment facilities and maintenance – many of the pits / tanks built in peri-urban areas leach into the surrounding environment. Given a high water table and poor maintenance on behalf of households, sanitation facilities also tend to overflow. It is mainly in these "emergency" cases when FS emptying and transport services are demanded. Poor containment is also reinforced by the lack of or unawareness of construction standards and guidelines, and insufficient vigilance.

- High inequity across the FSM service provision chain – while there are 27 different ERTLs operating in Santa Cruz, FS emptying and transport services remain unaffordable for the poorest and most vulnerable households. The cost of adequate sanitation and containment infrastructure is also high.

- No frameworks for FS reuse – although wastewater reuse for irrigation has been explored, FS reuse has not been considered yet. FS is currently discharged at one of SAGUAPAC's treatment plants with other EPSAs not having the capacity or the facilities to receive collected FS.

Whatever interventions are proposed as a result of detailed, extensive and focused studies to address these challenges, and recognising that Santa Cruz citizens will need to rely on on-site sanitation facilities for the next 15-20 years (as sewerage coverage will not grow as fast as the urban population), the findings of this study recommend:

1. Ensuring adequate infrastructure is available at all stages of the FSM chain, focussing mainly on containment and treatment. As mentioned in WSP (2016), technical norms and guidelines for the construction of sanitation, containment and treatment facilities need to be established and enforced by municipal governments.

2. Procedures and regulations for ERTL formalisation should be more flexible and aligned with the nature of service providers (i.e. small micro or family businesses), which currently face significant barriers to meet AAPS and SNI requirements. Besides the direct benefits perceived by these firms with formalisation, competition will increase as more businesses become formal, increasing the efficiency and equity of the FSM market.

3. Affordability and access to FS emptying and transport services needs to be guaranteed. Besides finding ways to increase competition among ERTLs, cross-subsidies or alternative payment schemes should also be considered to increase access for the poorest and most vulnerable.

4. Although the FSM market is relatively developed in Santa Cruz, the enabling environment is still focussed on the provision of sewerage services. FSM is encompassed in policy at different stages, but with several gaps containment and reuse. However, national or municipal water and sanitation plans have no targets for FSM components or OSS, and thus, there are no budget allocations for them either. Public sector institutions are already struggling to monitor and enforce recent FSM regulations, so more resources (including personnel) are needed by the sector. Established plans and budgets may also encourage political buy-in, especially at lower levels of government.

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Annex A Methodology

The overall case study methodology is explained in the Tools and guidelines and Data Collection Instrument.

A.1 Overall design

A key component of this study was primary data collection, since it aimed to build on an earlier 12-city FSM study based only on secondary data (Peal & Evans, 2013). The study had six different data collection instruments, four quantitative and two qualitative, each of which contribute to various project components. These instruments are summarised in Table 26 below.

Table 26 Summary table of data collection instruments

	Instrument	Data source	N per city
Quantitative	Household survey	Survey of households (i) in non-sewered areas of Santa Cruz (Sample A), (ii) in lowest-income non-sewered settlements (Sample B)	720 (360 in each sample)
	Observation of service provider practices	Observations of containment	Not carried out
	Testing fecal sludge characteristics	Samples from (i) pits/tanks, (ii) truck/vessel outflow, and (iii) compost for reuse.	Not carried out
	Transect walks	(i) Observation of environmental and public health risks through transect walks	Not carried out
		(ii) Drinking water supply samples, tested for fecal contamination and chlorine residual	Not carried out
		(iii) Drain water samples, tested for fecal contamination	Not carried out
Qualitative	Key informant interviews (KIIs)	(i) government (e.g. council / utility, ministries) (ii) service providers along the sanitation chain (iii) other key FSM agencies	As required
	Focus group discussions (FGDs)	FGDs with non-sewered, low-income and informal communities	10

The overall design decided by WSP was that the OPM/WEDC team should lead on methodology and analysis, while actual data collection would be managed by two types of consultants contracted separately. A local NGO, SNV Bolivia, was contracted by WSP to conduct primary data collection except for the Key Informant Interviews. In addition, a short-term consultant (Humberto Cáceres Magnus) was contracted to conduct the Key Informant Interviews and produce a draft of the Service Delivery Assessment and Prognosis for Change.

