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The authors would like to thank the field staff of GOAL, namely Sydnella Rogers, Samuel Kamara, and Millicent Sam, who led and managed the household interviews. The authors would also like to thank Sulaiman Parker who managed the project from the FCC side and actively contributed to the development of the survey. Finally the authors would like to thank all the household respondents who spared time to respond to the market assessment and provide invaluable feedback. This project would have not been possible without the funding and support of the Bill & Melinda Gates Foundation (BMGF) and the Department for International Development (DFID).

http://dx.doi.org/10.3362/1756-3488.2016.xxx, ISSN: 0262-8104 (print) 1756-3488 (online)

[CH]Assessing demand for faecal sludge management (FSM) services in Freetown

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[ABS]‘Achieving sustained environmental health improvements in Freetown through faecal sludge management enterprises’ was a partnership project between Freetown City Council (FCC), International Water Association (IWA), and GOAL. This project aimed to improve faecal sludge management (FSM) through public private partnerships and improved financial flows to ensure viability of businesses. A market assessment was conducted in Freetown which considered demand and supply for FSM services. This paper discusses findings from the household survey which was a key component of the market assessment. While the households felt that they were getting value for money for existing services they were not satisfied with existing services and hence were willing to pay higher prices for improved

services. This highlights the importance of quality service provision in relation to revenue generation. Improved pit emptying services was noted to be of high priority to households. In order to improve pit emptying services the FSM strategy proposed intermediate transfer stations and formation of a Sanitation Unit and Contact Centre within FCC.

[KEY]Keywords: Freetown, faecal sludge, transfer stations, market

FREETOWN, THE CAPITAL OF SIERRA LEONE, has a population of circa 1.0 million people (estimate based on 2004 census figures). Over 60 per cent of the population live in high density settlements with inadequate water and sanitation services. Under the Local Government Act 2004, urban sanitation is devolved to Freetown City Council (FCC) and various city councils in the provinces though sanitation budgets are retained and managed centrally (Bennett et al., 2012) which results in a lack of financial support for delivering sanitation locally.

There has been no improvement in urban sanitation provision in Sierra Leone with only 22 per cent of the urban population covered by improved sanitation facilities in 2012 as against 23 per cent of population coverage in 1990 (WHO and UNICEF, 2014). There is only one sewer network in Freetown which covers a small part of the central business district (Oxfam/3BMD/Atkins, 2008) and over 90 per cent of residents are served by on-site sanitation solutions such as such as pits with or without septic tanks (Blinker, 2006). The city's topography, narrow lanes, and the unequal nature of its development create significant challenges to pit emptying as vacuum trucks cannot gain access to pits in both densely populated and hillside areas. Services for on-site sanitation in Freetown are largely provided by unregulated service providers working informally such as manual pit emptiers.

The Freetown WASH Consortium (FWC), comprising members from GOAL, Save the Children, Oxfam, ACF (Action Against Hunger), and Concern in Freetown, estimates that 80,000 m^3 of raw faecal sludge is produced in Freetown each year. This equates to approximately 0.21 litres per capita/day which aligns with evidence captured from field studies in Ghana (Heinss et al., 1998). An estimated 17 per cent of the total sludge produced

in Freetown is disposed of inside the King Tom dumpsite (FWC, 2014, personal communication). The estimates by FWC are based on discussions with local stakeholders such as manual and mechanical pit emptiers and further studies would be required to develop more accurate figures. It is worth noting that the King Tom site was used for disposal of sludge but the treatment facility there has not been functional for at least 5 years. Now the facility is also used as a burial ground as part of the Ebola response operations which has reduced the space available for sludge disposal. The extent of illegal dumping of sludge versus on-site burial in Freetown is not known as there are no official records but it is likely that approximately 85 per cent of the city's sludge is dumped locally either through on-site burial or by being discharged into local waterways (Freetown WASH Consortium, 2014, personal communication). FCC signed a contract with Masada Waste Management Company (SL) Ltd in 2014, under which Masada would manage collection, transport, disposal, and reuse of solid and liquid waste in Freetown. Under the agreement, Masada is planning to install a fully integrated waste treatment and resource recovery system on the outskirts of Freetown at Kerry Town which will treat solid and liquid waste transported from King Tom.

The project 'Achieving sustained environmental health improvements in Freetown through faecal sludge management enterprises' funded by the Department for International Development (DFID) and the Bill & Melinda Gates Foundation (BMGF) was set up to identify means for improving faecal sludge management in Freetown. A market assessment was carried out in June 2014 with the view of gaining understanding of demand for desludging services and costings. If a performance-based contract is to be issued for emptying of public latrines and transfer stations with households paying for the private sector services, affordability and willingness to pay would be crucial to part or fully fund the costs. Hence, one of the key components of the market assessment was assessing demand from household customers for desludging services and willingness to pay for improved services. This paper discusses the findings from the household assessment and subsequent

development of a city-wide strategy for faecal sludge management (FSM) that engages the private sector.

[A]Methodology

[B]*Overview*

A market assessment was carried out by GOAL in order to assess demand and supply of FSM services in Freetown. The assessment included household surveys, consultation with Freetown WASH Consortium and key informant interviews with FCC, manual pit emptiers, and the private firm Royal Flush for mechanical desludging. This evidence was collected in June 2014 and has been used as a basis for this paper. In addition, this paper draws on the results of an earlier study commissioned by GOAL and DFID conducted by Mikhael (2010).

[B]*Household surveys*

Demand from households for desludging was analysed through an extensive household level city-wide survey. The respondents for this survey were selected using cluster sampling tools. Freetown City Council (FCC) provided a list of the 64 official city sections which was used as a basis to ensure representative sampling. The current population of Freetown was estimated using the 2004 census data and extrapolated at a uniform rate of 2.8 per cent per annum to nearly 1.0 million residents in Freetown. ENA for SMART (2011 edition, released 1 September 2013) was then used to randomly select 30 clusters from among that list, using probability proportional to size. ENA (Emergency Nutrition Assessment) software is a user-friendly analytical program recommended by SMART. It has automated functions for sample size calculations, sample selection, quality checks, standardization for anthropometry measurements, and report generation with automatic analyses. Once the clusters were selected, the required sample size was estimated using Raosoft (see website). A 5 per cent margin of error and 90 per cent confidence interval was applied for estimation of sample size. A total sample of 271, equivalent to 9.03 households/cluster, was derived from the

sample size calculator. The research team decided to work on a 10 households/cluster sample size equating to 300 households in Freetown.

In order to target approximately 300 households who use faecal sludge services it was necessary to interview a larger sample. A total of 616 households were interviewed across the clusters resulting in about 600 hours of interview time. Twenty data collectors were trained for one day and had half a day to pilot the survey and half a day to report their experience. The survey took 10 days and there were two data entry clerks at the office. One of the authors, who was the project manager, was based in Freetown and reviewed the evidence on a daily basis to ensure quality control and consistency. An informed consent form was signed by all participants of the survey before completion of the household questionnaire. Furthermore, evidence from the survey was validated by Freetown City Council in a Steering Committee Meeting organized in June 2014 where representatives from FCC, Ministry of Health and Sanitation, GOAL, and Masada reviewed the pro forma.

