CHAPTER 8

The long-term safe management of rural shit

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Abstract

Community-Led Total Sanitation (CLTS) has led to millions of pit latrines being built in rural communities across the world. However, pits or tanks filling up is emerging as a challenge to the open defecation free (ODF) status of some of these communities. Households or individuals may revert back to open defecation (OD) if digging a new pit is problematic or emptying services are not available or too expensive. Furthermore, fear of pits becoming full can dissuade people from using toilets. Services for emptying are often inadequate and can result in unsafe and indiscriminate dumping of pit content into the environment. This chapter explores this problem, which has the potential to become more pressing with time as more and more pits begin to fill, and presents potential options for tackling this challenge. It includes specific recommendations for CLTS practice that will help ensure rural shit is contained and managed safely and hygienically.

Keywords: Faecal Sludge Management, Rural sanitation, On-site sanitation, Health, Environment

Introduction

Bad rural pit latrine management, including pit emptying, has serious health and environmental risks (Evans et al., 2015). Most outcomes of Community-Led Total Sanitation (CLTS) programmes lead to households creating on-site sanitation solutions. Whether the outcome is a pit latrine or a septic tank, faeces are not directly taken away by sewage systems but remain contained, hopefully hygienically, in the ground below the toilet facility.

Faecal Sludge Management (FSM) encompasses the storage, collection, transport, treatment, and safe end use or disposal of faecal sludge (Strande et al., 2014). Discussions around FSM have not been ignored, but are usually confined to urban environments where higher population densities mean the poor disposal of sludge will have a higher impact on health. The 3rd International FSM Conference held in 2015 had only one presentation focusing on rural sludge. Last year saw the publication of *Faecal Sludge Management: Systems Approach for Implementation and Operation*. It argued for the need to first determine the final disposal options of sludge (Strande et al., 2014). It also suggested that all members of the community must properly manage faecal sludge to ensure

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public health benefits (Strande et al., 2014), something that may resonate with those familiar with the CLTS approach. However, the focus of the book was exclusively urban. By using an FSM lens, focusing on safe and hygienic storage, collection and transportation (where appropriate), and disposal or end-use, various issues that challenge the sustainable and safe confinement of rural shit begin to appear.

This chapter argues for the need for CLTS and other rural programmes to consider what will happen when pits begin filling up. It is an attempt to convince practitioners and policy-makers of the need to consider the safe confinement of shit permanently in rural environments as an issue needing attention from the start.

The problem: a mountain out of a molehill?

Why has FSM been given such little attention? Is it not a serious problem? Are most rural pits new additions to households and not yet full? Is it assumed that new pits are always dug?

When pits in rural areas are filling or full there are four options:

- Stop using and dig another pit.
- Empty the pit.
- Use sparingly.
- Abandon and revert to open defecation (OD) (Chambers and Myers, 2016).

Emptying pits can be expensive. In rural Laos, the average cost of emptying a pit is US$50. Households that were unable to afford this reverted back to OD (Opel and Cheuasongkham, 2015). In Cambodia, it has also been noted that there is an increased risk of reversion back to OD by households who can't afford pit emptying services (Wood, 2011).

Digging a new pit can be difficult where there is little space or the soil type, topography, or hydrogeology makes this process difficult and expensive. In Zambia, where pits are generally abandoned when full and a new latrine is then constructed, those with small compounds are running out of space (SNV Zambia, 2014). Furthermore, it is generally only viable when the superstructure is moveable (Tilley et al., 2014). Consequently, this option is not always feasible.