Detailed research protocols for the instruments in the table above are available in a separate instruments report here. This section briefly summarises each instrument, and the ensuing section describes the sampling approach.

Household survey

The household survey aimed to collect data from households using on-site sanitation regarding their use of FSM services and preferences for future FSM services. The household survey informs

multiple components of this research. The sampling was carefully planned so as to allow representative conclusions to be drawn from households in non-sewered areas of Santa Cruz Metropolitan Area[18], and separate conclusions for lowest-income non-sewered areas[19] in particular, on a purposive basis. Questionnaire sections included a household roster, dwelling characteristics, use of water and sanitation infrastructure, satisfaction and planning on sanitation, maintenance and emptying, and interest in the development of a call centre and willingness to pay.

Key informant interviews

Key informant interviews (KIIs) are the way in which primary information was sought to address key questions about how both the 'enabling environment' and the operating environment affects FSM services (past, current and future). KIIs were held with stakeholders having responsibility or interest in FSM services at city-level and beyond, allowing the enabling and operating environments to be better understood in relation to their influence within the city.

Focus group discussions

The objective of focus group discussions (FGDs) with residents of informal settlements was to gather qualitative data that would complement, validate, or perhaps challenge responses made during the household survey. Questions focused on obtaining information relating to household sanitation and FSM practices (particularly identifying the practices of "others", as individuals are reluctant to talk honestly about their own, or their families' practices), service levels, past interventions, risks and other issues associated with FSM services that affect their community.

A.2 Sampling

A.2.1 Household survey

The main sampling method design was for the household survey, with the sampling approaches for other instruments using the selected clusters as a basis. Therefore, the household survey is discussed first, and the remaining instruments are covered afterwards. Overall, it is crucial to understand that in the sampling, two pictures were being sought: the first to give an understanding of the situation of households in (1) non-sewered areas of Santa Cruz, and (2) a specific understanding of the situation in lowest-income areas.

Given that the main purpose of the household survey was to assess the feasibility of creating a call centre to provide FS emptying and transport services, the study population were households that rely on on-site sanitation and are not prioritised in any sanitation plan to get access to sewerage in the short term. There were two sub-sample areas (denoted A and B). Sub-sample A was representative of non-sewered areas (4,425 eligible households) while sub-sample B focused on the lowest-income non-sewered households (5,151 eligible households). Sub-sample B is not representative as households were purposively selected to be able to locate and focus on the most vulnerable on-site sanitation users. The aim was to get estimates at minimum cost and administrative burden. Hence, the sample has a relatively small size as compared to what would be necessary for studies with different objectives (e.g. an evaluation aiming to attribute impact to a specific sanitation intervention).

[18] In the other case country studies, sampling was designed to draw representative conclusions for the city as a whole, and lowest-income non-sewered areas in particular.
[19] Lowest-income areas were selected based on an estimated wealth index based on average household assets at the block (i.e. *manzana*) level.

Sub-samples and sampling units

For sub-sample A, the Primary Sampling Units (PSUs) were blocks or *manzanas*. For sub-sample B, households were chosen among the lowest-income blocks (i.e. lowest and second quintiles). The latter were chosen based on an estimated assets wealth index at the block level – household assets were averaged across the entire block, and these were then used in the Principal Component Analysis (PCA) for the estimation of the wealth index. The Secondary Sampling Units (SSUs) were households using on-site sanitation in both cases.

Sample sizes

To be consistent with other city case studies, the sample size for each sub-sample was 360 households, giving a total number of 720 households surveyed across both sub-samples.