The selection of houses was carried out through random sampling techniques. The field team went to the centre of the inhabited areas of the city section, threw a pen into the air and walked in the direction the pen was pointing to when it landed. If the pen was pointing to a house the enumerators would start with the third house to the right of that house. Then every third house on the right would be visited until the cluster was complete. If there was a problem the data collectors would again throw the pen at the door of the last household and proceed as described above. The interviews were carried out in the local language best suited to the household.

In order to achieve the required sample size of at least 300 users of faecal sludge services the first component of the questionnaire was administered to the full sample of 616 households. Then the second component was administered to the households who arranged for their pits to be desludged (368 households) and hence were already deemed to be engaged in the FSM market.

A questionnaire (available from the authors on request) was developed to be applied to households that are: 1) serviced by desludging trucks; and 2) use manual emptying for emptying pits. There were five sections for the household questionnaire:

- existing type and quality of service;
- costs for existing services;
- affordability of services (in relation to other household costs);
- expectations and willingness to pay for pre-identified improvements;
- financing options.

The questionnaire covered the nature of existing pit-emptying services. In order to assess quality of existing services, the frequency of service and customer satisfaction was used as a measure. Costs of the current service were reviewed in the context of existing disposable income to assess affordability of pit-emptying services. It is worth noting that this was a perception study which was used to assess response to proposed changes in faecal sludge management services, willingness to pay, and to understand perceptions on efficiency of existing services. The value of perception studies is to enhance existing knowledge based on behaviour and to understand how households are likely to respond to changes in existing systems.

[B]*Willingness to pay*

A ranking exercise was carried out with the households in order to prioritize and assess which improvements to desludging services were perceived to be more important than the others. There were six scenarios/action points presented during the market assessment, which the households ranked from 1 to 6 where 1 is the highest priority and 6 is the lowest priority. The six options presented in the questionnaire were based on feedback on gaps in FSM noted through field observations by GOAL and discussions with FWC. The scenarios have the potential for being implemented jointly as a set of actions or individually depending

on demand from users. The scenarios for service improvements are listed below and were displayed in a chart for the household interviews:

A. The pit emptier could be contacted more easily; e.g. by phone and arrives to do the job more quickly.

B. The pit emptier comes at a convenient time of day (as opposed to the time that he wants) and is able to complete the pit-emptying process more quickly once he is in your compound.

C. When the emptier comes to your compound to empty your pit, he is able to carry out his job more cleanly, so that less dirt and mess is left behind in your compound once he is done.

D. The pit emptier definitely takes the shit out of your compound.

E. The pit emptier definitely takes the shit out of your neighbourhood.

F. How safely the shit is disposed of once it has been taken out of your compound or neighbourhood; whether it is treated in a way that is safe for people's health or whether it is disposed of in a way that might harm the health of people near disposal site.

[B]*Development of city FSM strategy*

Ward-level population figures provided by FCC were used to estimate likely sludge volume production. GOAL also ran a survey with the Freetown WASH Consortium to categorize city wards by built up density (low/high), accessibility (good/inaccessible), and income (low/medium/high). Based on the categorization the likely nature of desludging (mechanical and manual) was assumed and this then led on to identification of potential city sections where intermediate transfer stations could be sited. Low income and inaccessible slum areas were identified as areas which needed a localized transfer station for collection of sludge obtained through manual desludging.

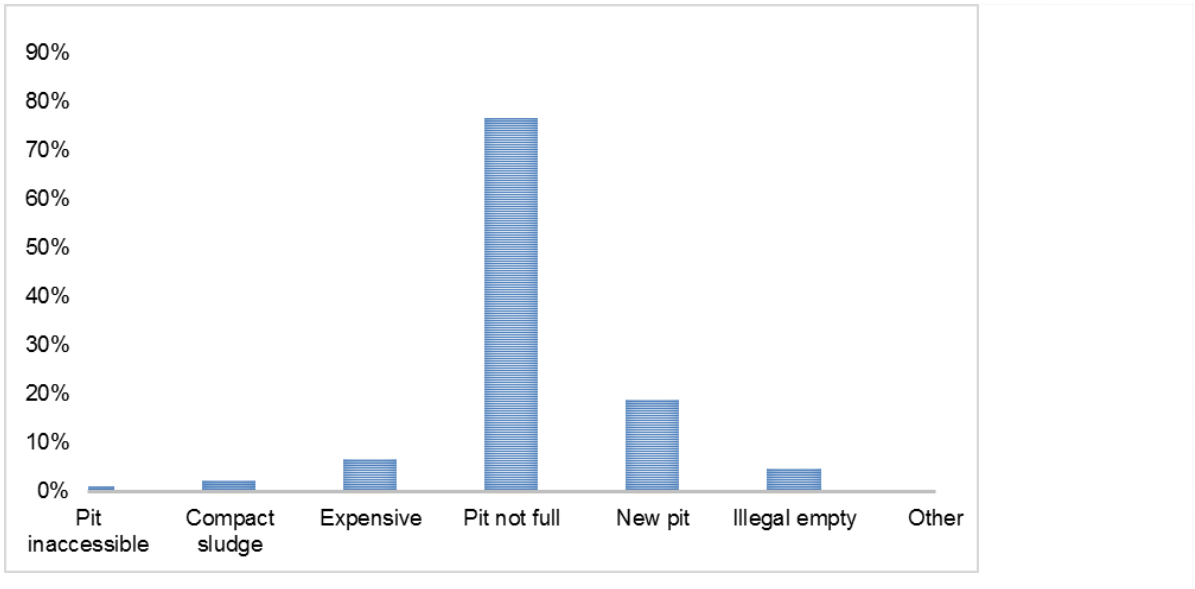
The financial figures such as household expenditure and willingness to pay (WTP) as obtained from the household surveys were used to develop an overall financial model for

improved FSM in Freetown. The tariffs for household desludging were set to a threshold as identified in the WTP survey. This paper will describe the market assessment and the overall city-strategy for FSM. The detailed financial analysis is outside the scope of this article.