Recently we have seen an increased interest in combining CLTS and sanitation marketing (see Coombes, 2016, this book; Munkhondia et al., 2016, this book). As households invest more in both the substructure and the superstructure, moving towards the middle rung of the sanitation ladder, digging a new pit becomes more and more difficult. Soil slabs can be made again relatively cheaply, concrete slabs can be moved but pits lined with concrete rings or bricks and superstructures made from bricks and stones are difficult to transfer to new pits. Once pits fill up, households are faced with the question of what to do next. The World Bank's Water

and Sanitation Program (WSP) 'Introductory Guide to Sanitation Marketing' recommends that masons should be trained in services, including proper sludge management (Devine and Kullman, 2011). However, a recent review of 22 rural sanitation supply studies commissioned by WSP found that there was little innovation in aftersales services such as maintenance, repairs, waste removal, and management once a pit or tank reaches capacity (Dumpert and Perez, 2015).

In Bangladesh, the evaluation of the BRAC water, sanitation, and hygiene (WASH) programme identified pit emptying and the safe final disposal of the sludge as a major 'second generation' challenge (BRAC, 2014). In addition, Chapter 2 on Bangladesh (Hanchett, 2016, this book) showed that because the country is so close to ODF the major challenge now is the problem of faecal sludge, in both rural and urban environments. It highlights the concerns of WASH professionals who described the installation of pit latrines across the country without considering what to do with the faecal sludge as a major problem (Hanchett, 2016, this book). The same problem has also been identified in Kerala, India, where latrine coverage is 96 per cent (Samuel, 2013).

In addition, the fear of having to empty pits can dissuade people from using toilets. In rural northern India, people strive for deep, large pits that will not have to be emptied in their lifetime (Coffey et al., 2015; Shah et al., 2013). The availability and perceived affordability of pit emptying services has also been noted as a key issue in sustaining latrine usage and subsequently ODF communities in Bangladesh (Hanchett et al., 2011).

Problems along the sanitation chain

Sanitation services need to be thought out throughout the entire sanitation chain (Verhagen and Carrasco, 2013). Using the FSM chain (storage, collection and transportation, and end-use and disposal) to frame practices in rural areas can help further expose the importance of the issue.

ATTENTION! It is important to note here the FSM does not always mean collection. The emptying, transportation, and disposal of sludge from pit latrines can pose a significant health risk alongside organizational difficulties (Water Research Commission, 2007). Covering pits and digging new ones can also be a safe and hygienic FSM option.

Storage

Human excreta needs to be contained and stored safely. Safe confinement means a slab that seals the pit and prevents rodents and flies from entering. Storage is where CLTS has focused; however problems have still occurred. Data collected in southern Ethiopia found that 30 per cent of slabs in ODF villages where CLTS interventions had taken place contained openings additional to the squat hole (Beyene, 2016, this book). In addition, personal experience from visiting CLTS villages in Uganda has highlighted a similar problem:

slabs made from wood with large gaps between the boards. Consequently, although there is no longer shit in fields where children play, slabs are not adequately sealed and vectors are able to move in and out of the pit, enabling the continuation of faecal-oral pathways.

There are different perspectives on the dangers associated with contamination of groundwater from pit latrines. WASH professionals have been accused of being irrational as health risks are usually lower than anticipated (Sugden, 2006). In the majority of cases, contamination of groundwater is not a serious concern and most on-site latrines separate latrine content from drinking water sources (Cave and Kolsky, 1999). However, baseline data collected by SNV in Ghana, Nepal, and Tanzania found that pit latrines were in danger of contaminating groundwater (SNV Ghana, 2014; SNV Nepal, 2014; SNV Tanzania, 2014). Although contamination risks may be low, alternative water sources in rural areas may be limited, making contamination very costly (Howard et al., 2014). Methods of reducing the risk of contamination include: increasing the distance between latrines and water points; moving the water point higher than the latrine; using a drier form of toilet; and increasing the vertical separation between the bottom of the pit and the water table (Sugden, 2006).

Collection and transportation (where appropriate)

As mentioned above, there are certain instances when emptying and desludging may be an appropriate action, where digging a new pit is not possible due to space or soil type or the substructure or superstructure is not easily movable. Those providing this service are often not well protected. In Bangladesh, sweepers often do not use either gloves or protective clothing, thus coming into direct contact with sludge (Evans et al., 2015). Furthermore, Aashish Gupta et al.'s contribution to this book shows the social stigma associated with *dalit* communities who traditionally deal with human waste (Gupta et al., 2016, this book).

