

Innovative WASH options in situations of severe overcrowding¹

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Questions

- *What innovative WASH options exist for situations of severe population overcrowding and limited space?*
- *What lessons have been learned from their application?*

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¹ This is Part One of a four part series.

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1. Overview

A rapid review of the literature has found a selection of innovative WASH options available for situations of severe population overcrowding and limited spaces. Case study information was collated from African, Middle Eastern, South Asian and Caribbean countries. As requested, a number of experts were consulted for their opinion where there was a lack of project evaluations or grey literature. Key findings are as follows:

- The *'Innovation in Water, Sanitation and Hygiene'* case study shows that although the general picture is one of incremental change, priorities have shifted between the three subsectors, leading to differences in the pace of innovation in each area (Rush and Marshall, 2015: 1). Early findings show that competitions are leading to a shift in the priorities of the government, making sanitation more visible and important (Ideas to Impact, 2015).
- In some cases, e.g. refugee camps, extending the lifespan of latrines is more important than the technology used (Patinet, 2010; von Münch & Ingle, 2012: 4-1). Innovative urine diversion dehydration (UDD).
- Private sector involvement is essential for improved pit emptying technologies, such as the modified pedal-powered (manual) Gulper technology (Chipeta et al., 2017) and eVac (Greene et al., 2017) have both been used in Malawi and Rwanda, respectively. An automated SMS service from the government has been used to decrease costs of faecal sludge removal in Senegal.
- The delegated management model (DMM) approach to improve water utility services specifically for the urban poor in Kenya is similar to innovative approaches used in Dhaka, Bangladesh and Manila, The Philippines (WSP, 2009: 3)
- Community-led and social innovations, such as DEWATS and CLTS, are popular in South Asian countries. Some cities have piloted city-wide Learning Alliances to trigger cross-learning in communities (Sutherland et al. 2015). Social marketing, as well as business and financing models, are other innovations which can be incorporated in up-scaling WASH projects for the urban poor (UN Habitat, 2014a: 34; Dubois, 2017: 1).
- Approximately 6,000 people have benefitted from SOIL's growing container-based sanitation (CBS) EkoLakay and EcoMobil toilet using their innovative social business plan in Haiti (Tilmans et al., 2015). Latrines based on innovative CBS designs have helped almost eliminate open faecal defaecation (OFD) in Haiti.
- e-vouchers that can be spent on hygiene items are used in Syrian camps (Aggiss, 2016: 5); The Urinal Project by Cewas Middle East provides a safe odourless unisex alternative to using camp toilet blocks. In Lebanon, GPS technology and installation of flow-meters will now be used to improve accountability for household sanitation services (UNHCR, 2016: 41 interviews).

In conclusion, often the term 'innovation' is limited to technological innovation. However, as far as the WASH sector is concerned, much of the technology already exists for use in these situations. Innovative solutions should be found in the areas of service delivery, financing and even data collection. Assistance with use of information and communication technologies has the great potential of increasing data availability, leading to better planning and resource allocation, as well as innovative ecosystems.

2. Innovative options in the WASH sector

Innovative WASH options are available for severe population overcrowding and limited spaces. However, understandings of ‘innovation’ vary. Therefore, for this rapid review, ‘innovative’ and innovations include new methods, inventions and/or modernisations used to improve WASH options.

The ‘*Innovation in Water, Sanitation and Hygiene*’ case study undertaken as part of the **Humanitarian Innovation Ecosystem**² project shows that although the general picture is one of incremental change, priorities have shifted between the three subsectors, leading to differences in the pace of innovation in each area. This has involved a shift from focusing primarily on the *Water* subsector towards encouraging greater innovation in *Sanitation*. *Hygiene* promotion has been, and remains, a relatively small part of the overall WASH innovation effort (Rush and Marshall, 2015: 1).

Sector experts argue that innovation in terms of business and contractual models, as well as financing mechanisms, in the WASH sector is urgently needed:

Innovations in business models

Innovation consultancy firms can help create innovative business models for public and private agencies. Two WASH collaborations are:

- **Innosight**, who claim to help create a “minimum viable innovation system” (MVIS concept) within the first 90 days of a project (Anthony et al., 2014), as was used by Manila Water in the Philippines.
- **Upande Ltd.**, in partnership with Kenyan start-up BRCK and Kericho Water and Sanitation Company (KEWASCO), plan to develop and implement the Water Sanitation Hygiene Management Information System (WaSHMIS) - a remote, cost-effective real-time monitoring system to reduce non-revenue water losses for KEWASCO (GSMA, 2017: 39).

Innovations in financing

According to IMC Worldwide, an innovation prize can be broadly defined as “a financial incentive that induces change through competition” bringing changes at political level, as well as incentivising local authorities to identify new service delivery methods (Ideas to Impact, 2015). These prizes aim to stimulate or induce innovation, rather than reward good performance (Ideas to Impact, 2015: 1). Innovation in this context can be understood in its broadest form – it does not have to be technical but can involve, for example, a change in behaviour or practice or the design of new business models that can successfully scale up technologies (Ideas to Impact, 2015: 1). Innovation in financing, such as prizes or challenges, is also stimulating and incentivising behavioural change in government agencies (Ideas to Impact, 2015).

The design of the prize, where local authorities autonomously decide what they want to achieve for their own community, with no strings attached, is increasing ownership. IMC Worldwide are

² A year-long programme of research led by the Centre of Research in Innovation Management (CENTRIM) at the University of Brighton.

testing the potential of innovation prizes within the **Ideas to Impact** action-research programme to stimulate creative solutions to social issues and help achieve the Sustainable Development Goals (SDGs) in water and sanitation.