[A]Results 1: existing service

[B]*Existing type and quality of service*

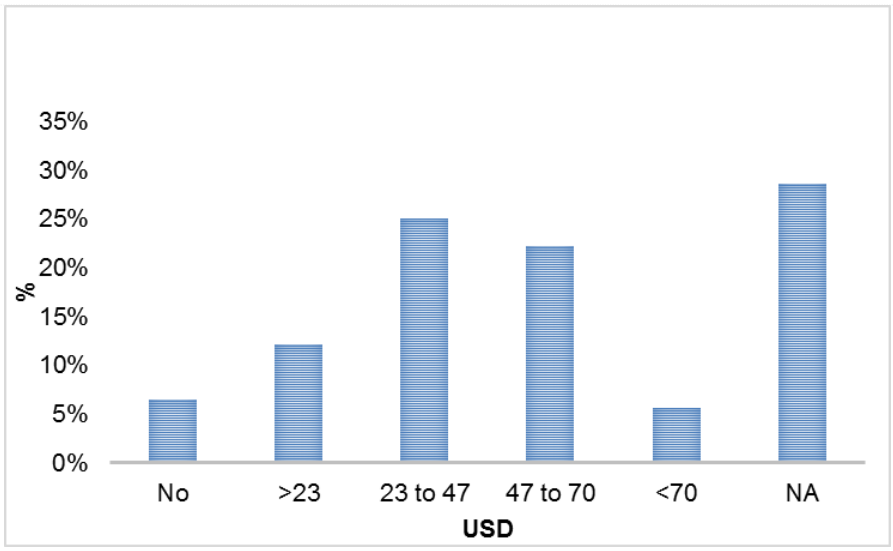
A total of 616 households with latrines were interviewed, of which 368 (60 per cent) desludged their pits through manual or mechanical means, while 248 (40 per cent) of the households did not get their pits desludged. Most of the households were waiting for their pits to fill or alternatively had already covered the full pit and dug a new pit (Figure 1). In some instances the pit was inaccessible and therefore not possible to empty by a desludging truck. The proportion of illegal emptying self-reported by interviewees was less than 10 per cent though visual evidence on the ground in the form of faecal sludge dumping points noted by GOAL suggested otherwise. Discussions with manual pit emptiers suggested that illegal emptying must be more than 10 per cent but there was a lack of clarity on the volume of illegal emptying. For the purposes of this study, illegal emptying was considered to be disposal of sludge on-site informally by households at designated or non-designated dumping points.



[CAP]Figure 1 Reasons why latrines not desludged (248 non-user households)

[B]*Willingness to pay*

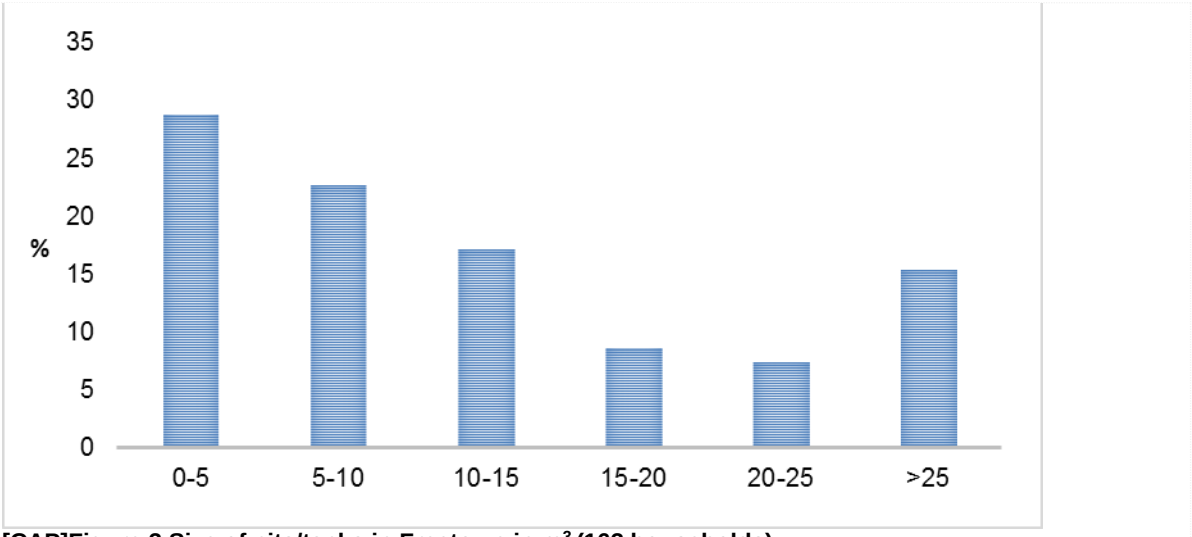
Currently, the willingness to pay (WTP) for desludging services, for 60 per cent of the non-users of faecal sludge services is in the range of US$23–70 (US$1 was approximately 4,300 Le in December 2014). As shown in Figure 2 a large proportion of households (30 per cent) did not respond to this question and around 5 per cent of households were not willing to pay.



[CAP]Figure 2 Willingness to pay (WTP) from the non-users for desludging (248 households)

[B]*Desludging services*

This section focuses on the 368 households who currently pay for their pits to be desludged. Out of those households there were 50 non-responses so evidence from 318 houses has been used in subsequent sections.



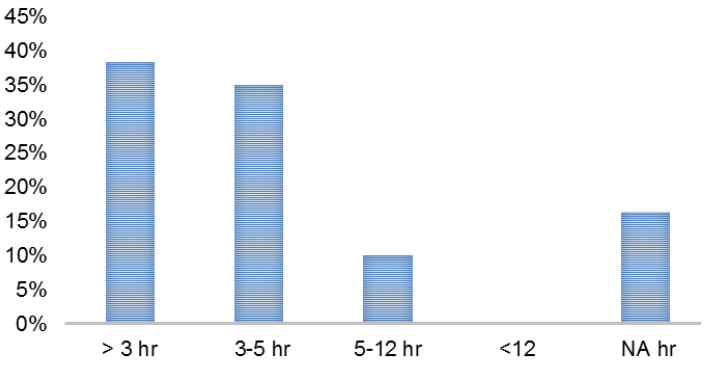
[CAP]Figure 3 Size of pits/tanks in Freetown in m^3 (163 households)

The size of tanks/pits reported varied over a wide range from 1 m^3 to 105.3 m^3 based on income groups. The average pit size estimated on site through observations on width and depth of pits from 163 households was 14.3 m^3. As shown in Figure 3, a large proportion of pits (29 per cent) were less than 5 m^3. Discussions with local manual pit emptiers confirmed that most of the smaller size pits were located in low income areas where access is a challenge. Low income areas comprising urban slums are predominantly located near water bodies and natural drainage paths in cities (Parikh et al., 2012). This is believed to result in disposal of sludge in water bodies and burial in vacant plots of land. The households emptied their pits either because of the bad smell or because the pit was full/overflowing but very few households actually made the connection between positive health impact and desludging of pits.