A.2.2 Other instruments

Key informant interviews

The total number of interviews required, as well as the range and extent of questioning, was influenced by the availability of current and reliable data from other sources, as well as constraints on time and resources. Selection of interviewees was purposive, based on advice received from stakeholders and existing knowledge of the World Bank consultant.

Focus group discussions

FGDs were distributed as follows:

- 2 FGDs were held in public and private institutions (e.g. schools, health facilities, etc.);
- 2 FGDs were held with high- or medium-level income households that have septic tanks;
- 2 FGDs were held with low-income households that have septic tanks and use FS emptying and transport services;
- 2 FGDs were held with low-income households that have a soakaway or lined pit and carry out maintenance activities;
- 1 FGD was held with low-income households who have lined pits (as a temporary sanitation alternative) and do not use FS emptying and transport services; and
- 1 FGD was held with low-income households who have an unlined pit and thus do not use or require FS emptying and transport services.

A.3 Fieldwork implementation

Pretesting, training and piloting

Initial pre-testing was carried out by SNV to refine the instruments –data collection instruments were piloted in one urban community, excluding those PSUs which were part of the sample.

Field team composition and data collection

For the quantitative survey, field teams were composed by one Supervisor and four Household Enumerators. An experienced Field Manager was responsible for ensuring overall management, field implementation and quality assurance.

The field teams collected the majority of the data from the 60 sampled PSUs in 4 weeks during April 2015.

Data entry, cleaning and analysis

The quantitative survey data were entered into SPSS at SNV's offices in Bolivia, using various data quality checks, including range checks, skips and internal consistency checks. After data cleaning checks, data were then transferred into the statistical software Stata. Data were analysed using Stata in OPM's offices in Oxford.

A.4 Limitations

This study has two key limitations which need to be considered to understand the strengths and weaknesses of the data and the conclusions that can and cannot be drawn from the analysis. These should be considered in the context of the objectives of the study (see Section 1.2 in the main report). These are:

- **Socio-economic survey** – household surveys with enumerators skilled in social research can only really ask questions of householders. Although enumerators were trained to observe and identify different characteristics of sanitation facilities, they cannot always make accurate technical inspections of the infrastructure, which would require a different skillset. Therefore, it is necessary to take the household's responses at face value (e.g. about the destination of their blackwater).

- **Sampling method** – sample surveys are designed to estimate indicators for a broader population. Therefore, they cannot produce detailed data for specific neighbourhoods without dramatically increasing the sample size and appropriate stratification. The sample size for this study is relatively small compared to what would be necessary for an impact evaluation, for example. In a similar vein, transect walks aimed to build up a broad picture rather than specific maps or explanations for individual neighbourhoods. Finally, the study only focuses on non-sewered residential areas and households of Santa Cruz, excluding sewered residential areas, and all public establishments and institutions.

Annex B Fecal waste flow matrices

Table 27 Fecal waste flow matrix – city-wide sample (based on primary & secondary data)

		Containment		Emptying		Transport		Treatment		Overall
		of which		*of which*		*of which*		*of which*		**Safe:**
Type of system	*% pop. using*	*contained*	*not contained*	*emptied*	*not emptied*	*transported*	*not transported*	*treated*	*not treated*	**28%**
Sewerage	49%	100%	0%	100%	0%	100%	0%	49%	51%	
		49%	0%	49%	0%	49%	0%	24%	25%	**24%**
Septic tank and soakaway – emptiable	35%	100%	0%	30%	70%	33%	67%	100%	0%	
		35%	0%	10%	25%	3%	7%	3%	0%	**3%**
Septic tank – emptiable	6%	100%	0%	24%	76%	33%	67%	100%	0%	
		6%	0%	2%	4%	1%	1%	1%	0%	**1%**
Cement-lined pit – emptiable	3%	100%	0%	17%	83%	33%	67%	100%	0%	
		3%	0%	1%	2%	0%	1%	0%	0%	**0%**
Flush to lined pit – not emptiable	0%									
Latrine to lined pit – not emptiable	0%									
Latrine to unlined pit – not emptiable	1%	1%	100%							
		0%	1%							
Directly to drain	0.2%	0%	100%							
		0%	0.2%							
Open defecation	5%	0%	100%							
		0%	5%							
		Containment	90%	Emptying	90%	Transport	61%	Treatment	53%	
Unsafe:	**72%**		**8%**		**31%**		**8%**		**25%**	