Disposal or end use (where appropriate)

Untreated faecal sludge is very dangerous and highly pathogenic, and direct contact should be avoided (Tilley et al., 2014). Despite this it is common for sludge to be disposed of in the sea, rivers, ponds, lakes, and onto land (Pickford and Shaw, 1999). A report published by IRC noted, 'In rural areas, it is becoming increasingly clear that when pit latrines are emptied, the sludge is dumped indiscriminately, leading to what may be labelled as "postponed open-defecation"' (Verhagen and Carrasco, 2013: 6).

In Ghana, SNV found that in 53.1 per cent of cases excreta had been emptied into a hole on the compound and just left open (SNV Ghana, 2014). In Laos, as official dumping sites are too expensive for the private sector, raw sludge is placed in roadside ditches, canals, and open water bodies with no objection from government or the public (Opel and Cheuasongkham, 2015). In Cambodia, sludge from pits is often put into neighbouring padi fields

(Wood, 2011). In Vietnam, even in urban areas untreated sludge is dumped into the environment (PSI Vietnam, 2014).

Safe and hygienic FSM can help not just sustain ODF communities but also sustain the removal of faeces from **everybody's** environment permanently.

Ways forward?

All major organizations working in WASH were contacted for this chapter; however it emerged that there is little programmatic experience. Below are examples of work happening across the world on pit latrine management and FSM.

Measuring

The saying 'what gets measured gets managed' seems appropriate here. The rate at which pits fill up, what happens after, and how this affects sustainability is something we know little about. The Joint Monitoring Programme 2014 Report suggests measuring 'the percentage of people who use a basic sanitation facility and whose excreta are safely transported to a designated disposal/treatment site or treated *in situ* before being reused or returned to the environment' to measure access to safely managed sanitation services (WHO and UNICEF, 2014). Having this information is an important first step.

As part of Plan's Pan Africa CLTS Programme participating countries were required to count the number of full pits. The data suggests that 3,000 toilets had filled up, approximately 1 per cent of the total constructed. However, it was also noted that the data was fairly unreliable (Robinson, 2014) and what happened afterwards was not measured.

In SNV's Sustainable Sanitation and Hygiene Results Programme, participating countries all included FSM emptying and collection as a sustainability indicator. A score of 0 to 4 is given depending on the system in place (SNV Zambia, 2014):

0 – no on-site storage;
1 – storage but no emptying;
2 – unsafe emptying;
3 – partially safe emptying and collection;
4 – safe emptying and collection.

At WaterAid, Post-Implementation Monitoring Surveys (PIMS) are used to assess the sustainability of their programmes. A range of different questions about water, sanitation, and hygiene are asked, including what will happen once the pit is full. Each country is supposed to conduct one small-scale PIMS each year, surveying a limited part of a WaterAid supported intervention. One country from each of the four different regions WaterAid work in are supposed to conduct a large-scale PIMS, meaning it covers all the interventions.

Researchers at the University of North Carolina are developing and piloting ways that international organizations and countries are able to estimate the

fraction of human excreta unsafely returned to the environment to establish at what points along the sanitation chain this happens. More information about the project titled *Unsafe Return of Human Excreta to the Environment* can be found on the Water Institute's project page.[1]

Certification criteria

The phased sanitation framework introduced in the Philippines by UNICEF (Robinson and Gnilo, 2016, Chapter 9, this book) has three stages of certification. In the second phase, Sustainable Sanitation Barangay, toilets must have sustainable designs which include the potential for safe emptying or replacement of the pit or septic tank (UNICEF Philippines, 2013).

Emptying technologies

There are a number of different technologies that are either manually operated or fully mechanized. However, these technologies do not help answer the question of what happens to the sludge after it has been removed. One is the Gulper, a manually operated pump that can be connected to pits via a pipe. The user raises and lowers a handle which pumps the sludge out of the pit. It has been used in urban areas but has also been tested in remote areas (Cranfield University et al., 2011).