There was an equal split between the households who used manual and mechanical means for desludging their pit most frequently. The households desludged their pits once a year (44 per cent) or more frequently (44 per cent). Through interviews with six groups of manual operators in Freetown, Mikhael (2011) estimated a high demand for desludging services during the rainy season because of flooding of containment structures. In addition the holiday seasons of Christmas and Ramadan were noted as peak periods as residents

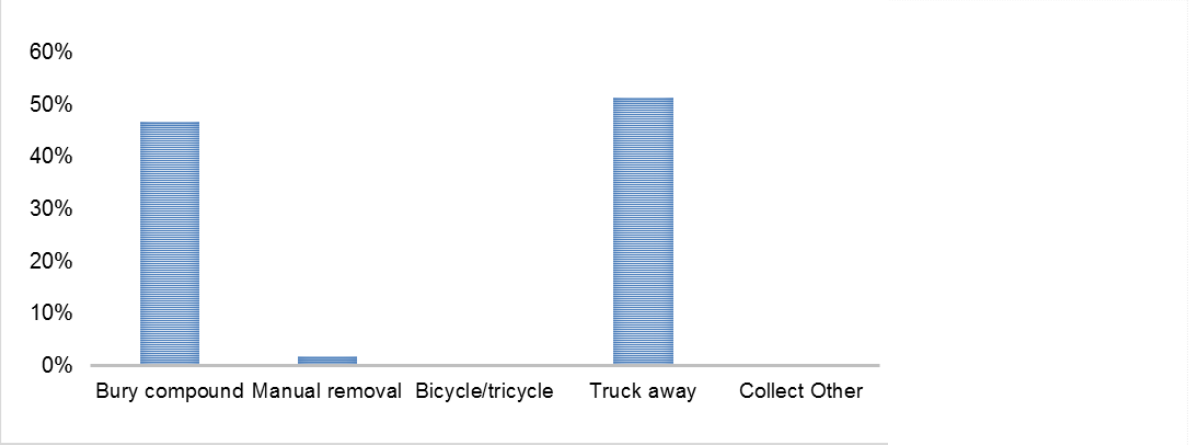
would clean their homes and empty their pits and septic tanks in preparation for visiting relatives (Michael, 2011). Only around 11 per cent of the households had their pits emptied less than once a year.

The manual and mechanical pit-emptying service providers were identified by households through word of mouth and community networks in lieu of formal advertising and marketing. The pits in most of the houses were emptied within five hours of the start of the emptying process; emptying took longer than five hours for only 10 per cent of households (Figure 4).



[CAP]Figure 4 Time taken for desludging (318 households)

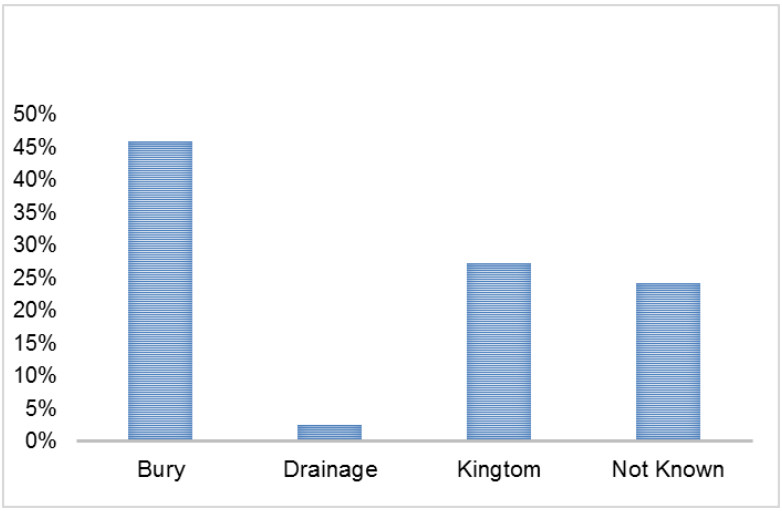
Discussions with manual pit emptiers confirmed the use of low-cost, labour intensive techniques and basic equipment for pit emptying particularly with smaller pits and with low income households. Mechanical desludging is predominant for larger pit sizes and higher income group households. The households were then asked about sludge collection from their pits. The faecal sludge is currently buried in the household compound, disposed of illegally, or collected via private truck companies, with an equal split between manual techniques such as burial in the compound and mechanical desludging through trucks (Figure 5).



[CAP]Figure 5 Household sludge collection (318 households)

[B]*Faecal sludge disposal*

A discussion with Freetown WASH Consortium (FWC) revealed that roughly 17 per cent of the city sludge is disposed at King Tom dumpsite. As a follow up question the households were asked if they knew where the sludge from their pits ended up. As shown in Figure 6 the household perception survey response indicates that about 27 per cent of the households believed that sludge reaches King Tom with most of the sludge buried locally or disposed into local drains, particularly during the rainy season. According to household perception, about 45 per cent of the sludge is buried onsite, 3 per cent disposed in drains, and 27 per cent possibly reaching Kingtom, leaving 25 per cent of sludge in the city which is not accounted for. The mismatch in figures and the gap in understanding of sludge disposal highlights the possibility of indiscriminate sludge disposal and unsafe practices. The disposal site at Kingtom was operational during the survey but has subsequently been reduced in size to accommodate burial operations as part of the Ebola response.



[CAP]Figure 6 Household sludge disposal perceptions (318 households)

[B]*Affordability of services (in relation to other household costs)*

Estimation of household income is challenging as respondents have a tendency to under-report their income for a variety of reasons including lack of regular income, incorrect forecasting of income, or seasonal variations (Islam et al., 1997). It was therefore decided to use expenditure (disposable income) as a proxy for household income to ensure reliability and accuracy of data. This technique has been used successfully for estimation of incomes in slums (Parikh et al., 2015). The average monthly household expenditure was $414 with the 50th percentile at $339 (Table 1). This was based on responses obtained from 248 households as other households were reluctant to share details of expenditure.

[CAP]Table 1 Household monthly expenditure in US$

Quartile	Monthly household expenditure (US$)
Minimum value	3
25th percentile	229
50th percentile	339
75th percentile	505
Maximum value	2791

[B]*Costs for existing services*

A few households were reluctant to share details of existing costs for desludging services and hence out of a total of 318 households responses were obtained from 304 households. Households were also asked if they were satisfied with services with a Yes/No response noted for varying levels of satisfaction. Almost 70 per cent of households (210) expressed full satisfaction with existing services provided.

Initially the costing for desludging services was split into quartiles to assess if the spread of costs was the same for satisfied households out of the total sample. Currently households spend an average of $90 for sludge collection. This cost is incurred for a single instance of emptying but typically once a year. The median quartile is $81 and minimum value is $19 which could be used as the minimum value that can be charged for households (Table 2). The quartile range analysis of the 210 households revealed a trend similar to the total sample indicating that the costs of services were similar for households irrespective of their current levels of satisfaction. If the pits are emptied typically once a year, the current cost is estimated to be 1.8 per cent of household expenditure. The current cost of services in Freetown is below the 5 per cent threshold of costs for water and sanitation as defined by the McPhail Rule (McPhail, 1993).

There was a higher level of satisfaction for mechanical desludging services – 56 per cent versus only 44 per cent for manual desludging customers – implying potentially the need for improvement of manual desludging services.