Innovations in communication

The World Bank's *Water and Sanitation Programme* (WSP) employs a diverse range of innovative communication tools to share key knowledge and lessons for use by partners and the global public, to build political will on key issues (World Bank, 2016: 52). In 2016, WSP continued to leverage its role within the Water Global Practice (GP) to communicate more strategically and on a much wider scale, engaging key stakeholders at key moments, fostering partnerships, and developing channels to create a deeper impact in WASH (World Bank, 2016: 52).

Mobile communication

With WSP's support, the Water GP is able to offer their technical staff a semi-monthly, mobile-friendly platform, accessible from anywhere in the world, to share new experiences, lessons, and insight. This has helped other GP staff avoid pitfalls and identify new opportunities for innovation, enhancement, and collaboration, strengthening the global expertise available to clients while offering staff recognition for their work, and reinforcing strengthening identity (World Bank, 2016: 52).

GSMA's *Mobile for Development (M4D) Utilities programme* was launched in 2013. It improves access to basic energy, water and sanitation services in underserved communities using mobile technology and infrastructure (GSMA, 2017). The mobile component can be voice, SMS, USSD (unstructured supplementary service data), machine-to-machine, NFC (near-field communication), a mobile operator network, or tower infrastructure.

Learning alliances (LAs)

When WASH system innovations become successful, such as low-cost options tailored to the needs of crowded urban environments, they need to be scaled-up. To help trigger and scale-up innovations, Learning Alliance (LA, or 'learning and action alliance') networks can be set up to trigger cross-learning to make use of existing knowledge across different levels and segments of society. The community level can also play a role and provide insights of needs, preferences and pro-poor business models. Some cities have piloted city-wide LAs (Sutherland et al. 2015) – examples of which are given in Section 3.

Innovations in mentoring and training

On the supply side, the **Toilet Accelerator** programme run by The Toilet Board Coalition is bridging the skills gap by mentoring and training sanitation entrepreneurs, and helping them launch commercially sustainable scaled businesses. Currently there are collaborations with the following social/business enterprises: Biocycle (South Africa), Sanergy and Sanivation (Kenya), Samagra and Svadha (India), Laguna water (the Philippines) and Lixil (globally) (Toilet Board Coalition, 2017).

Innovations in technical support

In light of the World Bank's twin goals³ and the SDGs, Water GP launched the *Water Supply, Sanitation, and Hygiene (WASH) Poverty Diagnostic Initiative* to highlight service delivery to the poor and vulnerable (World Bank Group, 2017: 1). A new model employed by the WASH Poverty Diagnostic Initiative is specifically equipped to support water and sanitation decision making.

3. Use of innovation options: case studies and lessons learned

Numerous innovative sanitation technologies are being researched, developed and tested in the field, some of which are listed in this section. Potential emerging technologies which have moved beyond the laboratory and into small-pilot phase, but are not currently being implemented in relevant contexts (i.e. in a developing country) are also listed here:

Case studies: Africa

Chad

Pit latrines are the main form of sanitation in unplanned areas, such as rapidly developing cities and refugee camps. The Chadian non-governmental organisation (NGO) Secours Catholique Développement (SECADEV), has been providing assistance to Sudanese refugees in camps along the border between Chad and Sudan since 2003. It has been testing its own ecological toilet in the Farchana refugee camp, eastern Chad since 2008. These are known as UDDTs: urine-diverting dry toilets, which can be easily emptied (Patinet, 2010; von Münch & Ingle, 2012: 4-1).

Lessons learned: The primary goal was to find a sustainable solution for sanitation that can be adapted in a protracted crisis context, however, a number of problems have been uncovered. For male users, urinals would have to be installed.⁴ Generally, there is a lack of space in the refugee camp to build new latrines. In addition, several hundred pit latrines have collapsed in the sandy soil of the camp. Therefore, the main reason for implementing the new family latrines with lined walls has been their extended lifespan (Patinet, 2010; von Münch & Ingle, 2012: 4-1).

The most innovative aspect of this latrine project is that it is adopted in a Chadian refugee camp for Sudanese refugees - 310,000 have fled to the area since 2003 according to [UN reports](#), with 111,500⁵ Chadian internally displaced people (IDPs) living in IDP sites according to [IDMC estimates](#) for 2015.

³ (i) Ending extreme poverty, and (ii) Boosting shared prosperity.

⁴ Male users standing over the UDDT for urination (rather than sitting or squatting) inadvertently urinate into the faeces vault/container. It is generally advisable that all UDDT users sit or squat to urinate.

⁵ This estimate does not include people displaced by slow-onset and sudden-onset natural hazards.

Ethiopia

Technical assistance from the World Sanitation Programme (WSP) has supported the implementation of the *One WASH National Programme (OWNP)*, of which the World Bank is the largest donor. The OWP was formed in 2013 and brings together four ministries⁶ to improve the effectiveness of financing in the WASH Sector, to modernise the way water and sanitation services are delivered to the public, increase access to water and sanitation services, and ultimately improve health.

Lessons learned: Significant support from WSP helped establish a formal government mechanism for the development of sanitation markets. The mechanism has been established through the creation of new partnerships at the national and subnational levels between government health institutions and agencies new to the sector, such as the business development agency and the vocational training agency. The initiative includes capacity building for sanitation entrepreneurs on technology development and business skills, as well as support for them to access financing and connect to market opportunities. WSP's technical support has also resulted in the Ministry of Health developing innovative behaviour-change communication (BCC) guidelines for implementation of the OWP and beyond (World Bank, 2016: 14).

Ghana

Case study 1

MDF Training & Consultancy, in collaboration with the Ghanaian NGO Fair River International Association for Development, has developed and piloted a hands-on programme on WASH entrepreneurship and innovation called **EnterWash**. Custom designed training and a practical training programme are delivered to equip participants from various backgrounds with the knowledge, skills and attitudes necessary to create and sustain innovative WASH business ventures.