For a range of different semi and fully mechanized technologies see Mikhael et al. (2014) and WASTE et al. (2015).

Transfer stations

Transfer stations act as a primary collection point. Those using manual or small technologies can empty into transfer stations which can then be collected by larger vacuum trucks and taken to treatment facilities. They have been used in urban areas where even the travel times to and from treatment or disposal sites can be too great for sludge collection to be economically viable. Establishing multiple transfer stations across cities should decrease the risk of illegal dumping as well promote the emptying market (Tilley et al., 2014). Despite built-in inefficiency, the shit having to be handled twice, they may be viable in rural areas where indiscriminate dumping is a problem. For more details on transfer stations in an urban environment see Mukheibir (2015).

Combining FSM services with sanitation marketing

Indonesian truck-based emptying services for pits and septic tanks are already worth an estimated US$100 m per year. There, 90 one-stop-shop (OSS) sanitation entrepreneurs offering a single enterprise for products and services have been set up. They offer a range of different product options, delivery of products, installation, flexible payment options, and bulk purchase discounts. In addition, and most importantly for FSM and sustainability of infrastructure,

some also provide after-sales services including maintenance. It is reported that between one (Pedi and Kamsan, forthcoming) and several (Budi Darmawan, personal communication) also offer desludging services. Although this number is disappointing, it is reported that many OSSs have built a strong customer base and are starting to see the potential of providing FSM services. Questions still remain regarding ways to encourage more to provide this service and what will happen further down the sludge chain (Pedi and Kamsan, forthcoming).

Ecological Sanitation (EcoSan)

Where appropriate, EcoSan could be a viable option. EcoSan comprises a range of technology options that promote the use of human excreta as a resource. The fact that households are able to manage their own sludge can be either positive or negative. A huge benefit, other than the reuse in agriculture, is that households are less reliant on others. However, households can also be unhappy about the extra burden being placed on them and there are many cultural barriers to the handling and reuse of excreta.

Different options include:

- **The Arborloo:** A shallow pit is dug and covered with a simple superstructure. Dried leaves are added to the bottom of the pit and a concrete slab is placed over the pit. After use, a mix of ash, soil and/or wood is added. Household rubbish should not be thrown in the pit. Before the pit is full the slab is removed and the pit filled up with soil and a tree planted (CSR, 2009). Arborloos are low cost and easy to make (Morgan, 2004). However, they require an adequate amount of space and old pits cannot be reused (Tilley et al. 2014). In addition, they are unsuitable in areas with a high water table.
- **Urine Diverting Dry Toilets (UDDT):** UDDTs are waterless with the urine and faeces being separated at the source and stored apart. UDDTs require less space yet have relatively high construction, operation, and maintenance costs (Nilsson et al., 2011).
- **Twin Pits:** A two pit model is currently being promoted in India as part of the Swachh Bharat Mission and has been promoted in Bangladesh by BRAC since 2008. The two pits are used in rotation. Once one pit is full it is left so that the content degrades into organic fertilizer. The other pit is then used. Sludge, once composted and therefore safe, can be emptied manually.

Tigers and worms: a way forward?

The Tiger Toilet is an onsite sanitation system that uses worms to change fresh faeces into vermicompost. A bedding layer made from locally available material acts as a filter with effluent infiltrating the soil below. Unlike other

options it reduces the frequency of emptying. Through field tests in India, developers have estimated that it would require emptying after approximately five years. Vermicompost is produced which is dry and soil-like and easy and safe to empty (Furlong et al., 2015).