Affected zones		*Local area and beyond via drains (amount direct to groundwater not identified)*	*Local area (via overflowing latrines or dumped FS)*	*Neighbourhood (via leakage/overflow from sewers or drains)*	*Receiving waters (via sewer outfall/discharge)*	

from household survey
from secondary data
de facto value

Table 28 Fecal waste flow matrix – non-sewered sample

		Containment		Emptying		Transport		Treatment		Overall
	% pop. using	*of which*		*of which*		*of which*		*of which*		**Safe:**
Type of system		*contained*	*not contained*	*emptied*	*not emptied*	*transported*	*not transported*	*treated*	*not treated*	**8%**
Sewerage	0%									
Septic tank and soakaway – emptiable	60%	100%	0%	30%	70%	33%	67%	100%	0%	
		60%	0%	18%	42%	6%	12%	6%	0%	**6%**
Septic tank – emptiable	10%	100%	0%	24%	76%	33%	67%	100%	0%	
		10%	0%	2%	8%	1%	2%	1%	0%	**1%**
Cement-lined pit – emptiable	17%	100%	0%	17%	83%	33%	67%	100%	0%	
		17%	0%	3%	14%	1%	2%	1%	0%	**1%**
Flush to lined pit – not emptiable	3%	0%	100%							
		0%	3%							
Latrine to lined pit – not emptiable	3%	0%	100%							
		0%	3%							
Latrine to unlined pit – not emptiable	5%	1%	100%							
		0%	5%							
Directly to drain	0%									

Open defecation	1%	0%	100%							
		0%	1%							
		Containment	71%	Emptying	71%	Transport	21%	Treatment	8%	
Unsafe:	**92%**		**12%**		**64%**		**16%**		**0%**	
Affected zones		*Local area and beyond via drains (amount direct to groundwater not identified)*		*Local area (via overflowing latrines or dumped FS)*		*Neighbourhood (via leakage/overflow from sewers or drains)*		*Receiving waters (via sewer outfall/discharge)*		

from household survey
from secondary data
de facto value

Annex C CSDA scoring table criteria

Sub-question		Question	Containment	Emptying	Transport	Treatment	End-use/disposal	Indicator/ Score	Comments
Enabling: What are current policies, planning issues and budgetary arrangements?	**1. Policy**	**1.1 Policy**: Is FSM included in an appropriate, acknowledged and available policy document (National/ local or both)?	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	1: policy is appropriate, approved (or in draft form), acknowledged and available 0.5: policy is appropriate, approved (or in draft form), but not clearly acknowledged / available 0: policy not available, or inappropriate to the context	The AAPS Administrative Regulatory Resolution No. 227/2010: (i) recognises the existence of septic tanks, latrines and ecological latrines that are not connected to sewerage; (ii) allows EPSAs to provide alternative FSM services for people relying on OSS solutions - services are to be provided at a low cost to peri-urban dwellers in areas where no sewerage expansion is planned in the short-run; (iii) AAPS will authorise ERTLs to provide services ensuring FS is discharged in EPSA treatment plants; (iv) ERTLs must comply with environmental standards; (v) AAPS will monitor implementation with the support of municipal governments. This is complemented by the AAPS Administrative Regulatory Resolution No. 546/2014, which approves the guidance document developed with WSP support to standardise administrative and technical processes for FS discharge. WSP is also helping GoB to standardise ERTLs registration and certification. The 2016-20 National Sanitation Plan develops a wastewater reuse policy and sets the goal of introducing wastewater irrigation schemes on agricultural land.
		1.2 Institutional roles: Are the institutional roles and responsibilities for FSM service delivery clearly defined and operationalized?	**0.5**	**0**	**0**	**0.5**	**0**	1: roles defined and operationalised 0.5: roles clearly defined but not operationalised, or not-defined by work in practice 0: roles not defined / not operationalised	According to WSP (2016), the roles and responsibilities of public institutions are still unclear. For example, many municipalities are not engaged in the provision of WSS services, despite being formally responsible. // A Wastewater Reuse Joint Commission was created in 2011 to stimulate dialogue and coordination between key WSS and irrigation stakeholders, but it is now losing momentum.