Lessons learned: A pilot programme was completed by November 2016, however, no evaluation is available at present. The participants and their businesses will be tracked for at least five years to monitor their progression and determine the extent to which their businesses have improved WASH in their communities.

Case study 2

On a wider scale, **The Sanitation Challenge for Ghana** is a competition which aims to solve the issue of liquid waste sanitation by encouraging local government assemblies to team up with their citizens and innovators to rapidly improve and deliver urban sanitation in the whole country (Di Bella & Mincey, 2017).

Lessons learned: The target group of participants⁷, albeit small, was well defined and easy to reach. So far 17 MMDAs have completed Stage 1 of the competition, although it is too early to

⁶ Water Resources, Health, Education, and Finance & Economic Development.

⁷ The local and district government staff from the Metropolitan, Municipal and District Assemblies (MMDAs) of Ghana.

proceed to Stage 2 (implementing the liquid waste management strategies that they have developed in their local communities).

It is also too early to state conclusively that innovation prizes such as this one are an effective tool to solve development challenges. However, early findings show that the competition is leading to a shift in the priorities of the government, making sanitation more visible and important. As sanitation is now higher on the government's agenda, local authorities are incentivised to identify new service delivery methods. Local authorities are excited about having the opportunity to decide what they think is needed in their area [Veronica Di Bella, former principle consultant, IMC Worldwide].

Case Study 3

Clean Team, a social enterprise set-up by WSUP, won a Digital Development Award from USAID for its innovative approach to mobile money in October 2017. It is an innovative CBS service piloted in 2012 in the densely populated low-income areas of Kumasi (WSUP, 2011). It draws on market principles: creating demand for a product or service in a poor community by serving the *least* poor members of that community first, thus creating an aspirational model that other members of the community will want to emulate.

Results: A cross-sectional survey showed that use of Clean Team UDDTs is likely to reduce faecal contamination of the environment through safer child defecation and stool disposal practices, and may increase the opportunity for post-defecation handwashing with soap (Greenland et al., 2016).

Lessons learned: Some Clean Team users commented that the current toilet design is not suitable for small children. Modification of the design to facilitate use by younger children and/or disposal of waste from potties or chamber pots could further increase their contribution to safer disposal of children's faeces (Greenland et al., 2016: 596).

Kenya

Case study 1

The *Kenya Slum Upgrading Programme* (KENSUP), a collaboration between the Government of Kenya and UN Habitat, used innovative social approaches to reduce crises associated with slums. Kibera, being one of the largest slum areas in Kenya, was chosen as the pilot intervention site. K-WATSAN⁸, the flagship project in the village of Soweto East, Kibera, Nairobi, was completed in 2008.

Lessons learned: Verifiable successes were achieved through K-WATSAN, however, achieving those successes relied heavily on cleaving to the best practices outlined in project planning documents - most notably engaging the community and ensuring that plans and practices reflect community input (UN Habitat, 2014a: 34). It is evident that good project management, for these circumstances, was a willingness to commit to objectives, to monitor progress, to adapt as needed, and to maintain commitment even in the face of adversity.

⁸ The Kibera Water and Sanitation Project.

In Kibera, benefits are that the water mafia ring has been broken, and dry kiosks have reopened. However, constraints include the temptation to create a new water mafia (Morel, 2006: 21-22). The intervention in Kibera demonstrated a combination of new and innovative concepts and strategies in social innovation (i.e. active community engagement as an alternative framework to allow empowerment). Key aspects critical for the success of any slum upgrading programme include: national government's commitment; partnerships; inclusive participation; delegated decision-making; sustainability; communication; good governance; gender awareness, and Public Private Partnerships (UN Habitat, 2014b: 63). Active adaptation to evolving circumstances is essential when innovation is required (UN Habitat, 2014b: 141). Therefore, coordination amongst agencies is crucial, although the lack of a consensus on an action plan should not be used to delay or stop innovative action (UN Habitat, 2014b: 139).

Case study 2

A 2008-2013 case study from Nyalenda, one of the largest informal settlements (slums) in Kisumu, reveals a successfully delegated management model (DMM) to improve water utility services for the urban poor. The water utility KIWASCO appointed master operators (MOs), to sell bulk water to community contractors, who then sell it to households or kiosk vendors (WSP, 2009: 2). This DMM approach is similar to approaches used in Dhaka, Bangladesh and Manila, The Philippines (WSP, 2009: 3). Although Nyalenda is not an 'illegal' settlement, as landowners have freehold titles, it is grossly underserved in terms of basic services (WSP, 2009: 7).

Results: In 2012, the project was serving an estimated 64,000 people through 366 kiosks (serving about 18,300 households) and 590 individual household connections. Prices for water were lower (20KSh per 20L down to 3KSh, or from USD0.19 to USD 0.03) and more stable (WSP, 2009: 2). Fewer water shortages were experienced. Women and children travelled shorter distances from their homes, and used less time in collecting water. Residents also were empowered to influence decisions at the utility via their MOs.

Lessons learned: The main advantage was an improvement in the technical and financial performance of water utilities, such as outsourcing of distribution and customer care to private operators or community-based organisations; this allowed the utilities to focus on supplying high quality potable water as their core business. Accountability at all steps of the services chain, up to the end consumer, was increased (Morel, 2006: 13). However, constraints included lack of communication between stakeholders, and the community being uninformed and minimally involved (Morel, 2006: 14).

The results have been encouraging, but the full benefits of the DMM in Kisumu will only be seen when all the consumers are served through the MO lines. It is recommended that the DMM should be scaled up in Kisumu; and it could well be replicated in other countries that have a supportive policy framework and adequate supply of water (WSP, 2009: 15). However, a recent field report evaluation by UCL and Practical Action (Frediani & Monson [eds.], 2016) reveals that inequalities remain in terms of risks and benefits.