The vermifilter below the ground is connected to a pour-flush toilet. The water seal provides a superior system to current traditional pit latrine options giving it the potential to be an aspirational product with similar benefits of a septic tank but with better waste treatment and at a considerably lower cost (Furlong et al., 2015).[2]

Challenges to safe rural pit management services

There are various challenges to safe rural pit management in rural areas. Increased distances to towns where FSM services may be located raises the costs of safe and hygienic emptying. Treatment and disposal facilities are also more likely to be further away, increasing prices and encouraging dumping. Furthermore, market-based solutions are only viable where communities see there is a problem. In West Bengal it has been noted there is little to no dissatisfaction with dumping sludge (Sugden, 2015), while in Laos there is limited awareness about the health issues associated with the unsafe disposal of sludge (Opel and Cheuasongkham, 2015). Indiscriminate dumping in Laos does not trigger complaints from governments or communities (Opel and Cheuasongkham, 2015). Dispersed populations in rural areas also makes it more difficult to regulate and enforce laws (Sugden, 2015) even in areas where governments are keen to take action.

Even for those wanting to make a career out of pit emptying, the social costs can be heavy (Sudgen, 2013). For example, in India the lowest castes are seen as both permanently polluted as well as polluting to others. Those who clean human faeces are considered the most polluted. This link to pollution is often used to justify continued oppression. Those who do this job are the most socially excluded (see Gupta et al., 2016, this book; Coffey et al., 2015). It is important that any FSM system does not lead to those dealing with shit also being treated like shit.

Recommendations and ways forward

- It is important not to overload the triggering process and dilute the communities' realization that they are eating each other's shit (Roose et al., 2015). However, actions with the community can be taken in the post-triggering phase where different latrine options are being considered.
- Follow-up could include facilitated discussions about fill-up rates, options once pit latrines have filled up and raising awareness about the health and environmental risks involved in the indiscriminate dumping of faecal sludge.

- Finding the appropriate timing for introducing any pit management/FSM component to a project is an area of formative research. Further thinking and discussion is needed about whether pit management should be incorporated into post-triggering or post-ODF follow-up.
- FSM options must be user-friendly. Following in the tradition of CLTS, communities should participate in discussions surrounding what happens when pit latrines fill up. Should new pits be dug or should they be emptied and disposed of safely? Consumer preferences, including costs, need to be discussed and considered. Any discussion around toilet options should include how technologies affect pit management. Those working in FSM could learn from CLTS practitioners about participatory methods.
- Beyond the technological, social considerations are needed, especially in South Asia, where there is the risk that pit management/FSM service providers could be ostracized.

Conclusions

Using an FSM lens, assessing all parts of the chain is helpful to identify problems and suggest areas where inventions are needed to sustain the safe containment or removal of faeces from pits or tanks and the environment. This also includes safe storage of faeces while pits are filling up. An increase in interest in sanitation marketing that focuses on hardware components will exacerbate the problem. It is essential that households who invest in more permanent and less mobile sub- and superstructures have affordable services available or are able to deal with the sludge safely without assistance. There are many opportunities within the CLTS process post-triggering and post-ODF that can help. However, developing FSM services is riddled with problems and additional support from those outside the community will be necessary in most cases including government and the private sector.

About the author

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Endnotes

1. http://waterinstitute.unc.edu/research/current-projects/unsafe-return/
2. For more information contact Dr Claire Furlong c.furlong@lboro.ac.uk.

References

Beyene, H. (2016) 'Sanitation infrastructure sustainability challenges case study: Ethiopia', in P. Bongartz, N. Vernon and J. Fox (eds.) *Sustainable Sanitation for All: Experiences, Challenges, and Innovations*, Practical Action Publishing, Rugby.

BRAC (2014) *Faecal Sludge Management – 1*, BRAC Water Sanitation and Hygiene Programme, Dhaka, http://www.ircwash.org/sites/default/files/brac_wash_faecal_sludge_management_dec_2014.pdf [accessed 25 January 2016].

Cave, B. and Kolsky, P. (1999) *Groundwater, Latrines and Health,* WELL Resource Centre, http://www.lboro.ac.uk/orgs/well/resources/well-studies/full-reports-pdf/task0163.pdf [accessed 28 January 2016].