An interview with Royal Flush which is the largest mechanical pit-emptying company in Freetown revealed that costs for mechanical desludging varied depending on proximity of the site from the central business district to account for extra fuel costs (Royal Flush, interview by Priti Parikh and GOAL as part of the market assessment study, June 2014 in Freetown). Costs for emptying cesspits is higher than septic tanks as it would take 20 minutes longer to empty the cesspits. An interview with a manual pit emptier revealed that costs were dependent on pit sizes as larger parts would require additional manpower (B.

Bunter, interview by Priti Parikh and GOAL as part of the market assessment study, June 2014, Freetown).

[CAP]Table 2 Household costs for desludging split by quartiles (US$)

Quartile by current costs	Current cost US$	Current cost for satisfied customers (US$)
Minimum	19	19
25th percentile	70	70
50th percentile	81	81
75th percentile	105	116
Maximum	233	233
Number of households	304	210

The household costs for desludging were also split into quartiles categorized by household expenditure using the thresholds identified in Table 1. It was observed that average household costs for desludging did not vary significantly across income groups (Table 3) implying that low income households paid a higher proportion of their income for desludging services.

[CAP]Table 3 Household costs for desludging split by household expenditure quartiles (US$)

Household expenditure range (US$)	Average desludging costs (US$)
Less than 229 (25th percentile)	79
229–339 (25–50th percentile)	92
339–505 (50–75th percentile)	91
Number of households	243

[A]Results 2: priority mapping and willingness to pay for improvements

The households were provided with six options listed below for an improved service and were asked to rank these options and provide an estimate of their willingness to pay for each option.

Scenario A: The pit emptier can be contacted more easily and will come to do the job more promptly.

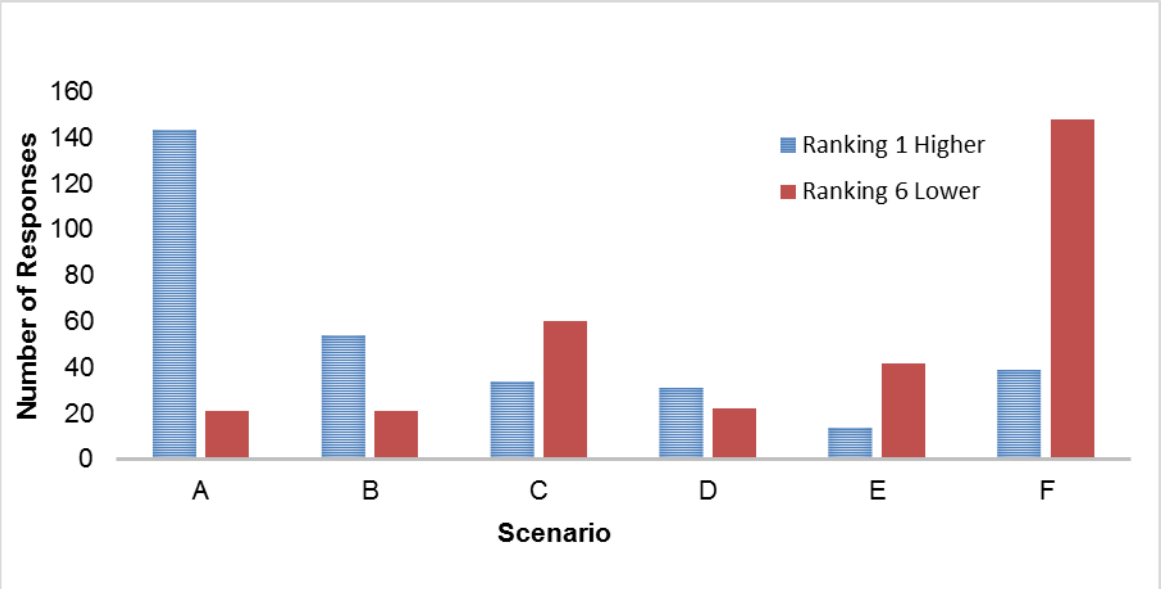
Scenario B: The pit emptier comes to do the job at the time of day that I would like and complete the job faster.

Scenario C: The pit emptier leaves my compound cleaner and leaves less dirt behind in my compound.

Scenario D: The pit emptier definitely takes the shit out of my compound.

Scenario E: The pit emptier definitely takes the shit out of my neighbourhood.

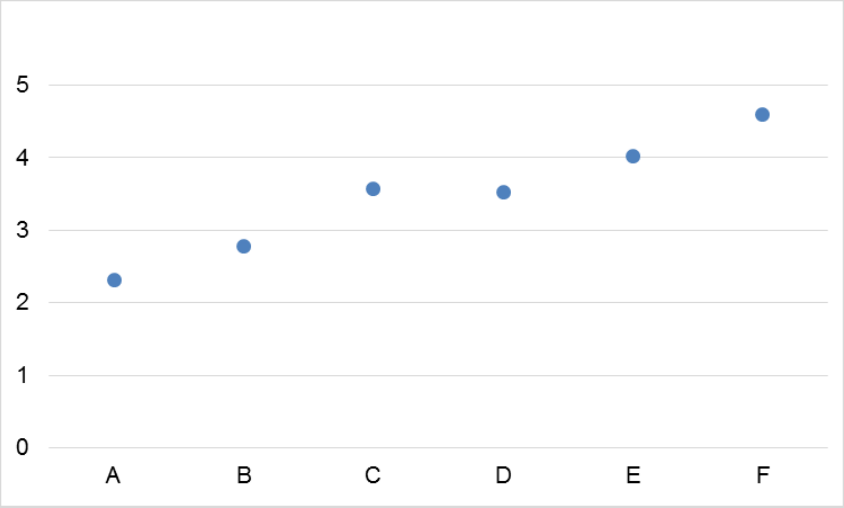
Scenario F: The shit is disposed of more safely once they have taken it out of my compound



[CAP]Figure 7 Highest and lowest priority ranking of service improvement scenarios (318 households)

Figure 7 shows that Scenario A received the largest number of responses as being the highest priority option and lowest number of responses as the low priority option making it the most preferred option by households. Conversely, Scenario F was deemed to be the least preferred scenario. Average rankings (see Figure 8) demonstrate that contacting the pit emptier easily and he arrives to do the job quickly (scenario A) is high priority followed by the timing of pit emptying (Scenario B), removal of FS out of compound, clean removal of FS, and removal of FS from the neighbourhood. The lowest priority was apportioned to the safe disposal of FS outside the neighbourhood indicating a 'Not in My Backyard' (NIMBY)

tendency. In terms of forming a financing strategy the results indicate that households would be more willing to pay for collection and less so for safe disposal of sludge outside the neighbourhood. The NIMBY tendency and associated lower willingness to pay for sludge transport and disposal aligns with other similar studies carried out in Chennai, India, where willingness to pay for solid waste services and water points was explored through household interviews (Anand, 1999, 2002). Respondents in India prioritized yard tap water connections over quality of service and also prioritized solid waste services within their neighbourhood (ibid).



