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**ENSURING AVAILABILITY AND SUSTAINABLE MANAGEMENT
OF WATER AND SANITATION FOR ALL**

**Overcoming capacity gaps in fecal sludge management
through education and training**

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2.7 billion people around the world are in need of Fecal Sludge Management (FSM) services, and this number is expected to rise to 4.9 billion by 2030. Key FSM challenges include the gap in knowledge related to the science behind FSM, the lack of skills and experience in viable implementation models, and the absence of policy to ensure an enabling environment. The Centre for Affordable Water and Sanitation Technologies (CAWST) is working toward filling the capacity gaps in FSM through developing and delivering education and training activities to sanitation implementers. This paper describes the systematic program development process that CAWST undertook to plan and develop the education materials, pilot the FSM workshop to sanitation implementers in Nepal, and use the feedback to improve and finalize the education materials. Results and feedback from the pilot workshop are discussed, and next steps are explained.

Introduction and background

Significant efforts are being made to reduce open defecation and build latrines around the world. Yet the next steps – emptying full latrines and safely managing the fecal sludge – are essential services that are often neglected. 2.7 billion people around the world are in need of Fecal Sludge Management (FSM) services (Cairns-Smith, Hill, & Nazarenko, 2014). By far the greatest number are in Eastern Asia with 1.1 billion people, Southern Asia with 593 million people, and Sub-Saharan Africa with 439 million. These populations consist of households and communities that use latrines but are without access to or unable to afford FSM services. If present sanitation trends continue, the number of people needing fecal sludge management services will rise to 4.9 billion people by 2030 (Cairns-Smith et al., 2014). This number could increase even faster as water scarcity becomes more severe and there is a move away from water-intensive off-site sanitation systems.

One of the key challenges associated with FSM is a gap in knowledge and skills. In terms of experience and research, FSM is at least a hundred years behind wastewater management (Strande, Mariska, & Brdjanovic, 2014). The gap includes:

- Knowledge and skills of stakeholders: Many stakeholders, including civil society, government, and private sector, are not conversant in FSM and do not have the knowledge and skills to implement strong FSM systems.
- The science behind FSM: There are still many unknowns such as what fecal sludge is made up of and the variability of fecal sludge. There is still no standardized methodology, for example, to characterize and quantify fecal sludge. This limits knowledge particularly on treatment and use of fecal sludge. This lack of understanding has led many engineers to manage fecal sludge like wastewater, leading to major technical failures.
- Viable implementation models: There are very few examples of successful implementation of FSM across the sanitation sector. The debate continues on how to properly manage the whole sanitation system and which stakeholders are best suited for the different roles.
- Enforced policy and legal framework: Many countries are lacking a policy and legal framework on FSM. Policy and laws are often based on developed countries and hence focus on sewerage systems. As a

result, FSM is often unplanned, unreliable, and informally operated. This leads to illegal dumping of untreated faecal sludge into the environment, which increases health risk. Even in places where there is a legal framework, enforcement is weak.

CAWST is a non-profit organization based in Canada that provides education, technical training, and consulting services in developing countries for organizations and agencies who implement water, sanitation, and hygiene (WASH) projects. CAWST clients include governments, small and large nongovernmental organizations (NGOs), and entrepreneurs. Since 2001, CAWST has developed and made available online over 800 WASH focused education materials, conducted over 900 workshops, and completed over 400 consulting visits in 51 countries.

In 2007, CAWST initiated the development of a workshop called “Introduction to Low Cost Sanitation,” which was focused on the implementation of latrines and provided an overview of environmental sanitation. In 2012, CAWST recognized a need to develop a more comprehensive suite of sanitation education materials that addressed all components of the sanitation system, including user interface, excreta storage, emptying and transportation, treatment, use, and disposal (Tilley, Ulrich, Luthi, Reymond, & Christian Zurbrugg, 2014). Realizing the global need for FSM and the gap in knowledge and skills of sanitation stakeholders, CAWST developed and piloted a set of education materials focused on FSM as part of its suite of sanitation education materials. The suite currently includes workshops called Introduction to Environmental Sanitation, Latrine Design and Construction, and Introduction to Fecal Sludge Management. A fourth workshop called Sanitation Implementation will be initiated in 2016.

This paper describes the general process CAWST undertakes to plan and develop a workshop, using the FSM workshop as a case study. The process includes the development of the FSM education materials, the piloting of the FSM workshop to sanitation implementers in Nepal, and the use of feedback from the pilot to improve the education materials. Results and feedback from the pilot workshop are discussed, and next steps are explained.

