Monday 19 January 2015 – CONFERENCE DAY 1 – Program

Room 2

17.15 – 18.00 Value of Research & Development to support FSM sector development

Moderator Jay Bhagwan, Water Research commission, South-Africa

*The DST-BMGF Sanitation Demonstration Programme: Lessons learnt from phase I of the Technology Demonstration Programme in South Africa* - Stuart Woolley, Water Research Commission (WRC), Pretoria, South Africa

*Status of FSM in Southern and Eastern Africa: A snapshot from the Sanitation Research Fund for Africa Project* - Sudhir Pillay, WRC (South Africa Water Research Commission), SFRA project, Pretoria, South Africa

*Facilities offered by the Pollution Research Group to support FS research* - Chris Buckley, Pollution Research Group, University of KwaZulu-Natal, Howard College Campus, Durban, South Africa - Panel discussion, including Stefan Reuter, BORDA, Germany and Roshan Shrestha, BMGF, USA
The DST-BMGF Sanitation Demonstration Programme: Lessons Learnt from Phase I of the Technology Demonstration Programme in South Africa

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Background
A plethora of cutting edge sanitation technologies have been developed through the Bill & Melinda Gates Foundation (BMGF) Water, Sanitation and Health Programme’s “Reinvent the Toilet Challenge” initiative. In March 2014, at the Reinvent the Toilet Challenge Fair in Delhi, a Memorandum of Understanding (MoU) was signed between the South African Department of Science & Technology (DST) and the BMGF to move towards the piloting of demonstration-ready technologies developed through the BMGF’s sanitation portfolio in South Africa. As outlined by this MoU, DST has committed R 30 million (USD 3 million) towards the demonstration programme for new sanitation technologies whilst the BMGF has committed R 10 million (USD 1 million) towards support of the programme. DST has partnered with the WRC to select, evaluate and develop procedures for the new sanitation technologies.

The DST and WRC have identified 28 District Municipalities (DMs) as priority candidates to host the new technology prototypes, due to their critical need of all municipal services, including sanitation intervention. The WRC, as the implementing agent, will supervise the deployment of the new prototype systems to areas agreed upon with the DST. A range of novel technologies will be implemented at demonstration scale in these regions. The technologies use treatment processes that are new to the sanitation field, limit the resources required for operation and maintenance, and focus on beneficiation of waste streams. The purpose of this workshop at the FSM3 conference in Hanoi would be to disseminate the lessons learnt from the implementation of these technologies during Phase I of the demonstration programme. Engagement with broader sanitation community of practice will enable designers, practitioners and researchers to identify bottlenecks in the implementation of novel sanitation technologies and will allow input from various stakeholders and interested parties.

Scope of Work
During demonstration trials, the new technology prototypes of BMGF grantees will be evaluated according to:

- Unit performance
- User preferences
- Social acceptance
- Maintenance requirements
- Operational requirements
- Real world costing analyses
- Business opportunities for local entrepreneurs and community uptake of entrepreneurship opportunities through implementation of the technologies.
The project is planned to run over two phases, where prototypes of each selected technology are implemented in select locations and scrutinised in Phase I. After evaluation of Phase I and providing feedback to all stakeholders, the technologies will then be scaled up and deployed more broadly in Phase II. The evaluation period of Phase I, is scheduled for October 2014 to January 2015, with constant monitoring and capturing of evaluation results throughout the four month evaluation period.

**Results**

Results will include all evaluated factors and lessons that have been learned from the demonstration programme. The results of the evaluation period will be presented with the lessons learned to be disseminated to attendees, essentially a study of real-world performance of new sanitation solutions and lessons that will be taken forward to Phase II.

**Status of Faecal Sludge Management in Southern and Eastern Africa: A Snapshot from the Sanitation Research Fund for Africa Project**

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Key words: faecal sludge management; sanitation.

**Introduction**

The SRFA - Sanitation Research Fund for Africa – Project is joint initiative between the South African Water Research Commission (WRC) and the Bill and Melinda Gates Foundation to stimulate local capacity and solutions for faecal sludge management in Southern and Eastern Africa. The project is being executed using the WRC’s 40 year old water research and innovation model which includes peer review of project teams’ progress. Twelve research teams have been selected for the project from 8 different countries (Table 1) and focus on either the characterisation of pit latrine contents or developing innovative pit emptying tools and / or disposal routes for faecal sludge. One of the first tasks of the research teams was to provide a situational analysis of faecal sludge management in their respective study area with emphasis on dry pit latrine technologies.