		1.3 Regulation: Are there national and/or local regulatory mechanisms (i.e. bylaws and means of enforcement) for FSM?	**0.5**	**1**	**1**	**0.5**	**0.5**	1: regulatory mechanisms for FSM exist and are operational 0.5: regulatory mechanisms for FSM exist but are not operational 0: no regulatory mechanisms for FSM exist	There is no formal regulation for the construction of OSS facilities nor for wastewater reuse. // AAPS has limited enforcement capacity. // The Municipal Ordinance 031/2001 enacts the rules for the Management of Wastewater and Sludge in Santa Cruz, describing and providing some regulations for the type of services that should be provided for people that are not yet connected to the sewerage network. // Not all WWTPs have operationalised AAPS Regulatory Resolution No. 546
		1.4 Service provision: does the policy, legislative and regulatory framework enable investment and involvement in FSM services by appropriate service providers (private or public)?	**0**	**0.5**	**0.5**	**0.5**	**0**	1: legal framework enables investment, with evidence of increasingly formalised involvement 0.5: legal framework doesn't address investment, but evidence of involvement (through formal or informal mechanisms) in practice 0: legal framework doesn't enable investment and/or no evidence of involvement (through formal or informal mechanisms)	AAPS and other government authorities have imposed legal requirements that cannot be met by most family-run ERTLs, discouraging formal FSM service provision.
	2. Planning	**2.1 Targets:** Are there service targets for (each part of) the FSM service chain in the city development plan, or a national development plan that is being adopted at the city level?	**0**	**0**	**0**	**0**	**0**	1: targets are clearly included 0.5: service levels are included, but no targets stated 0: no reference to service levels or targets	The Sector Development Plan for Basic Sanitation 2011 - 2015 only encompasses access to sewerage for people in urban and peri-urban areas. FSM is included in different policy documents but there are no specific targets.
		2.2 Investment: Is FSM incorporated into an approved and used investment plan (as	**0**	**0**	**0**	**0**	**0**	1: investment plan for FSM exists, based on identified needs and addressing human resource and TA needs	

		part of sanitation) - including ensuring adequate human resources and Technical Assistance? (Ideally a medium term plan, but if not, at least an annual plan)						0.5: investment plan for FSM exists, but does not address human resource or TA needs 0: no investment plan for FSM	
	3. Budget	**3.1 Fund flows:** Does government have a process for coordinating FSM investments (domestic or donor, e.g. national grants, state budgets, donor loans and grants etc.)?	**0**	**0**	**0**	**0**	**0**	1: coordination of investments is defined and operationalised 0.5: coordination of investments is defined, but not operationalised 0: no coordination of investments defined	Investment plans seem to be primarily related to expanding the sewerage network and building new treatment plants.
		3.2 Adequacy & structure: Are the annual public financial commitments to FSM commensurate with meeting needs/targets for Capex and Opex (over the coming 5 years)?	**0**	**0**	**0**	**0**	**0**	1: annual public financial commitments are sufficient to meet >75% of requirements (estimated need if no targets set) 0.5: annual public financial commitments are sufficient to meet >50% of requirements (estimated need if no targets set) 0: annual public financial commitments insufficient to meet 50% of requirements (estimated need if no targets set)	Some investments on regulatory frameworks and adapting WWTPs for FS discharge.
Developing: What is the level of expenditure, degree of	**4. Capital expenditure**	**4.1 Capital funding:** What is Capex expenditure per capita on FSM (3 year average)?	**0**	**0**	**0**	**0**	**0**	Range of Capex expenditure (This will be matched to service levels and needs)	