Objectives

The objective of this project was to develop and pilot a FSM workshop that supports key stakeholders working in sanitation to better understand and implement appropriate FSM. The purpose of a pilot workshop is to improve the workshop by garnering and incorporating feedback into the flow of the workshop and effectiveness of lesson plans, as well as identify content gaps or points of confusion for participants. In fulfilling these objectives, CAWST aims to make progress toward closing the gap in FSM knowledge and skills of key stakeholders, leading to better management of fecal sludge and, in turn, improved health and social outcomes in developing communities. CAWST also supports the dissemination of viable implementation models by sharing lessons learned and challenges of FSM implementation in different parts of the world.

Methodology

The following methodology was followed to develop and pilot the FSM workshop:

1. Identify the need: CAWST staff observed that their clients were facing challenges in implementing sustainable sanitation services in developing communities due to lack of experience with and knowledge on FSM. Many of CAWST’s clients are focused on building latrines and reducing open defecation; however, these latrines eventually fill up and require FSM services. To provide appropriate FSM services, implementers need to design appropriate sanitation systems that consider FSM at the outset. Concurrently, CAWST’s education program development team identified a lack of existing resources focused on filling the knowledge and skills gap in FSM for sanitation implementers. For these reasons, CAWST prioritized the development of a FSM workshop focused on addressing this gap.
2. Determine the workshop goal, outcomes, and target audience: CAWST’s education program development team conducted a literature review and consulted with CAWST staff and clients to determine the goal of the workshop, outcomes, and target audience.

The target audience was determined to be individuals or groups who are:

- Working in sanitation, community development, or health projects seeking solutions for sustainable sanitation systems, including NGOs, governmental organizations, and private sector service providers
- Program organizers or project managers responsible for organizing projects and making decisions
- Engineers or technicians responsible for designing and constructing latrines and FSM systems
- Motivated to start or strengthen projects for improving sanitation, particularly in FSM

The specific objectives for the workshop are to:

- Describe the importance of fecal sludge management in relation to the sanitation system
 - Describe risk management to reduce health issues and environmental contamination
 - Define different emptying and transportation technologies as well as their benefits and challenges
 - Describe different innovative, transferred, and established treatment technologies
 - Explain fecal sludge use options – including agricultural use and energy use – and disposal options
 - Establish a network of contacts with other project implementers
3. Identify key topics, workshop structure and specific learning outcomes: A team of CAWST staff with different knowledge and skills in sanitation, education program development, and training identified the key topics to be included in the workshop. Key challenges were determining the right level of detail within specific lessons and creating a logical flow of the content. Certain topics, such as treatment objectives, will confuse participants if they are not provided with enough information or, conversely, if the information is too detailed. A key challenge, for example, was how to explain stabilization without discussing molecular structures.
- In terms of flow, it was important to discuss fecal sludge use before treatment. This emphasizes the importance and good practice of selecting a use for fecal sludge, in order to choose an appropriate treatment technology. For example, if you are using the fecal sludge for agriculture, then the product of the treatment technology needs to be dewatered or dry fecal sludge with a low concentration of pathogens. Co-composting would be a technology that could be used to produce this product. This is very different than if the fecal sludge is being treated in an anaerobic digester (biogas reactor) and being used for energy. Beginning with the end in mind, it's also advantageous, to evaluate the market for the product, prior to designing a treatment facility to create the product.
4. Develop participant materials: A detailed literature review was completed to gather the technical content for the participant materials. Ten technical briefs and 15 fact sheets were developed, based on the literature review, and comprised the participant materials. During the literature review, some challenges that were encountered included:
- FSM as a relatively new field of study: There were many unknowns in the literature due to the limited examples of and studies relating to FSM. For a workshop aimed at sanitation implementers, it was challenging to acknowledge the many unknowns without making FSM seem impossible and demotivating participants. There is no standardized method to characterize fecal sludge, for example, which can demotivate participants. Showing examples of different techniques that have been implemented and sharing current research, however, can encourage participants.
 - Conflicting information and opinions: CAWST aims to present technical information in a clear and objective way; however, there were many different views presented on the validity of different FSM approaches and technologies. For example, there is a lot of debate on the safeness of fecal sludge for agricultural use and the recommendations for operating different treatment technologies.
 - Inconsistent use of terminology throughout the literature: It was challenging to understand the variety of different terms and then to ensure their consistent use throughout the materials. The term “disposal”, for example, is sometimes used for the collection of fecal sludge into an on-site sanitation system but most times is used as the last component of the sanitation system.
5. Develop trainer materials: The trainer materials were based on the technical content from the participant materials. A trainer manual was developed, including the agenda and participatory lesson plans. CAWST's education program development team used a range of participatory learning techniques to develop lesson plans designed to engage and motivate participants and promote effective adult learning. The result was a 3-day workshop, to be delivered by a trainer to a group of approximately 20 participants. Table 1 shows an overview of the lesson topics and agenda for the 3-day pilot workshop:

Table 1. Overview of the lesson topics and agenda for the 3-day pilot workshop		
Day 1	Day 2	Day 3
<ul style="list-style-type: none"> • Introduction to FSM • Global FSM issues • FSM in Nepal • What is fecal sludge? • Risk management • Emptying and transportation 	<ul style="list-style-type: none"> • Fecal sludge use • Disposal options • What is treatment? • What kills pathogens? • Treatment technologies • Effluent management • Project implementation framework 	<ul style="list-style-type: none"> • FSM scenarios • Field trip • Action planning • Workshop review

There were certain topics that were determined to be out of scope of this workshop and better suited for other workshops within CAWST’s sanitation suite. For example, this workshop focused on technical knowledge of FSM, including basic information about treatment technologies and risk management. CAWST’s workshop on Sanitation Implementation will cover specifics of implementation such as creating demand, supplying products and services, monitoring for improvement, building human capacity, and program financing.

6. Pilot the workshop: The workshop was piloted in November 2015 by two trainers from CAWST, with 18 workshop participants. This pilot consisted of 2.5 days of theory and a 1/2 day field trip. The workshop was conducted at the offices of the Environment and Public Health Organization (ENPHO). After some logistical discussions, ENPHO agreed to host the pilot workshop, as they have been partners with CAWST for more than 10 years and FSM is particularly relevant to them and their partners in Nepal. The participants all had experience in sanitation and came from ENPHO, Oxfam, Lumanti, and the Nepal Engineering College, Centre for Postgraduate Studies. Ideally, the participants in the pilot would have represented all target audiences including government and private sector service providers.

Local adaptation of the workshop was achieved in a variety of ways. First, a local expert provided a lesson on “FSM in Nepal.” This lesson provided a basis for the discussions throughout the workshop. Second, participants working on existing FSM projects used their projects as case study exercises throughout the workshop. Finally, trainers drew out experiences of the participants in all lessons to encourage participant engagement and connect the workshop material with their own local experience. Such local adaptation is key to ensuring effective training, and CAWST actively works with and supports partners and clients to adapt existing training materials to the local context for this purpose.

Each participant provided feedback to the CAWST trainers following the workshop through a workshop evaluation questionnaire and throughout the workshop within the lessons and activities. CAWST also had a meeting with ENPHO trainers for an in-depth debrief of the workshop and documented lessons learned.

7. Use feedback from the pilot to improve the education materials: The workshop materials were updated following the pilot in Nepal to incorporate feedback from the participants and trainers. This feedback is discussed in the results section below.

Results

Following the pilot workshop, all participants filled out a detailed workshop evaluation questionnaire, in order to provide formal feedback. The trainers also took detailed notes of informal feedback during the workshop to evaluate the effectiveness of the lessons, flow of the workshop, and content. The feedback will be used to improve and finalize the workshop materials. This section describes feedback that was provided.

Workshop evaluation questionnaire responses

Of the 18 workshop participants, six reported that the workshop completely met their expectations, and twelve reported that the workshop partially met their expectations. For participants whose expectations were fully met, the main reasons reported were that the workshop covered all information relevant to FSM and included demonstrations. For participants whose expectations were only partially met, the main reasons were that they expected the workshop to include a greater level of technical detail, design of FSM technologies, and implementation processes and solutions. The majority of workshop participants (12 of 18) reported that the workshop was relevant to their work. The main reasons they provided were that FSM is highly relevant to participants’ work in sanitation. Six participants stated that the workshop was only somewhat relevant. They agreed it was important and would help their projects but only to a certain extent.

There were a variety of responses by participants on which parts of the workshop were most useful. The most common responses were the field visit and picture slideshows at the end of many lessons. A lot of the workshop is theoretical, and certain concepts can be difficult to imagine. Pictures and the field visit to a treatment facility improved participants understanding of the content. Other activities that participants mentioned as being useful included the information on treatment technologies, project implementation framework, and risk management as well as discussing local challenges in groups. The participants responded that they would have liked more information on strategic planning, local legislation and more case studies to learn from (particularly developed country case studies) to make the workshop more useful.