**Table 1. Research Teams involved in the SRFA Project.**

<table>
<thead>
<tr>
<th>Institution / Organisation</th>
<th>Country</th>
<th>Study</th>
</tr>
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<tbody>
<tr>
<td>University of Botswana</td>
<td>Botswana</td>
<td>Pit characterisation</td>
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<tr>
<td>Jimma University</td>
<td>Ethiopia</td>
<td>Pit characterisation</td>
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<tr>
<td>Egerton University</td>
<td>Kenya</td>
<td>Pit characterisation</td>
</tr>
<tr>
<td>Mzuzu University</td>
<td>Malawi</td>
<td>Develop pit emptying tools</td>
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<tr>
<td>University of Malawi</td>
<td>Malawi</td>
<td>Pit Characterisation</td>
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<tr>
<td>ATL-Hydro</td>
<td>South Africa</td>
<td>Mobile solar pyrolysis</td>
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<td>Rhodes University</td>
<td>South Africa</td>
<td>Anaerobic digestion + pasteurisation</td>
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<tr>
<td>University of the North-West</td>
<td>South Africa</td>
<td>Co-digestion</td>
</tr>
<tr>
<td>Makerere University</td>
<td>Uganda</td>
<td>Pit characterisation</td>
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<tr>
<td>Water for People</td>
<td>Uganda</td>
<td>Decentralised sludge plant</td>
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<tr>
<td>University of Zambia</td>
<td>Zambia</td>
<td>Pit characterisation</td>
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<tr>
<td>Chinhoyi University of Technology</td>
<td>Zimbabwe</td>
<td>Decentralised anaerobic plant</td>
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</tbody>
</table>

**Method**
Data was made available from literature (policy documents, reports, etc.) or from the SRFA project teams themselves where no readily accessible data was available. In the latter, interviews and surveys were conducted in accordance to their local ethical committee guidelines.

Results

Access to Sanitation and Faecal Sludge Management Practices

This section provides an overview of access to sanitation provided by all research teams in their respective countries. A clear difference was observed among countries with respect to what to access to sanitation meant, specifically in reference to the technology used. In South Africa and Botswana, the basic minimum standard was a ventilated improved pit latrine toilet whilst in other countries this was not clearly defined or the UNICEF & WHO (2012) term “improved sanitation” (defined as “lined pit latrines to flush toilets with sewerage connection”) was used as the benchmark to indicate minimum acceptable level of access to sanitation.

In Botswana, proliferation of dry sanitation technologies, specifically pit latrines, began through a series of initiatives since the 1980’s. VIP units were introduced through the “Urban Sanitation Research Project” initiated in 1979, and later double vault VIPs, which became the norm in urban areas in Botswana. Several other programmes were initiated thereafter to increase sanitation provision such as the UNICEP assisted “Self-Help Environmental Sanitation Project”, the “National Rural Sanitation Programme” and the “National Development Plan” (Odirile, 2013). These programmes significantly increased access to sanitation provision from 38% in 1990 to around 64% in 2011 with higher levels of service provision in urban areas than rural areas (78% versus 42%, respectively) (WHO & UNICEF, 2012). Faecal sludge is collected from pit latrines by the municipality and is transported to the main wastewater treatment plant to be treated in drying beds. Thereafter it is sold to the public for use in gardens as manure. The sludge is collected by individuals in private pick-up trucks without any protection to contaminants.

In Ethiopia, 403 households were surveyed in Addis Ababa and the results from the survey compared to the WHO & UNICEF (2012) report on access to sanitation and water in that country (Beyene, 2013). The survey revealed that 69.48% of the Addis Ababa population have access to sanitation. The results were in agreement with the WHO & UNICEF (2012) report. However, the survey revealed that only 11.4% of the sanitation facilities are private which is by far less than 27% reported in the WHO & UNICEF (2012) report. From the households surveyed, 63% had pit latrines with a superstructure. Pit latrines without a superstructure and open defecation accounted for 22.33% and 8.19% of facilities in use, respectively. The open defecation percentage was similar (8.9%) to that reported by UN-Habitat (2003). Users of toilets in the area indicated that most of the toilet facilities have odour problems (68.4%) and fly infestations (43.3%). Almost all (97.2%) of the toilets did not have hand washing facilities indicating a lack of hygiene awareness in the area (Beyene, 2013). Around 88% of the households surveyed rely on municipal emptying services with around 8% discharging to nearby rivers. There were no manual pit emptying practices in the study area. Among the households that uses either municipal or private pit emptying services, only 15% were satisfied with the services. The reasons for the dissatisfaction were its availability (waiting period at least 3 months) when needed and the high cost for municipal (US$ 9) and private pit emptying services (US$ 36), respectively, with an average pit emptying frequency of 2 times per year. As results of the severe constraints of pit emptying services, most toilet facilities (about 50%) surveyed were full or nearly full (Beyene, 2013).