equity and level of output?	**5. Equity**	**5.1 Choice:** Is there a range of affordable, appropriate, safe and adaptable technologies for FSM services available to meet the needs of the urban poor?	**0.5**	**0.5**	**0.5**	**0.5**	**0**	1: range of technical options exist (i.e. are "offered" formally) and are used by the urban poor 0.5: range of options exist, but are not accessed by the urban poor, or just not used 0: options are not present	In Santa Cruz, services remain unaffordable to the poorest, with emptying costs amounting to around a third of the minimum wage.
		5.2 Reducing inequity: Are there specific and adequate funds, plans and measures to ensure FSM serves all users, and specifically the urban poor?	**0**	**0**	**0**	**0**	**0**	1: funds, plans and measures are codified and in use 0.5: funds, plans and measures are codified but not in use 0: no funds, plans and measures codified	
	6. Outputs	**6.1 Quantity / capacity:** Is the capacity of each part of the FSM value chain growing at the pace required to ensure access to FSM meets the needs/demands and targets that protects public and environmental health?	**0.5**	**1**	**1**	**0.5**	**0**	1: capacity growing at a pace to meet >75% of the needs/demands and targets to protect health 0.5: capacity growing at a pace to achieve >50% of needs/demands and targets to protect health 0: capacity insufficient to meet 50% of the needs/demands and targets to protect health	There is still a segment of the population that practices OD and relies on unimproved facilities. Lack of norms and regulation for pit/tank construction also leads to households having inadequate facilities. // There are not enough WWTP for ERTLs to discharge all the FS collected, encouraging illegal dumping in nearby areas.
		6.2 Quality: Is the quality of FSM sufficient to ensure functioning facilities and services that protect against risk through the service chain?	**0.5**	**1**	**0.5**	**1**	**0**	1: >75% of services that protect against risk and are functional through the service chain 0.5: >50% of services that protect against risk and are functional through the FSM service chain	Not all facilities have hatches for emptying and many households still rely on unimproved facilities. // Not all FS collected is transported to a treatment plant, with a relatively high proportion being dumped illegally. // Not all WWTP operate effectively and provide efficient treatment (only SAGUAPAC's WWTP are reliable).

								0: less than 50% of services that protect against risk and are functional through the FSM service chain	
		6.3 Reporting: Are there procedures and processes applied on a regular basis to monitor FSM access and the quality of services and is the information disseminated?						1: regular reporting on both access and quality of FSM services, with information disseminated 0.5: regular reporting on either access or quality of FSM services (with information disseminated or not) 0: no regular reporting on either access or quality of FSM services	EXCLUDED FROM THIS COMPONENT AND INCLUDED AS PART OF 7.2 BASED ON WORKSHOPS HELD IN SANTA CRUZ.
Sustaining: What is the status of operation and maintenance, what provisions are made for service expansion and what are current service outcomes?	**7. O&M**	**7.1 Cost recovery:** Are O&M costs known and fully met by either cost recovery through user fees and/or local revenue or transfers?	**0**	**1**	**1**	**0.5**	**0**	1: O&M costs known and >75% met (through appropriate mechanisms) 0.5: O&M costs known and >50% met 0: O&M costs not known and/or <50% met	ERTLs do not systematically keep financial records, but other studies show that firms are making profits - this is partly explained by the fact that markets are under oligopolistic competition.
		7.2 Standards & monitoring: Are there norms and standards for each part of the FSM value chain that are systematically monitored under a regime of sanctions (penalties)?	**0.5**	**0.5**	**0.5**	**1**	**0**	1: norms and standards exist, are monitored and sanctions applied 0.5: norms and standards exist and are monitored, but no sanctions applied 0: norms and standards (if they exist) are not monitored	Both the Municipal Ordinance 031/2001 and the documents drafted through the TA P132278 have set out standards for emptying, transport and treatment FS services.
	8. Expansion	**8.1 Demand:** Has government (national or city authority) developed any policies and	**0**	**0**				1: policies, procedures or programs are being implemented, with resulting demand for services growing and being responded to	