Chambers, R. and Myers, J. (2016) 'Norms, knowledge and usage', *Frontiers of CLTS: Innovations and Insights* 7, Institute of Development Studies, Brighton.

Coffey, D., Gupta, A., Payal, H., Spears, D., Srivastav, N. and Vyas, S. (2015) *Culture and Health Transition: Understanding Sanitation Behaviour in Rural North India*, International Growth Centre Working Paper, IGC, London, http://www.theigc.org/wp-content/uploads/2015/04/Coffey-et-al-2015-Working-Paper.pdf [accessed 25 January 2016].

Coombes, Y. (2016) 'User centred latrine guidelines. Integrating CLTS with sanitation marketing: a case study from Kenya to promote informed choice', in P. Bongartz, N. Vernon and J. Fox (eds.) *Sustainable Sanitation for All: Experiences, Challenges, and Innovations*, Practical Action Publishing, Rugby.

Cranfield University, SKAT, WaterAid and IRC (2011) *Africa Wide Water, Sanitation and Hygiene Technology Review*, WASHTech Deliverable 2.1, Cranfield University, Cranfield, https://washtechafrica.files.wordpress.com/2011/04/washtech_wp2-1_africa_wide_water_sanitation_hygiene_technology_review.pdf [accessed 25 January 2016].

CSR (2009) *Innovations in Water and Sanitation: The ArborLoo Latrine*, http://www.medbox.org/key-resources/innovations-in-water-and-sanitation-promoting-ecological-sanitation-in-ethiopia-through-the-arborloo-latrine/preview?q [accessed 28 January 2016].

Devine, J. and Kullmann, C. (2011) *Introductory Guide to Sanitation Marketing*, Water and Sanitation Programme: Toolkit, WSP/The World Bank, Washington, DC.

Dumpert, J. and Perez, E. (2015) 'Going beyond masons training: enabling, facilitating, and engaging rural sanitation markets for the base of the pyramid', *Waterlines,* 34.3: 210–226 <http://dx.doi.org/10.3362/1756-3488.2015.021>.

Evans, B., Fletcher, L.A., Camargo-Valero, M.A., Balasubramanya, S., Rao, C.K., Fernando, S., Ahmed, R., Habib, A., Asad, N.S.M., Rahman, M.M., Kabir, K.B. and Emon, M.H. (2015) *VesV - Value at the end of the Sanitation Value Chain*, University of Leeds, Leeds, http://www.ircwash.org/sites/default/files/vesv_final_report_30-mar-2015_macv_-_amended.pdf [accessed 25 January 2016].

Furlong, C., Gibson, W.T., Templeton, M.R., Taillade, M., Kassam, F., Crabb, G., Goodsell, R., McQuilkin, J., Oak, A., Thakar, G., Kodgire, M. and Patankar, R. (2015) 'The development of an onsite sanitation system based on vermifiltration: the "tiger toilet"', *Journal of Water Sanitation and Hygiene for Development*, 5(4): 614–9 <http://dx.doi.org/10.2166/washdev.2015.167>.

Gupta, A., Coffey, D. and Spears, D. (2016) 'Purity, pollution, and untouchability: challenges affecting the adoption, use, and sustainability of sanitation programmes in rural India', in P. Bongartz, N. Vernon and J. Fox (eds.) *Sustainable Sanitation for All: Experiences, Challenges, and Innovations*, Practical Action, Rugby.

Hanchett, S. (2016) 'Sanitation in Bangladesh: revolution, evolution, and new challenges', in P. Bongartz, N. Vernon and J. Fox (eds.) *Sustainable Sanitation for All: Experiences, Challenges, and Innovations*, Practical Action, Rugby.

Hanchett, S., Krieger, L., Kahn, M.H., Kullmannn, C. and Ahmed, R. (2011) *Long-Term Sustainability of Improved Sanitation in Rural Bangladesh*, World Bank, Washington, DC, https://openknowledge.worldbank.org/handle/10986/17347 [accessed 28 January 2016].