Case Study 3

Sanergy, a Nairobi-based social enterprise, is tackling the sanitation crisis in urban slums in partnership with the SWIFT Consortium.⁹ It takes an innovative, systems-based approach to address the entire sanitation value chain. Sanergy build high-quality, low-cost CBS units, known as **Fresh Life Toilets**, which they franchise to community members who run them as businesses. The waste is collected on a regular basis, and converted into valuable by-products, including organic fertiliser and insect-based animal feed, which is sold to regional farmers. Through this model, the enterprise is making it profitable – and thus sustainable – to provide hygienic sanitation in urban slums (Auerbach, 2016).

Results: In a comparison with Fresh Life toilets, sewer-connected pour-flush toilets provided by the Ministry of Education experienced challenges with a lack of water and lack of water pressure, which led to blocked and unusable toilets. The toilets were also slower and around five times more expensive to install than Fresh Life Toilets, which benefit from daily waste collection and on-call maintenance services (Bohnert et al., 2016). According to SWIFT, around 60,000 people have benefited from hygiene promotion activities and gained access to hand-washing stations at Fresh Life Toilets and in schools, although the number invoiced through SWIFT's Payment by Results¹⁰ contract was considerably lower. Sanergy has also installed Fresh Life Toilets in schools in the Nairobi slum area of Mukuru, and provided WASH training for teachers and 'edutainment' days for pupils in collaboration with WASH United.

Lessons learned: These results support the provision of a private sector service delivery for school sanitation as an option in slums as a complement to the existing provision options. Public-private service delivery partnerships could allow for the Ministry of Education to outsource sanitation responsibilities to private service providers to meet the demand for safely managed sanitation. A "one-size-fits all" approach to toilet designs is not sustainable in slums. Future research should explore the life cycle costs associated with the ability of schools to continue to pay for private sector services and sustained maintenance. A follow-up study will allow sustainability of the hardware to be assessed, and capture the life cycle costs of these two approaches.

Case study 4

On a wider scale, the country-wide *Up-scaling Basic Sanitation for the Urban Poor* (UBSUP) programme is aimed at providing access to basic household sanitation across all Kenyan urban low-income areas. The programme is implemented through licensed water utilities. The USUP concept covers the entire sanitation service chain: it incorporates an innovative social marketing concept¹¹ (aimed at increasing demand for improved sanitation), technical concepts for

⁹ The SWIFT Consortium is led by Oxfam, with Tearfund and ODI as global members, and Water and Sanitation for the Urban Poor (WSUP) as global associate.

¹⁰ Instead of a grant, payment is tied to outputs and outcomes: non-delivery will result in non-payment, and non-sustainability will result in reduced payment.

¹¹ The guiding principle is the 6 P's of sanitation marketing i.e. Promotion, Partnership, Policy, Place, Price and Product. In addition, they also have further P's such as Participation and Positioning (using other marketing entities to inform the beneficiaries about the product). These are achieved through focus group discussions, advertisements, social marketing tools e.g. posters, and general information dissemination.

infrastructure, emptying and transportation, as well as business and financing models (Dubois, 2017: 1).

Lessons learned: Several innovative social marketing techniques are currently being tested within the UBSUP programme, as a range of technology options are needed to cater for different socio-cultural and economic contexts in different areas of implementation (Dubois, 2017: 5).

Malawi

Innovation in local pit latrine emptying technologies in unplanned settlement areas within Mzuzu City, northern Malawi has been shown to be possible using modified pedal-powered (manual) Gulper electric pump technology¹² (Chipeta et al., 2017).

Lessons learned: Based on Phase IV research findings, the Gulper modification is promising as a potential emptying technology. However, design criteria should include cost, safety, and effectiveness. Rubbish in pit latrines poses a challenge to emptying, even for vacuum trucks, especially in lined pit latrines commonly found in unplanned settlement areas. The success rate of the technology was approximately 17% (i.e. 5 out of 30 sampled lined pit latrines were successful); this reflects the difficulty in finding a single technology that can work well in all types of pit latrines with varying contents (Chipeta et al., 2017).

Rwanda

The overcrowded capital of Rwanda has also benefitted from practical advances in pit emptying technology. The eVac is a portable vacuum pump developed in South Africa by Partners in Development (PID), with the initial research and development work done as part of a larger Water Research Commission (WRC) study.

Results: The Pit Vidura Company has had an eVac in service since May 2016, and in October 2016 this was supplemented by two more eVacs in response to the growing demand for the service. As with the Gulper, gradual modifications were made to enhance the suitability of the eVac for use.

Lessons learned: It is difficult to envisage the “perfect pit emptying machine” given the vast range of conditions and contents encountered in the pit latrines of Kigali (Greene et al., 2017). The eVac has proven a good starting point, and adaptations continue to be made week to week to refine it for the local context. This local and incremental means of technology development is critical to development of practical pit emptying technologies, as it is infeasible to replicate such wide pit variations in a laboratory. Therefore, the private sector should be actively engaged in the continuing improvement of latrine emptying technologies with field testing included as a continuous part of development.

Senegal

Dakar is the seventh fastest growing city in Africa – with its population of two million estimated to double over the next 15 years, according to [research](#) by the African Development Bank. The Bill

¹² It is capable of lifting faecal sludge from a depth of 1.5m with a mean flow rate of 0.00058 m³/s. If the rubbish content is low, a typical pit latrine with a volume of 1-4 m³ can be emptied within 1-2 hours.

and Melinda Gates Foundation has developed an automated **SMS service**, comparable to the Uber taxi app, for latrine pit emptying. Customers in Dakar send an SMS whenever they need their pits emptied.¹³ A computer then sends out a tender to all the pit emptiers in the vicinity, triggering a bidding war. The initial goal is to demonstrate that it is possible to structure pit-emptying services for poor communities with market and business innovation.