[CAP]Figure 8 Average ranking of service improvement scenarios (318 households)

The willingness to pay (WTP) for improved services was noted to be an average of $107 which is $17 higher than the current average household cost for desludging. Table 4 shows the quartile ranges obtained from 303 households. The median quartile is $93 and the minimum value is $23, which could be used as indicative of potential charging for households in low income areas.

[CAP]Table 4 Household maximum WTP for desludging (US$)

Quartile	Service charge (US$)

Minimum value	23
25th percentile	70
50th percentile	93
75th percentile	116
Maximum value	1163

Based on the difference of existing costs (Table 1) and maximum WTP (Table 4), the households were then asked to allocate the additional financial resources that they would be willing to contribute in order to achieve the specified service improvements. The surveyed households were provided with counters, and each counter represented $1.16 (Le 5,000), which the respondents could allocate either to one improvement or distribute across a few improvements. The purpose of this exercise was to examine WTP in detail and prioritize service improvements.

[CAP]Table 5 WTP for service improvements for scenarios A–F

Scenario	**A**	**B**	**C**	**D**	**E**	**F**
Average rank	2.3	2.8	3.6	3.5	4.0	4.6
Additional WTP (US$)	3.6	3.3	2.3	2.7	2.3	1.9
Max additional WTP (US$)	34.9	23.3	14.0	24.4	23.3	11.6
Min additional WTP (US$)	0	0	0	0	0	0
% of total	22.5	20	14	16.5	14	12

Table 5 presents the average ranking for each scenario with additional payment amounts for the scenarios. As expected with scenario A, the average additional payment is the highest at $3.6 (Le 15,582), and constitutes 23 per cent of the total additional payment amount. Scenario F, which was the less preferred option, captures only 12 per cent of the total additional payment contribution with an average of $1.9 (Le 8,365) additional payment.

[B]*Financing options*

Eighty-nine per cent of households expressed satisfaction with current methods of payment. Cash payment to both the manual pit emptier and truck operator is the most popular method, with a small proportion of houses expressing interest in using their mobile phone for payment. Almost 53 per cent of the households expressed that a one-off payment for pit emptying was their preferred option, while 45 per cent of households would prefer to be able to make payments in instalments. The nature of payment through instalments was not specified during the household interviews. The remainder of the households (2 per cent) did not respond to this question. Based on feedback from 12 community meetings, Mikhael (2010) noted that currently payments have to be made in advance by 100 per cent for mechanical desludging and by 50 per cent for manual pit emptying. During the community meetings households expressed an interest in the possibility of payment through monthly instalments. Service providers will therefore need to offer different monthly payment plans depending on their customer base. The service providers would need support from local representatives for collection of payments. About 89 per cent of the households highlighted the role of seasonality and income variability, which is where the instalment option can support low income households.

[A]Discussion

The household survey demonstrated an even mix between the use of manual and mechanical means for desludging their pits. This implies a need for a faecal sludge management strategy which addresses improvements in both mechanical and manual desludging depending on the location and needs of the customer. Only 44 per cent of manual desludging customers were satisfied with the current service compared with 55 per

cent of mechanical desludging customers so there is scope to concentrate efforts on improving manual sludge collection techniques.

The norm of household water and sanitation expenditure is 5 per cent (McPhail, 1993) with sludge collection likely to constitute 0.5 per cent of household income for low-income countries (Vodounhessi, 2006). Currently households in Freetown spend an average of $90 for sludge collection which is 1.8 per cent of their household expenditure (disposable income) assuming that desludging is likely to occur once a year. The challenge here for FCC is to balance the actual capital and running costs against tariffs and likely income streams. Given that households are already spending 1.8 per cent of their income on desludging, the potential to increase tariffs is limited and will be dependent on the nature of improvements in service.

With limited potential to increase tariffs as demonstrated through household interviews, there is a need to explore different business models such as subsidy and lease arrangements with private firms to enable investment in service improvements. There is also a need to explore opportunities for revenue generation such as reuse of treated waste for agriculture, energy generation, and potential for improving efficiency of services through promoting competition between service providers. This is only feasible if private sector involvement is monitored and regulated by an adequately capacitated public sector (Boot and Scott, 2009). FCC's vacuum trucks are currently non-operational and hence the private sector is engaged for desludging through contracts with FCC. The private sector currently charge a daily rate depending on the part of the city that they operate in and the distance from the disposal site of Kingtom. Manual pit emptiers are also privately employed by households and recover full costs of their operations (S. Parker, interviewed by Priti Parikh and GOAL as part of the market assessment study, June 2014). So, FCC would need to play a stronger role in monitoring and regulating services provided by the private sector in Freetown.

Through household interviews this study addressed a gap in knowledge and understanding of user perception of current services and response to potential service

improvements for sanitation provision within low and middle income communities (Tumwebaze et al., 2013). The willingness to pay (WTP) for improved services was noted to be an average of $107 which is $17 higher than the current average household cost for desludging. This indicates the potential to provide higher quality service with additional costs. The survey also indicated the role of seasonality and income variability where instalment payment plans could be helpful. In terms of service improvements the highest priority for households was that the pit emptier could be contacted more easily and would respond more promptly. Almost 60 per cent of the households waited between one and seven days with almost 12 per cent of the households having to wait more than a week for desludging after contacting a service provider. This highlights the need to connect customers to service providers more effectively to ensure that timely and efficient desludging services are provided. Improved monitoring and strong accountability of centralized management structures are required to improve response to households. Within this improved management structure there is then an opportunity to provide decentralized and localized pit-emptying services through development of local transfer stations. Decentralization of services by installation of transfer stations could help to reduce response time and shift from non-responsive, large-scale, centralized treatment facilities to a hybrid of intermediate transfer stations and a centralized treatment facility (Tremolet, 2012).

An estimated 17 per cent of the sludge reaches the city disposal site of King Tom with most of the sludge buried locally or disposed into local drains particularly during the rainy season. Based on observations noted in Figure 8 there is at least 25 per cent of city sludge unaccounted for. There is therefore a need to improve collection, transport, and safe disposal practices for faecal sludge in Freetown. There needs to be a balance between centralized treatment facilities and the need to improve manual collection services which require decentralized/localized support. Treatment of faecal sludge is one of the key challenges noted, especially as centralized treatment systems are more cost effective than decentralized solutions which require local management structures and may be land intensive (Parkinson and Tayler, 2003). The combination of centralized treatment and

decentralized intermittent collection stations with local transport and storage facilities would improve pathways for faecal sludge management in Freetown. This would be cost efficient as there would be a reduction in transport costs, improved customer satisfaction translating into improved willingness to pay for services, and a cost-efficient, centralized treatment process.