With respect to the length and timing of the workshop, 16 of the 18 participants reported that the workshop length was 'just right'. They explained that there was enough time to cover all of the workshop topics and that the field visit was a valuable use of time. The remaining two participants thought that the workshop was too short, stating that more time focusing on project implementation and field visits would be useful. The participants also reported that the balance of time between presentations, large group activities, small group activities, participatory activities and breaks was generally good, although some requested more time for action planning.

Informal feedback

There were several lessons that highlighted the wealth of participant experience and commitment to solving FSM challenges in Nepal. Participants identified challenges that were specific to Nepal as well as challenges similar to those faced by FSM implementers in other areas. For example, the Government of Nepal has set a target that the country will be open defecation free by 2017. This has created demand for FSM because many stakeholders want to know how fecal sludge will be managed as sanitation use increases throughout the country and the target is met. As for challenges shared with FSM implementers outside of Nepal, the participants wanted additional examples (besides biogas) of FSM treatment technologies that have been successful in Nepal. Due to the lack of implementation of FSM in Nepal and elsewhere, there are not other examples to share.

Another particularly rich lesson was on the Implementation Framework, during which participants formed small groups and discussed their strategies for overcoming the challenges in Kathmandu Valley. They developed strategies on how to create demand in both communities and at the government level. An outcome of that discussion was that ENPHO discussed the possibility of developing a FSM workshop focused on government participants. The informal feedback captured during the pilot workshop proved critical to improving the workshop and better adapting it to the local context with respect to participant experience, expectations and needs.

Conclusions

Overall, the pilot workshop was successful and met participants' expectations. However, many participants were interested in learning more about implementation and technical specifications for FSM technologies and wanted more case studies of FSM in both developing and developed countries. CAWST will take this into consideration when revising and finalizing the workshop. One challenge will be meeting participant's expectations for treatment technology design. Any treatment technology needs to be designed based on variables specific to the location and project, making it out of scope for a workshop format. CAWST and its partners can address this by providing ongoing one-on-one consulting support to workshop participants, following the workshop and connecting participants to experts in the design of FSM.

Next steps

The next steps will be to:

- Update and finalize the education materials based on the feedback from the pilot. CAWST will also develop several alternative workshop agendas, which can be varied based on the specific interests of the participants. Using this format, the level of detail and technical depth can be made appropriate for a variety of audiences.
- Co-develop a FSM workshop with EAWAG based on the Nepal pilot and EAWAG's objectives. EAWAG's technical expertise and field experience will improve the workshop content particularly in terms of FSM design and implementation.
- Publish the final FSM education materials on CAWST's online resources website, so that they are freely available for WASH implementers to access and use globally. CAWST encourages and supports

organizations using the materials to adapt them to their context by providing local case studies, challenges and FSM implementation examples within the lessons. Wide distribution of the education materials will enable a range of WASH practitioners to learn from them and contribute to closing the FSM knowledge gap. This also enables CAWST to follow up with FSM implementers to learn from their experience and incorporate that experience into future updates of the materials, and, therefore, provide timely support and experience to implementing organizations.

- Continue delivering in-person FSM training workshops to sanitation stakeholders and supporting partners as they do the same, in order to contribute to closing the FSM knowledge gap.
- Follow up with the pilot workshop participants six months after the training to determine if and how they have used what they learned in the workshop. This can help determine whether the objectives of improving the amount and quality of FSM implementation are being achieved.

Recommendations

Delivery of capacity building activities to bridge the gap in FSM knowledge and skills is essential. However, training workshops alone will not bridge the gap. CAWST's approach is to provide training and ongoing consulting support services for implementers as well as to partner with local organizations, such as ENPHO, that provide similar services in their country or region. These are also important steps to support stakeholders to implement FSM projects. CAWST's approach is one of many activities needed to support an increase in FSM implementation globally.

Capacity building activities also need to take place within an environment that enables FSM implementation. Strong government institutions are required to develop and enforce a policy and legal framework that will support FSM implementation. More research is needed to characterize and quantify fecal sludge as well as develop treatment technologies and uses. Also, strong partnerships between government, civil society, educational institutions and private sector are required to implement viable FSM models and share lessons learned throughout the sector. These steps combined will lead to better management of fecal sludge and, in turn, improved health and social outcomes in developing communities.

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