Results: The (as yet un-named) app has a database of 65,000 customers. In the first year of the service, the average cost of emptying pit latrines decreased from USD150 to USD90 a year because of this app. Lack of access to sanitation means private companies can step in, but costs are inflated because the emptiers typically lose 8% of their income to police harassment, and spend 30% on fuel and 12% on repairs, according to the Senegal National Sanitation Utility (ONAS). ONAS have stated that the target cost for the emptying service will be USD60 per year.

Lessons learned: The new service faces many challenges, most of which revolve around the complexity of safely collecting and transporting the waste from pit latrines to the treatment plant. One of the major issues is that many of the pits are down extremely narrow alleys, which are almost entirely inaccessible for the large emptying trucks. Furthermore the waste processing plants themselves are very far away from people's homes, as understandably no one wants to live near them, meaning a solid business model for waste collection is necessary. Some of these challenges are being met with the SMS service and financial aid being provided to the emptiers, however close observation of the system will be required for success across the entire city (NexSMS, 2015).

South Africa

Case study 1

Many households in congested villages do not have the space to build toilets and tube wells far apart. Toilet technologies piloted in South Africa had limited use of water and did not require reticulated sewers (Bhagwan, 2008). Innovative technologies are also currently being developed through the Bill & Melinda Gates Foundation 'Re-Invent the Toilet Challenge'. The ultra-compact **Blue Diversion Toilet and wash station**¹⁴ by Eawag Aquatic Research is one of the off-the-grid solutions being proposed for informal urban areas. Field tests occurred in Kampala, Uganda and Nairobi, Kenya in 2013 and 2014, respectively.

Lessons learned: Communal ablution blocks (CABs) in informal urban areas such as eThekkiwi have proved successful as they have a paid cleaner and provide toilet paper. According to experts consulted for this review, there are also facilities for washing laundry available.

The Blue Diversion toilet is currently a prototype; Eawag are currently seeking industrial partners for manufacturing. According to anecdotal evidence they are also working on another version where faeces and urine are treated in the toilet.

¹³ A single shallow pit will need emptying more frequently than a more expensive deep pit, but this may suit the finances of the household.

¹⁴ The Diversion toilet won the USD 40,000 award for outstanding design of a toilet user interface at the Bill and Melinda Gates Foundation Reinvent the Toilet Challenge in 2011.

Case study 2

Eco-San toilets¹⁵, which are commercially produced using technology developed by the California Institute of Technology (Caltech), have been shipped to South Africa and are in the process of being installed in peri-urban, informal areas and under supervision of the WRC in Durban, according to experts consulted for this review.

Lessons learned: Because construction and use of EcoSan toilets are very different from conventional toilets, intensive training must be given to the mason, users and supervisory staff for a successful outcome. Post-construction monitoring is crucial for at least one year so the family can learn processes (such as when to close the first chamber and start using the second one, and when to remove the compost). If there is a mistake in any one of the three steps, the system will not work (Gupta, 2014).

Uganda

SHARE research partner Shack/Slum Dwellers International (SDI) explore ongoing learning processes in developing sustainable solutions to basic sanitation needs in developing countries. SDI particularly focusses on progress relating to the construction and management of two toilet blocks in Rubaga (Lubaga) in Jinja and Kinawataka in Kampala (Bachmayer, & Shermbrucker, 2014: 17). These have flush toilets, showers, clean water access, and sometimes a community hall on the top floor (Bachmayer, & Shermbrucker, 2014: 9).

Results: The facilities built in Rubaga were among the first rolled out by the National Slum Dwellers' Federation of Uganda (NSDFU) and the national support NGO ACTogether in 2012. The broader ambition is to construct similar facilities at scale, to have a meaningful citywide impact. To do this without relying heavily on donations, a robust business model that also identifies alternative finance is needed¹⁶.

Lessons learned: The experiences in Lubaga and Jinja demonstrate the disparity between cost projections and reality. Loan repayments progress was slower than projected, even with a subsidised interest rate. The facilities also remain a relatively costly service, and the Ugandan alliance continues to innovate and decrease the price. Nonetheless, both projects were integral to the Federation being given more land in Jinja and Kampala for sanitation projects, for promoting community contracting, and for increasing the exposure of the federation to other sanitation actors, from which new partnerships have emerged (Bachmayer, & Shermbrucker, 2014: 17).

¹⁵ This innovation won the USD 100,000 first prize at the Bill & Melinda Gates Foundation *Reinvent the Toilet Challenge* in 2012.

¹⁶ For ACTogether, this could mean using commercial finance at a cost of over 24% per annum when capitalising future facilities. Commercial capital is extremely difficult due to high and volatile interest rates. Figures of 18-30% in Uganda make borrowing commercial capital extremely expensive and the fluctuations introduce considerable risks into the scaling-up of sanitation lending. Either the market needs to become more stable or new forms of commercial loans need to be brokered, nationally or internationally, with lower and more predictable interest rates. Without state subsidies options are limited and donor finance becomes an attractive option. If donor finance takes the form of loans, as opposed to one-off grants, it will be more effective to increase the scale of sanitation production in the long term.

Case studies: Middle East

Iraq

The *Sustainable Sanitation for Syrian Refugees* project was created in Kurdistan (KRI); the catalyst to start the project was the Syrian refugee crisis which spread across the Middle East in 2011. It is supported by Cewas¹⁷. The Urinal Project aims to provide safe, cheap, innovative, odourless urinals for female heads of households with young children or elderly persons, who face difficulties walking long distances to the public toilets. These unisex urinals are an alternative, which can be used in the safety and convenience of tents. Once the urine is collected, it is transported, tested and reused, saving water, reducing pollution and creating an organic fertiliser for tree and plant production. The families are also paid a small incentive for their support. The project will work with families located throughout numerous locations, including those living near the Dyana Church, in Soran Erbil, Mar Elias Church in Ainkawa, Erbil, and the Agricultural Camp in Erbil.