This study highlights the need to raise awareness of local residents and service providers on the benefits of safe sludge disposal and the need to improve disposal and treatment of sludge to avoid contamination and public health risks for the Freetown population.

[A]Faecal sludge management (FSM) city-wide strategy

In partnership with Freetown City Council, GOAL implemented a six month project to support the development of a city-wide strategy for FSM that engages the private sector.

The strategy was developed through the in-depth research undertaken into: the problems at all stages in the value chain, the challenges faced by FCC, research on appropriate technical and management solutions, and the priorities and needs of Freetown's citizens.

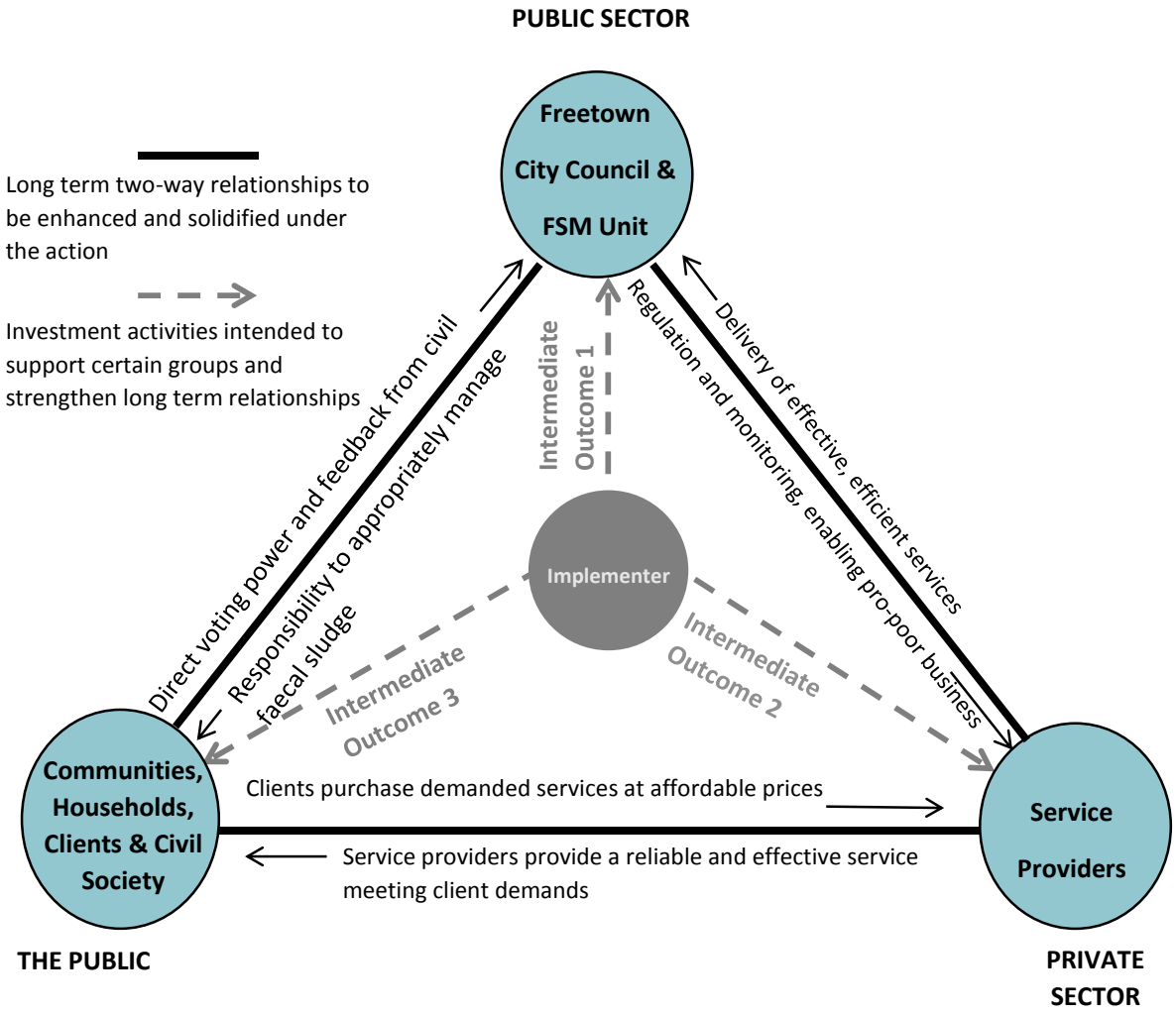
The household survey and key informant interviews from the market assessment provided evidence on quality of existing service, challenges/gaps, and willingness to pay for improved services. This evidence was used to develop a detailed financial model for FSM which informed the strategy for public private partnership and included calculations for tariffs, capital investment required, operational costs, and potential profits if any.

The findings from the household survey fed into development of the strategy for Freetown. The survey indicated that manual desludging and treatment/disposal were key challenges in the FSM chain. In 2014, the private firm Masada had been contracted to manage the treatment of solid and liquid waste at Kingtom so the city-wide strategy focused on collection, safe storage, and transportation of faecal sludge. The strategy aligned with

Masada plans and targets to ensure that the sanitation value chain was covered in entirety. During a steering committee meeting held at FCC in June 2014 Masada suggested using Kingtom as a sludge disposal site and pre-treatment site. Masada would then collect sludge from Kingtom and transport it to a new final facility being set up at Kerry Town (FCC, 2014). The design of the new plant/facility would be determined by the quality and quantity of waste though Masada highlighted that with increased sludge collection through implementation of a new strategy there could be a gap in sludge collection and treatment capacity of the plant. Given the need to balance more localized needs for improved household services for collection with efficient transport and safe disposal, an innovative public private partnership (PPP) has been proposed with a view to reducing the quantity of untreated faecal sludge being released into the environment of Freetown. This PPP links the customers to both public and private sector actors to ensure improved delivery of service and a feedback mechanism through performance-based service contracts. As shown in Figure 9 the strategy has three key outcomes, discussed below.