Howard, G., Reed, B., McChesney, D. and Taylor, R. (2014) 'Human excreta and sanitation: control and protection', in O. Schmoll, G. Howard, J. Chilton and I. Chorus (eds.), *Protecting Groundwater for Health: Managing the Quality of Drinking-Water Sources*, World Health Organization, IWA Publishing, London.

Mikhael, G., Robbins, D.M., Ramsay, J.E. and Mbéguérém, M. (2014) 'Methods and means for collection and transport of faecal sludge', Chapter 4 in D. Brdjenovic, M. Ronteltap and L. Strande (eds) *Fecal Sludge Management: Systems Approach for Implementation and Management*, IWA Publishing, London http://www.eawag.ch/fileadmin/Domain1/Abteilungen/sandec/publikationen/EWM/Book/FSM_Ch04_Collection_and_Transport.pdf [accessed 26 January 2016].

Munkhondia, T., Simangolwa, W. and Zapico, A. (2016) 'CLTS and sanitation marketing: aspects to consider for a better integrated approach', in P. Bongartz, N. Vernon and J. Fox (eds.), *Sustainable Sanitation for All: Experiences, Challenges, and Innovations*, Rugby: Practical Action Publishing.

Morgan, P. (2004) *The Arborloo Book: How to Make a Simple Pit Toilet and Grow Trees or Make Humus for the Garden*, Stockholm Environment Institute, Stockholm.

Mukheibir, P. (2015) *Learning Paper: Septage Transfer Stations*, prepared for SNV Netherlands Development Organisation by Institute for Sustainable Futures, University of Technology Sydney, Sydney, http://forum.susana.org/media/kunena/attachments/1609/SNVISFSeptagetransferstationslearningpaper-draftJune.pdf [accessed 26 January 2016].

Nilsson, Å., Cross, P., Robinson, A., Alvetag, T., Bara, A., Quiroga, T. and Yun, L. (2011) *Evaluation of EcoSanRes Programme*, Phase 2 (personal communication).

Opel, A., and Cheuasongkham, P. (2015) *Faecal Sludge Management Services in Rural Laos: Critical Gaps and Important Ways Forward,* 3rd Faecal Sludge Management Conference, Hanoi, Vietnam.

Pedi, D. and Kamsan, A. (forthcoming 2016) *Sanitation Market Transformation in Indonesia: Designing Viable Business Models*, Water and Sanitation Program, World Bank, Washington, DC.

Pickford, J. and Shaw, R. (1999) 'Emptying pit latrines, Technical Brief No. 54', in R. Shaw (ed.) *Running Water: More Technical Briefs on Health, Water and Sanitation*, IT Publications, London.

PSI Vietnam (2014) *Rural Sanitation Rapid Market Scan Report*, PSI, Vietnam, http://www.psi.org/wp-content/uploads/2014/11/Sanitation-Market-Scan-Final-rev-2.pdf [accessed 26 January 2016].

Robinson, A. (2014) *Plan Pan African CLTS Program Benchmarking Summary Report*: Q5 June 2014, unpublished (personal communication).

Robinson, A. and Gnilo, M. (2016) 'Beyond ODF: a phased approach to rural sanitation development', Chapter 9 in P. Bongartz, N. Vernon and J. Fox (eds.) *Sustainable Sanitation for All: Experiences, Challenges, and Innovations*, Practical Action Publishing, Rugby.

Roose, S., Rankin, T. and Cavill, S. (2015) 'Breaking the next taboo: menstrual hygiene within CLTS', *Frontiers of CLTS: Innovations and Insights* 6, Institute of Development Studies, Brighton.

Samuel, S. (2013) *Septage: Kerala's Looming Sanitation Challenge*, The Water Blog, World Bank, http://blogs.worldbank.org/water/septage-kerala-s-looming-sanitation-challenge [accessed 7 September 2015].