Lessons learned: Although a convenient option, there are no published evaluations available at present, according to the experts consulted for this review.

Lebanon

In Lebanon, as part of the Syrian refugee crisis response, Oxfam piloted the use of vouchers for latrine waste collection for families living in informal tented settlements in Bekaa valley¹⁸.

Lessons learned: The pilot encountered some difficulties: each latrine has a pit capacity of only 1m³ – whereas the desludging tank has a capacity of 16m³ (which was the basis for price negotiation with Oxfam). This meant when the programme started the service provider was reluctant to visit a settlement without sufficient demand for the service (i.e. that the truck would be filled). In large settlements beneficiaries could organise this fairly easily, so that the desludging service could be provided to numerous households on a single visit. However, some communities did not have enough beneficiaries to make this possible. The increase in fuel costs for the vendor caused by repeated visits to each settlement increased the vendor's rates. Another difficulty faced by families was being able to check that the service had been completed and that the pit was actually empty. Action Contra la Faim (ACF, or Action Against Hunger) plan to make use of GPS technology and installation of flow-o-meters on the carts to improve accountability (UNHCR, 2016: 41 interviews).

¹⁷ Cewas is the world's first and only dedicated water and sanitation start-up incubator and business innovation training programme. Since its inception, Cewas has created more than 40 international water and sanitation start-ups, and executed over 20 water entrepreneurship training programmes on 4 continents (Blue Peace in the Middle East, 2016).

¹⁸ Oxfam engaged the services of private vendors offering desludging services and agreed upon the price for their services. Oxfam then distributed vouchers to households, which could be redeemed with the service provider in return for the emptying of their household latrine. The service provider would then redeem these vouchers with Oxfam.

Syria

Relief International Turkey set up a pilot, cross-border cash project in Syria to support WASH outcomes between December 2015 and June 2016 (Aggiss, 2016). 2,352 households in Mar'rat An Nu'man, Idlib province in northern Syria, received e-vouchers that they could spend on hygiene items at five pre-selected vendors (Aggiss, 2016: 5).

Lessons learned: Prices were lower than initially planned, beneficiary feedback was positive, and cleanliness levels in houses improved (Aggiss, 2016: 6-7).

Case studies: South Asia

Indonesia

Community-Managed Decentralised Wastewater Treatment Systems (DEWATS) offer the possibility of relatively swift sanitation improvements in high priority neighbourhoods¹⁹ that communities can manage themselves. DEWATS are common in Asia; these sewer systems can serve up to 1,000 households.

Lessons learned: A review of DEWATS in Indonesia found that users and their management committees needed both technical and non-technical support to professionalise community-based organisations. Keeping the infrastructure working is essential, but managing community dynamics, sustaining behaviour change and motivating users to pay, matter even more (Eales et al., 2013: 12). Indonesia's government regards DEWATS as an intermediate technology - as a bridge towards centralised sewerage and wastewater management - probably managed by local utilities or private operators (Eales et al., 2013: 21).

Pakistan

In three provinces, comprising approximately 75% of the country's population, World Bank rural sanitation programmes offered affordable innovative methodology and technology options²⁰ and infrastructure rewards to communities becoming 100% open defaecation (OD) free (World Bank, 2016:13).

Results: In 2016, more than 300 Pakistani officials were trained in Community-Led Total Sanitation (CLTS), totalling more than 1,300 officials at 41 events over the past four years to help them motivate and empower communities into building latrines. WSP played a critical role linking policy work to local level pilots, creating and testing innovative programming, and building partnerships with like-minded organisations such as UNICEF (World Bank, 2016: 13-14).

Lessons learned: CLTS has been morphed and changed, departing from what some might describe as the traditional approach. CLTS is increasingly being combined with other approaches such as Sanitation Marketing (Coombes, 2016). Sanitation CLTS and School-Led Total Sanitation (SLTS) are both included as part of the Pakistan Approach to Total Sanitation

¹⁹ Where local government does not yet provide a full sanitation service.

²⁰ Pioneered in 2000 in Bangladesh by Kamal Kar together with VERC (Village Education Resource Centre), a partner of WaterAid Bangladesh, while evaluating a traditionally subsidised sanitation programme.

(PATS), national guidelines promoting five different total sanitation models. Several organisations (mainly in the Asian context), such as Plan Pakistan, WaterAid and Muslim Aid, have since integrated it as part of their strategy (CLTS, 2017).

Case study: Caribbean

Haiti

Household-level CBS²¹ services were proposed to help address the persistent challenge of providing effective, affordable sanitation services for which low-income urban households are willing to pay (Russel et al., 2015). To test this innovative project, a pilot in the Shada community of central Cap Haitien was conducted in 2013 by SOIL's EkoLakay and EcoMobil social business pilot (Tilmans et al., 2015).

Results: Apart from almost eliminating the reported use of OD and “flying toilets” (plastic bags used for defaecation) among service recipients, nearly 6,000 people accessed Sustainable Organic Integrated Livelihoods (SOIL) EcoSan CBS toilets. Latest reports show that 84 metric tons of Konpòs Lakay compost was sold last year for agricultural and reforestation efforts across Haiti (Roma, 2016).

Lessons learned: The costs of this pilot small-scale service were higher than those of large-scale waterborne sewerage. However, economies of scale have the potential to reduce CBS costs over time (Tilmans et al., 2015: 99). CBS systems may be useful for reaching low-income households residing in dense, un-regularised urban communities. However, much more needs to be learned about the socioeconomic, cultural and geographic contexts in which CBS services are likely to be effective, and thus about the size of the potential market for this approach. Similarly, additional efforts are needed to identify the adaptations needed – both to toilet and waste conveyance technologies, as well as to the CBS service delivery business model – to meet users' needs in different settings. Finally, it is noted that scaling sanitation innovations beyond the pilot phase can be impeded when relevant regulatory frameworks are absent, incomplete or contradictory. Future work that deals explicitly with such institutional considerations of scaling CBS services would thus be a valuable contribution (Russel et al., 2015: 538).