		procedures, or planned and undertaken programs to stimulate demand of FSM services and behaviours by households?						0.5: policies, procedures or programs are being implemented (or partially implemented), but resulting demand is not fully addressed 0: policies, procedures or programs are not being implemented	
		8.2 Sector development: does the government have ongoing programs and measures to strengthen the role of service providers (private or public) in the provision of FSM services, in urban or peri-urban areas?	**0**	**0.5**	**0.5**	**0.5**	**0**	1: programs and measures to strengthen service provision have been/are being implemented; service providers are organized, their actions are coordinated and the FSM services they provide are expanding. 0.5: programs and measures to strengthen service providers have been implemented or partially implemented; the majority of service providers remain largely disorganized and the FSM services they provide are not expanding at an appropriate rate. 0: programs and measures to strengthen the service providers do not exist (or exist on paper only and have not been implemented); the service providers remain disorganized and the FSM services they provide are not expanding.	There are no specific programmes but WSP has been working jointly with the GoB and Santa Cruz authorities to improve the provision of FS services in the city through TA P132278. The creation of a call centre to enable competition between service providers will potentially strengthen the role of service providers in the FS market - smaller and inefficient firms are likely to exit the market with increased competition.
	9. Service outcomes	**9.1 Public Health:** What is the magnitude of public	**0**	**0.5**	**1**	**1**	**0**	1: low level risk identified (compare to Excellent result from PHRA)	WSP studies suggest that many facilities are not properly built, leaching into the surrounding environment. Faulty equipment has been reported

		health risk associated with the current FS flows (through the stages of the FS service chain)?						0.5: medium level risk identified (compare to Good or Bad result from PHRA) 0: high level risk identified (compare to Terrible result from PHRA)	in an analysis of ERTLs, with some hoses leaking and workers not having adequate protection to handle the FS. Household survey data also indicated that "hygiene" elements of service provision could be improved. Not all of the FS collected reaches a treatment facility, with some being illegally dumped in nearby areas.
		9.2 Quantity: Percentage of total FS generated by the city that is managed effectively, within each part of the service chain	**0.5**	**0.5**	**0.5**	**0**	**0**	Identify a score for each stage of the service chain (containment / emptying / transport / treatment / disposal / end-use): 1: >75% of FS generated is managed effectively, at that stage of the service chain 0.5: >50% of FS generated is managed effectively, at that stage of the service chain 0: <50% of FS generated is managed effectively, at that stage of the service chain	Based on the SFD. A 2010 assessment found out that of the 40 service providers available, approximately two thirds transport the FS to SAGUAPAC's treatment plants, with the remaining third disposing of FS in surrounding rural areas or vacant plots.
		9.3 Equity: To what extent do the city's FSM systems serve low-income communities? (Containment, Emptying and Transport services only)						1: FSM systems and services are widespread and readily available in low-income communities 0.5: FSM systems and services are available on a partial / piecemeal basis in low-income communities (or in some) 0: FSM systems and services are not available to any significant extent in low-income communities	EXCLUDED AND ASSESSED AS PART OF 5.2.
		Scores	**4**	**7.5**	**7.5**	**7**	**1**		