In Kenya, access to improved sanitation increased from 25% in 1990 to 29% in 2011 (WHO & UNICEF, 2012). A number of dry on-site sanitation technologies are used in different parts of Kenya. An earlier survey conducted by the research team in Nakuru revealed that simple unimproved latrines were the most common technology used (nearly 50%) with VIPs constituting around 15% (cited in Muchiri, 2014). Emptying is mechanical or
manual in Kenya with the city or local authority responsible for emptying. In Nairobi, sludge is emptied into manholes connected to conventional wastewater treatment plants after issuing of a permit from Nairobi Water and Sewerage Company. The sludge is mixed with municipal sewerage and end up in wastewater stabilisation ponds. A similar situation occurs in Kisumu. Informal emptying practices are common with emptiers wearing no / little protective wear (Muchiri, 2014). A study funded by the BMGF indicated that faecal sludge re-use occurs and sells for US$ 1.25 per tonne and US$ 1.45 per tonne in Kisumu and Nairobi, respectively (Mwangi et al., 2012).

In Malawi, shared pit latrines without a slab or an open pit are the most common sanitation facility with unshared VIPs and pit latrines with a slab constituting less than 2% and 9% of the toilets used, respectively (Malawi Government, National Statistical Office & ICF Macro, 2011). A questionnaire survey carried out by the University of Malawi in Ntopwa, sampling 221 households, revealed that 67% of the households are owned by the inhabitants (Thole, 2013). The same questionnaire revealed that that 93% of the households have built their own latrines albeit at low construction standards (substructure made of unburnt bricks or clay and the pit floor constructed from logs, clay and sand). Such traditional pit latrines constituted 62% of the toilets that existed in the area with only one flush toilet, and 27 improved pit latrines encountered among the 221 households. Open defecation amounted to nearly 26% in the area surveyed, much higher figures than that reported elsewhere (Malawi Government, National Statistical Office & ICF Macro, 2011). Among the few who empty their pit latrines when full, 17% hire mechanized pit-sludge emptying services and 24% employ hired manual labour. Others do the emptying manually on their own (32%). Around 23% of full pits are abandoned in the study area. Most respondents (89%) indicated that the pits require emptying only after 2 years or more of operation. Slightly over half of the population did not consider that there is a problem in pit sludge management in Ntopwa (55%) but the other half thinks otherwise (45%). The result has implications on the management of these systems from an ownership perspective.

In South Africa, the national Census (2011) was used by research teams to indicate sanitation access in their respective study areas. Although the VIP toilet is the minimal acceptable level of sanitation, there were numerous instances in the Eastern Cape and Limpopo provinces where conventional pit latrines outnumber the number of VIP units installed. Generally, in the rural areas, there is space to relocate the pits once full. However, there does not seem to be emptying programme for toilets which cannot be relocated especially in peri-urban areas. In such instances, there is a preference to provide full waterborne sanitation to unserved communities which are in meantime being serviced through different types of toilets (chemical toilets, etc.).