Case studies: Multiple locations

Affiliate exchanges

Organised communities have the potential to develop functional and sustainable systems for the planning, construction and management of communal toilet blocks. The National Slum Dwellers Federation of Uganda (NSDFU) has engaged in many exchanges to support its sanitation

²¹ Over the past several years, a small number of organisations have begun experimenting with CBS systems as an alternative model for excreta management. CBS systems are typically waterless; most rely on urine-diverting toilets that use dry cover material, chemicals, or biodegradable plastic film for odour and pest control (Tilmans, 2015: 90).

agenda. Three innovative exchanges in 2012-13 with India, Tanzania, and Ghana were the biggest impact on the sanitation work in the country.

Results: Shared learning, practical experience and exchanges driven by communities assisted in refining the sanitation systems and technologies piloted. It was found to be valuable, especially in terms of scale and leverage, by including City Authorities in the provision of communal sanitation.

Lessons learned: The Indian exchange showed the NSDFU the value of having community halls on the top of sanitation units, and also how community caretakers can manage the facilities. While Uganda still sees the benefit to building some of the larger units with community halls on top (as these serve as Federation regional offices, and a source of revenue when rented out), to go to scale smaller and more affordable units will be necessary (Bachmayer, & Shermbrucker, 2014: 21). The experts consulted for this review also concur that caretakers/managers for such projects are important.

The Federation is now a destination for many other affiliate exchanges eager to see this innovation in toilet building (Bachmayer, & Shermbrucker, 2014: 21). In Tanzania, the Federation learned to make soil-interlocking bricks, which will support it to reduce the costs of sanitation units in the next phase of construction. The high cost of cement in East Africa led to innovations in this respect. Technology is also providing jobs and skills for the youth in the Federation who are trained to make the bricks themselves. The Ugandan Federation has learned about a septic-alternative technology in Ghana, which is also being tested and has the potential to cut the cost of Uganda's sanitation units by half.

Learning alliances (LAs)

LAs are an innovative researcher-initiated intervention in urban water management. Their design implies that researchers actively engage with urban water management and governance issues. Researchers' views and their role in LAs are considered alongside views from "city stakeholders."

Results: Findings from a series of interviews and observations conducted during the Switch project were analysed using key elements of an effective engagement process derived from literature on cross-sectoral partnerships and strategic alliances. The interviews indicated not only acceptance of the LA concept in the context of the need for technical innovation, but also that many actors see the potential for LA to engage with water governance issues. In most Switch cities, as part of the project design, the LA was involved in research demonstrations (Sutherland et al., 2012: 321). In Accra (Nigeria), Alexandria (Egypt), Tel Aviv (Israel), Beijing and Chongqing (China) the water governance arrangements were more specifically linked to rapid urbanisation creating high levels of demand on water supply and sanitation services, with increasing competition between various uses of water and relatively more opportunities for technical innovation (Sutherland et al., 2012: 322).

Lessons learned: Sometimes there was uneasiness about using the term LA. For example, in Tel Aviv the term 'water club' was chosen instead. In Alexandria, researchers indicated that the term LA did not sound official or serious enough and more official sounding names were suggested. Despite these challenges, LAs were established in most of the cities, and the operational procedures were worked out in practice and in context. National cultures proved

significant in terms of understanding the mechanisms for supporting innovation that might work better than others (Sutherland et al., 2012: 326).

4. Points to consider for best practice and conclusions

Based on interviews with experts²², the following points may be of use when planning use of innovative WASH options in severely overcrowded areas:

Management and coordination

Although there is some level of coordination from key actors, innovation ecosystem are mostly ad hoc and informal (Rush and Marshall, 2015: 54). A DMM approach could be successful (WSP, 2009). The providers of the service must have ultimate responsibility, and make sure that they adhere to policies (e.g. price regulation of services) and take into account public health impact (i.e. at the household and community levels).

Private sector

The private sector can play a pivotal role in bridging water and sanitation service delivery gaps by partnering with the public sector to provide innovative and low-cost water and sanitation solutions to the poor (World Bank, 2016: 2).

Financing: innovation prizes

The Ideas to Impact programme developed a four-stage guide to assessing whether and how prizes will be effective in various contexts. Using this guide as a framework. A broad review of the WASH sector to identify unresolved challenges that could potentially be overcome with the help of innovation prizes was undertaken²³. Many of those consulted agreed that the WASH sector is one in which “shiny new toys” are not what is needed to achieve lasting change at scale, particularly in the developing world. It is essential to weigh up advantages and disadvantages from the point of view of both sponsors and applicants. In many cases, the technical solutions exist; therefore, what is needed is a means of overcoming barriers to the widespread adoption of these solutions, such as affordability constraints or political resistance. Innovation prizes need to be considered and developed in the context of broader support programmes, to act as a catalyst for larger investments (Ideas to impact, 2015: 2).

As a result, sector experts argue that the WASH sector urgently needs innovation in terms of business and contractual models, as well as financing mechanisms (Ideas to Impact, 2015: 2).

²² Further details are listed in the separate Appendix.

²³ Analysis was based on prior knowledge of the water sector; an evaluation of current government and donor priorities; consultation with thought leaders in the sector and targeted literature review.

Issues affecting vulnerable groups

Demographic and economic factors

New urban areas may be very heterogeneous - both ethnically and in terms of wealth distribution. They may also face a constant influx of new migrants. Similar ideals may be needed for refugee camps.