Shah, A., Thathachari, J., Agarwai, R. and Karamchandani, A. (2013) *A Market Led, Evidence Based Approach to Rural Sanitation*, White Paper prepared by Monitor Inclusive Markets on behalf of The Bill and Melinda Gates Foundation, DTTIPL, India, http://www.gramalaya.in/pdf/Market_Led_Approach_to_Rural_Sanitation.pdf [accessed 26 January 2016].

SNV Ghana (2014) *Sustainable Sanitation and Hygiene for All Results Programme*, Baseline Survey Report, Ghana, DFID Sustainable Sanitation and Hygiene for all Results Programme, http://snv-website-2015.live.dpdk.com/public/cms/sites/default/files/explore/download/p1-gh-1_baseline_report_ghana_0.pdf [accessed 26 January 2016].

SNV Nepal (2014) *Sustainable Sanitation and Hygiene for All Results Programme,* Nepal Baseline Report, SNV, Kathmandu, (unpublished).

SNV Tanzania (2014) *Sanitation Baseline Results for Karatu, Babati, Geita, Kwimba, and Chato Districts in Tanzania,* SNV Smart Development Works, http://snv-website-2015.live.dpdk.com/public/cms/sites/default/files/explore/download/p1-tz-1_baseline_report_tanzania.pdf [accessed 26 January 2016].

SNV Zambia (2014) *Zambia Country Baseline Report: Sustainable Sanitation and Hygiene for All Results Programme*, SNV, (unpublished).

Strande, L., Ronteltap, M. and Brdjanovic, D. (2014) *Faecal Sludge Management: Systems Approach for Implementation and Operation*, IWA Publishing, London.

Sugden, S. (2006) *The Microbiological Contamination of Water Supplies,* WELL Resource Centre, http://www.lboro.ac.uk/orgs/well/resources/fact-sheets/fact-sheets-htm/Contamination.htm [accessed 28 January 2016].

Sugden, S. (2013) 'The importance of understanding the market when designing pit-emptying devices', *Waterlines*, 32(3): 200–212 <http://dx.doi.org/10.3362/1756-3488.2013.021>.

Sugden, S. (2015) *Rural FSM Development in West Bengal*, unpublished.

Tilley, E., Ulrich, L., Lüthi, C., Reymond, P. and Zurbrügg, C. (2014) *Compendium of Sanitation Systems and Technologies*, Eawag, Dübendorf.

UNICEF Philippines (2013) 'Development of a multi-stakeholder implementation strategy for scaling up rural sanitation: Final Report', (unpublished), UNICEF, Philippines.

Verhagen, J. and Carrasco, M. (2013) *Full-Chain Sanitation Services that Last: Non-sewered Sanitation Services*, IRC, The Hague.

WASTE, Netherlands Red Cross and the International Federation of Red Cross and Red Crescent Societies (2015) *Testing and Developing of Desludging Units for Emptying Pit Latrines and Septic Tanks*, WASTE/IFRC/ESP, http://www.speedkits.eu/sites/www.speedkits.eu/files/Elaborate%20report%20field%20testing%20pit%20emptying%20Blantyre.pdf [accessed 26 January 2016].

Water Research Commission (2007) *Design and Operation Requirement to Optimize the Life Span of VIP Toilets: Outcome of WRC Project 1630*, WRC, South Africa, http://www.susana.org/_resources/documents/default/2-253-wrc-2007-optimize-life-span-vip-en.pdf [accessed 26 January 2016].

WHO and UNICEF (2014) *Progress on Drinking Water and Sanitation*, 2014 Update, WHO/UNICEF, Geneva, http://www.unicef.org/gambia/Progress_on_drinking_water_and_sanitation_2014_update.pdf [accessed 26 January 2016].

Wood, J. (2011) 'The quest for sustainable sanitation in Cambodia', in *What Happens When the Pit is Full?* Report of FSM Seminar, Durban, 14–15 March 2011, Water Information Network, South Africa/Water Research Council, http://www.ecosanres.org/pdf_files/WhatHappensWhenThePitIsFullFSMSeminarReportSouthAfricaNodeMarch2011.pdf [accessed 26 January 2016].