In Uganda, surveys were conducted by Water for People in Kampala. The survey indicated that simple pit and VIP units as the 2 commonly used latrine types. As with Malawi and Ethiopia, land ownership is a challenge for faecal sludge management due to tenant / landlord issues. Three main categories of pit emptying practices occurred in Kampala namely: pure manual; semi-mechanical and fully mechanised (vacuum tankers as the main category). Service providers included vacuum tanker entrepreneurs (owning 54 cesspool trucks), KCCA (owning 5 cesspool trucks), and 10 Gulper (semi-mechanised desludging tool) entrepreneurs. The total available capacity for emptying services is 335 m$^3$/day of which 96% is provided through vacuum tanker operators and 4% by Gulpers. However, the projected faecal sludge demand for Kampala was estimated at 937 m$^3$/day representing a shortfall of about 63% in the demand for pit emptying services (Kenneth and Stephen, 2013). The research is currently evaluating a decentralised faecal sludge treatment plant with the aim of reducing the transportation costs associated with disposal to the wastewater treatment plant.
In Zambia, the WHO & UNICEF (2012) report was used to provide statistics of sanitation provision in that country. Sanitation coverage, in terms of access to improved facilities, did not progress significantly from 1990 to 2010. A range of technological dry sanitation options are used in Zambia with pit latrines the most common technology in peri-urban areas. Two types exist depending on affluence of the owners. Where resources are available, improved single-pit latrine (provided with structurally safe squatting plate and superstructure) is constructed. However, the majority of pit toilets are of a poor construction quality (a hole in the ground and a basic superstructure). In some instances, the superstructure is temporary. Deep latrines are not built around the capital Lusaka due to the rocky geology of the area. Manual emptying is the most common method of desludging with the main disposal route being burial of the contents. For elevated pits, a hole is dug near the latrine and is then punctured to let the contents flow by gravity into the receiving hole. In some cases, it is difficulty to dig the hole to receive the latrine contents as some areas are rocky. In such cases, the latrine contents may be allowed to flow on the streets. For traditional pit latrines (dug hole), emptying is also usually by hand using different types of desludging tools. In cases where the sludge is thick, water or/and chemicals are first added and the contents stirred to form a fluid paste. This slurry is then scooped out of the pit and placed in a nearby hole. One of major desludging challenges observed is the high trash disposal into the pit and the use of the toilet facility for bathing and washing. Recently, formalised pit latrine desludging enterprises have been created through a Water Trust. Faecal sludge is removed using a variety of manually operated tools and is loaded into 60 litre barrels on push-carts. The contents are discharged at a biogas producing facility which is also managed by a Water Trust. This service is offered at a cost of about US$50 up to 12 barrels. For barrels between 13 and 24, the charge is US$65 (Tembo and Nyambe, 2013).

In Zimbabwe, the Blair VIP unit was the technology of choice approved by the Ministry of Health. Half a million units were built serving an estimated 3 million people. However, when donor support faded, the number of units build rapidly declined, the unit considered too expensive for most families to build and full toilets abandoned. Although it is unlawful to build pit latrines in urban areas, pit latrine management practices which have been widely promoted in peri-urban communities by the non-governmental organisations. Common practices include the installation of shallow pit latrines where trees are planted on top after latrine use is discontinued, composting toilets for vegetable tree planting, bags and buckets for storage and humus production, and collection of urine and direct application onto soil. In both urban and peri-urban areas, faecal and / or sewerage commands a value and is often used as a fertiliser in the production of vegetables and field crops (Bangira, 2013).

Key Findings
The reviews and surveys from the different research teams indicated vast differences in what is a pit toilet, type of anal cleansing material, and ownership issues with regards to the toilet facility used. The reviews also indicated a policy vacuum with regards to FSM and lack of tested disposal facilities.

Acknowledgements
The SRFA Project consortium is acknowledged for providing data and reviews.

References


Facilities Offered by the Pollution Research Group to Support Faecal Sludge Research

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Keywords: field trials, laboratory tests, prototype evaluation

The Water and Sanitation unit of the eThekwini Municipality has been a leading innovator in the development and implementation of sanitation services to the unserved. The Pollution Research Group at the University of KwaZulu-Natal has undertaken applied research with the municipality for many years in terms of a Memorandum of Agreement between the two organisations and with additional funding from the South African Water Research Commission and the Bill & Melinda Gates Foundation. Laboratories have been established in which excreta samples can be safely examined and tested. This partnership is able to offer researchers and developers in the field of sanitation services a wide range of assistance in the gathering of data of faecal sludges and for the laboratory or field testing of processes and systems.

Levels of Engagement

The level of services offered range from:-

- a brief exposures to different sanitation systems (unimproved pit latrines, ventilated improved pit latrines, different dry on-site patented systems, urine diversion toilets, on-site dry and wet sanitation systems for school and for community ablution blocks and low flush latrines,
- specific sampling campaigns for different streams (fresh faeces, fresh urine, old excreta etc) and a variety of properties (physical, chemical and biological) from the different systems,
- sharing of Standard Operating Procedures, health and safety approaches and training in different sampling and laboratory techniques,
- use of the laboratory facilities to undertake the primary work-up of excreta samples so that they conform to international safety and transportation regulations prior to sending back to the home laboratory for more advanced analysis,
• bringing specific equipment to Durban or having it made or modified locally in order to undertake specific trials on excreta streams,
• obtaining samples of excreta streams ranging from kilogram to ton quantities and the subsequent safe disposal.

Test Equipment Available
A wide range of test equipment is available (see http://prg.ukzn.ac.za/) for use by in-house technical staff or after training by visiting researchers. The presentation will more fully describe the above information and provide examples of projects that have been undertaken.