Gender-based violence

Public toilets are sometimes combined with public ablution blocks or even community centres. A major problem with these is the gender violence that they seem to attract. Women in many poor urban communities are harassed, abused, raped and sometimes murdered on the way to or from a communal defaecation site. In the public toilets of Bangalore, usage rate among men was double that among women; female usage rate fell off sharply with distance from the home. On questioning, fear of sexual harassment was the most commonly-voted reason for non-use. Significantly, the same pattern was found, irrespective of the entity which managed the toilets. Although toilets do not cause the violence, the toilet blocks seem to crystallise the gender tension around them (Biran et al, 2011). The experts consulted for this review state that this phenomenon has also been found in other states of India and in East Africa. WaterAid has led the production of a kit to develop preventive measures, supported by DFID through the SHARE Consortium.

Disability

A report by Human Rights Watch (2017: 8) reveals that access to WASH facilities is a major problem for disabled refugees. Documenting the range of WASH challenges faced by disabled people in overcrowded and limited spaces, as well as identifying commonalities within this range, may facilitate the development of innovative hardware and software solutions (White et al., 2016).

Other points to consider

Community/human centred design approach: Innovative social marketing (aimed at increasing demand for improve sanitation) could be successful. The community must also be consulted on design (does it smell? Does it look bad? etc.), and socio-cultural issues (is it socially acceptable for groups to share a water source/toilet? etc.).

Social business approach: Projects should have identified income streams that can become financially self-supporting. This can become “a third way” between unsustainable, foreign-funded humanitarian projects on the one hand, and expensive, exclusive, and environmentally-hazardous businesses on the other (SOIL, 2017).

Appropriate technology: The “one size fits all” does not work in slums, therefore, the solution must be affordable for the poor. High-tech solutions are not necessarily the best: some simple

latrines can be very effective (Prüss-Ustün et al., 2008: 17). With UDDTs, urinals may also need to be installed for male users. Some toilets may not be suitable for small or younger children.

Long term vs short term: According to experts consulted for this review, long-term options, which are a more permanent solution, include simplified sewerage (if water is available for flushing), household toilets with communal septic tank, and CBS (provided that there are services in place to maintain the system).

Short-term options can expand to emergency sanitation options, such as peepoo bags²⁴ or “flying toilets”, bucket latrines, and CBS (provided that there are services for collection), otherwise it has to be shared toilet facilities (these range from mobile toilets to more simplistic trench latrines). These options are not necessarily all “innovative”, however, they can be creative.

Location: The ground may not support the building of heavy structures, or access to the area may be limited.

Shared vs. public toilets: As reliance on shared sanitation²⁵ is increasing, research is necessary to determine the circumstances, if any, under which shared sanitation can offer a safe, appropriate and acceptable alternative to individual household latrines (Heijnen et al., 2014). In practice, shared toilets vary along multiple dimensions including user group size, user group restrictions, distance from dwelling, ownership, payment model (if any), and operation and maintenance arrangements (Evans et al., 2017: 349 and personal communication).

Another common concern is that shared toilets are rarely designed and managed in a way that ensures accessibility, safety and dignity for all users, particularly women and girls. However, not all shared toilets are poorly maintained, unhygienic and unsafe. And for millions of people living in densely populated urban areas, especially slums, shared sanitation is the only alternative to open defaecation, which has much more serious consequences for health, safety and dignity (Evans et al., 2017: 350).

Conclusions

Often the term “innovation” is limited to technological innovation. However, as far as the WASH sector is concerned, much of the technology already exists for use in these situations. Innovative solutions should be found in the areas of service delivery, financing and even data collection. Use of information and communication technologies has the great potential of increasing data availability through greater support, leading to better planning and resource allocation.

²⁴ This innovative biodegradable bag with two layers is designed for excreta collection when a permanent user Interface technology is not available (Tilley et al., 2014:166). It has been extensively used in Kenya, the Philippines, South Africa, and Bangladesh, among other places.

²⁵ Shared sanitation facilities include: (a) *shared household toilets* (toilet in one household also used by other households); (b) *compound toilets* (toilets used only by the people living in a particular compound); (c) *community toilets* (non-household toilets used by a restricted group of households); and (d) *public toilets* (open to anybody).

While conclusive evidence on the value and use of innovation prizes will only emerge at the end of the programme in 2019, IMC Worldwide can already draw three key lessons based on their experience (Ideas to Impact, 2015):

1. Know your local context and stakeholders

These relationships and networks can ensure that the design of the prize is relevant. It also allows creation of strong links to the prize participant community, to identify and understand those who will benefit from the winning solutions in these countries.

2. Cast your net wide and know your pool of participants

A primary benefit of innovation prizes is their ability to reach many potential new participants with innovative ideas. Understanding which type of solvers you should target and how to incentivise them helps to attract the right attention to a prize and results in workable solutions.

3. Support applicants and level the playing field

The winning initiatives that are emerging from Ideas to Impact suggest that innovation prizes can stimulate creative solutions. A clear objective, a moderately large but well-defined pool of potential problem solvers and an enabling environment are essential ingredients is still necessary, as is the willingness of participants to bear some of the costs and risks.

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Key websites

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- World Toilet Day (19 November 2017): <http://www.worldtoiletday.info/>
- Q&A: What is the future of innovation for water and sanitation? (17 November 2016): <https://www.theguardian.com/global-development-professionals-network/2016/nov/10/live-qa-what-is-the-future-of-innovation-for-water-and-sanitation>
- 10-minute video about eThekweni municipality (Durban, South Africa) innovations in supplying water and sanitation to informal settlements (slums) and rural areas: <http://www.youtube.com/watch?v=WZjHnkapRgg>
- Ideas to Impact: www.ideastoimpact.net and follow @IdeastoImpact on Twitter, where more lessons and evidence will be shared over the next two years.

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About this report

This report is based on five days of desk-based research. The K4D research helpdesk provides rapid syntheses of a selection of recent relevant literature and international expert thinking in response to specific questions relating to international development. For any enquiries, contact helpdesk@k4d.info.

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