[B]*Outcome 1: Strengthened regulatory environment and improved public infrastructure for FSM.*

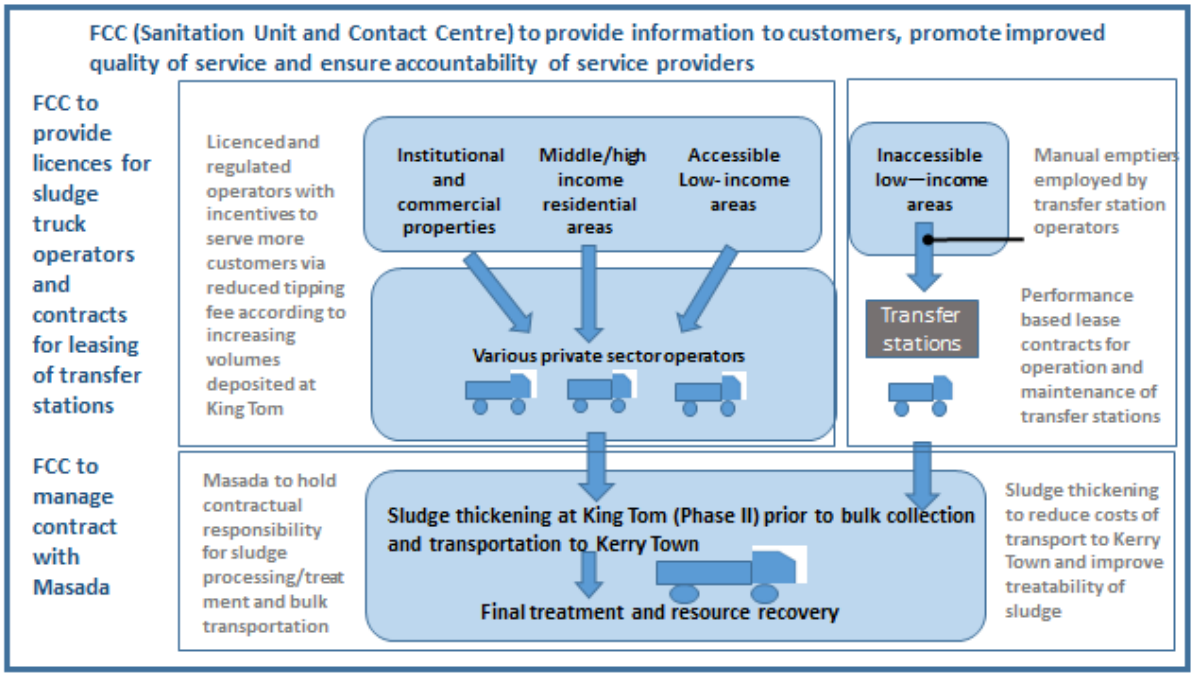
This outcome focuses on improving regulation in order to facilitate the private sector in operating effective and efficient services along the value chain. The market assessment highlighted low levels of satisfaction with desludging and in particular manual desludging. The strategy proposes contracting arrangements such as performance-based payments in order to promote private sector involvement and ensure that the services provided achieve both coverage and quality.



[CAP]Figure 9 Institutional arrangements for schematic FSM strategy (Freetown)

[C]*Sanitation Unit and Contact Centre.* Additionally, effective regulation would require a robust mechanism for gathering and analysing information on performance, from a variety of sources including individual clients, communities, community-based organizations, and service providers. It was proposed to set up a Sanitation Unit and Contact Centre within FCC in order to provide overall regulation, oversight, and monitoring, supported with a system for collecting and collating information about the performance of service providers in relation to their contractual obligations. The proposed Sanitation Unit and Contact Centre (Figure 10) would facilitate households to use its services for requesting pit emptying and reporting perceived quality, efficiency, and legality of services within their own community. It would also ensure that community views on FSM

and sanitation in general are represented to facilitate development of a policy framework which would meet community needs and respond to challenges at community level.



[CAP]Figure 10 Improved customer services through call centre and transfer stations

The strategy also proposes the construction of 12 decentralized intermediate transfer stations in the initial phase which would improve sludge collection rates and ensure that the sludge is then collected and transported safely to the disposal site. Based on a survey run by GOAL with the Freetown WASH Consortium to categorize city wards by density, income, and accessibility, areas with limited access to mechanical desludging were identified. The intermediate transfer stations would be sited in locations where manual pit emptying is dominant and hence would facilitate and improve collection of sludge. Intermediate transfer stations can effectively link manual pit emptiers and local private operators for manual and mechanical desludging to public operators who are more traditionally involved in transportation, disposal, and treatment of sludge (Boot and Scott, 2009). FCC would issue performance-based contracts to the private sector to ensure that transfer stations are managed and maintained effectively. Transport service providers with mechanized systems

such as vacuum tankers would operate with sufficient and sustainable capacity to ensure sludge is safely and efficiently transferred to final treatment facilities.

[B]*Outcome 2: Strengthened private sector entities at all stages along the FSM chain*

Developing contractual arrangements for private sector involvement by itself would not suffice. The market assessment highlighted service gaps in manual desludging and sludge disposal. Enhancing the technical and business management skills of the formal and informal service providers engaged in FSM would improve the quality, efficiency, and coverage of faecal sludge collection, safe storage, and transportation of waste. The potential for reuse of waste would be explored and encouraged in order to create sustainable economic opportunities along the value chain.

[B]*Outcome 3: Increased community awareness, acceptance, and use of appropriate FSM*

GOAL's field experience suggests that community opposition to siting transfer stations in their neighbourhood presents a major barrier to the achievement of the FSM strategy. Only with increased awareness of the need for FSM services and support for the necessary infrastructure will the value chain be able to function. It was acknowledged that the success of the city-wide FSM strategy would be dependent upon community acceptance and without support from households untreated sludge will continue to be released into the environment. This aspect would need further study in future work.

[A]Conclusion

Provision of water and sanitation infrastructure can improve health, education, income, and housing and also be a driver for improved well-being and increased productivity (Parikh and McRobie, 2009; Parikh et al., 2012, 2015; Tremolet, 2012). There is therefore a strong economic case for investment in sanitation (Tremolet, 2012).

An economically viable and technologically appropriate FSM system will lead to improved pit emptying, sludge transport, and waste management services. This in turn will lead to health benefits for the affected population and increasing economic opportunities along the faecal sludge value chain. The proposed strategy for FSM requires an effective and robust government oversight, a strong and vibrant private sector with the technical capacity to provide effective services, and public understanding of and commitment to appropriate management of FS. The market assessment contributed to the development of the strategy by proposing measures to enhance the technical and business management skills of the multitude of formal and informal service providers engaged in FSM, improving the quality, efficiency, and coverage of FS collection, transportation, treatment, and disposal. The market assessment and consultation has ensured that the proposed strategy would be affordable and acceptable to local stakeholders. The proposed Sanitation Unit and Contact Centre will ensure information from customers is shared with service providers. This will enable service providers to respond to community and household needs efficiently and improve pit desludging services.

Overcrowded living conditions and high reliance on pit latrines without adequate collection and disposal of sludge has increased the incidence of waterborne diseases in Freetown (Blinker, 2006). An improved FSM system would potentially reduce the incidence of waterborne disease and reduce the strain on the country's health systems. Furthermore, the strengthening of FCC's ability to manage a city-wide system will improve its capacity to manage public health planning. The outbreak of Ebola in 2014 and frequent cholera outbreaks highlight weaknesses in the government's ability to effectively mobilize trained health workers, adequate equipment, and supplies, and conduct public health campaigns which can effectively educate citizens about the realities of a disease of which many are fearful and ill-informed. In addition to the Ebola challenge the government still has to address waterborne disease-related health treatment which has taken a backseat. An improved FSM system will reduce the burden of health care in a nation grappling with post-civil war recovery and the Ebola outbreak.

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