Addressing Sanitation Services in Dense Urban Slums: A Container Based Model

By moving from built infrastructure to subscription services we can create flexible sanitation models that are more effective at managing waste, enhancing sustainability, and providing services in informal urban settlements.

Background
As of 2010, 2.5 billion people either relied on sanitation facilities that did not meet basic hygienic standards (21% of the world's population), or had no facility at all (15%)\(^1\). This service gap contributes to morbidity and mortality from diarrheal disease, still the second leading cause of death for children under the age of 5\(^2\).

Although the international development community sought to close this critical gap in access through the Millennium Development Goals, which are set to expire at the end of 2015, there is recognition that much work remains to be done. A new set of Sustainable Development Goals (SDGs) have been proposed for the post-2015 period, including a specific goal for water supply and sanitation service provision. SDG Goal 6—“Ensure availability and the sustainable management of water and sanitation for all”—includes targets for ending open defecation and full-supply-chain management of waste. Rapidly growing, dense urban populations present considerable challenges to achieving these targets.


About the Researchers
The research was led by Sebastien Tilmans and Kory Russel, members of the re.source project team associated with Stanford’s program on Water, Health and Development, in collaboration with co-authors Rachel Sklar, Leah Page, Sasha Kramer and Jenna Davis (Associate Professor, Civil & Environmental Engineering).

Simply put, there is a looming sanitation crisis in cities. Slum populations are expected to double from the current 1 billion by 2030, as the world’s population continues to urbanize at a rapid pace\(^3\). Cities are struggling to expand critical infrastructure to accommodate this unprecedented growth.

As a result, the percentage of city households that have a sewer connection in the United Nations’ group of Least Developed Countries (including Haiti) has actually declined since 1990. The challenges to sewerage provision are not just financial and logistical, however. Many urban communities are informal or illegal. Governments are often reluctant to legitimize these settlements by installing piped infrastructure. With sewer systems a remote possibility for the majority of urban residents

---

in the developing world, there is a dire need to develop viable alternatives. The two predominant approaches to sanitation in low-income urban areas today are public toilets, and private “on-site” facilities such as pit latrines and pour-flush toilets with septic tanks. Each approach has critical flaws. Public toilets are often poorly maintained and are usually inaccessible at night. Private on-site facilities require substantial up-front investment from the household, which can be prohibitive for poor families and for those who are renting their homes. Equally important, latrine pits and septic tanks eventually fill with waste. Roads in low-income areas of developing cities are often inaccessible by emptying vehicles. Pits and tanks are thus often emptied manually, exposing community members to human wastes.

A small number of groups around the world are developing a different approach to excreta management, termed container-based sanitation (CBS), that is uniquely suited to the challenges of dense cities. CBS consists of a service that provides waterless toilets built around sealable, removable containers. The sealed containers are removed from the community without exposing residents or workers to the waste, and are brought to treatment or resource recovery centers where the material can be safely managed. The toilets can be compact enough to fit within very small homes. CBS toilets can also be portable, reducing investment risk for households by enabling new subscription-based service models. The portability and modularity of the system also may enable governments to help finance it in informal settlements without the political liabilities of piped infrastructure. Finally, CBS has built-in end-to-end management of the waste, facilitating improved monitoring of service performance throughout its supply chain.

In collaboration with the NGO Sustainable Organic Integrated Livelihoods (SOIL, oursoil.org), a team of researchers at Stanford developed a CBS service in the city of Cap Haïtien, Haiti. A new study from Stanford Civil and Environmental Engineering researchers Sebastien Tilmans, Kory Russel, and Jenna Davis and their collaborators Rachel Sklar, Leah Page, and Sasha Kramer provides initial results from the piloting of this service. The authors found that CBS has the potential to dramatically improve the management of human waste in dense urban communities.

**Key Research Findings — Management of Human Waste**

One of the principal challenges of urban sanitation is to capture, isolate, and convey human waste away from dense areas to a place where it can be properly managed.
Full-Cycle Waste Management

CBS services provide end-to-end management of waste from initial capture in a toilet to final treatment or resource recovery

- Even high-quality public toilets in the study community could not meet this objective. Whereas half of study participants reported using the public toilets for their daytime needs, only a third did so at night. The remainder typically defecated in the open, or used “flying toilets,” plastic bags that are later tossed into alleyways.

- The CBS service reduced reported open defecation and use of flying toilets to less than 1%, and achieved a 3.5-fold reduction in the share of feces that was unmanaged in the study group.

The team found that CBS has tremendous potential to improve management of waste in the areas where previous solutions have been unsuccessful.

Research Findings — System Costs

Whereas CBS is an effective system for managing waste, its implementation costs at pilot scale remain high relative to the costs of full-scale sewer systems. Nevertheless, there is considerable potential to reduce the costs of CBS through service efficiency improvements, new learning, and economies of scale.

Considerations for Policymakers

1. Container-based sanitation is an effective option for sanitation service provision in urban communities with limited alternatives
2. Larger implementations of CBS services are necessary to verify and demonstrate their viability at scale
3. Municipal governments and donor agencies can play a key role in helping fledgling CBS services scale up, by providing an enabling regulatory environment and facilitating financing.

Conclusions

The findings by Tilmans and his colleagues indicate that CBS can dramatically improve management of waste in otherwise hard-to-serve areas of developing countries. The costs must be further optimized, but there is great potential for improvements and cost reductions. To fully characterize the potential of CBS, further evidence of impacts of CBS on user attitudes, perceptions, and demand for sanitation is necessary. A forthcoming paper in Environment & Urbanization led by Russel will present results on these issues in October 2015.

This brief is based on the paper “Container-based sanitation: assessing costs and effectiveness of excreta management in Cap Haitien, Haiti” (Environment and Urbanization, April 2015).

Contact Us

Mail
Stanford Woods Institute for the Environment
Jerry Yang & Akiko Yamazaki Environment & Energy Building
MC 4205 / 473 Via Ortega, Stanford, CA 94305

Phone 650.736.8668
Fax 650.725.3402
Email environment@stanford.edu

Online
woods.stanford.edu