DESIGNING THE NEXT GENERATION OF SANITATION BUSINESSES

A REPORT BY HYSTRA FOR THE TOILET BOARD COALITION - SEPTEMBER 2014

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THE TOILET BOARD COALITION

The Toilet Board Coalition is a global, business-led coalition of leading public and private organizations, sanitation experts and non-profits that aims to end the sanitation crisis through scalable business approaches. It will catalyze market-based solutions through initiatives that will bring together the resources and expertise of corporations, and the innovations and know-how from the civil society and development sectors. The Toilet Board Coalitions' mission is also to advocate and share knowledge about market-based approaches for sanitation. It will continue to support the creation of free-to-use, innovative content, such as this very Report.

This Report was prepared in close collaboration with and in support of the work of the Toilet Board Coalition. We aim to provide strategies and solutions that tie in with those of the Toilet Board Coalition, by providing insights and recommendations about promising initiatives and business models, and how to accelerate and replicate them.

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Two Indian women in a rural village
Credit: Hystra

INTRODUCTION

Dozens of innovative sanitation solutions have gained ground across the world: NGOs are training village-based producers to adopt efficient latrine production techniques and market them in neighboring villages; scientists are developing new processing technologies to capture economic value from human waste; local entrepreneurs are developing waste collection services in slums.

What makes these projects distinctive is that they serve the *Base of the Pyramid*[1] (BoP) in a financially sustainable manner by selling improved sanitation solutions at a price that the poor are willing and able to pay.

This Report is a testimony of the work of these innovators and entrepreneurs – their creativity, vision and energy.

Yet, although these market-based innovations have already provided millions of poor with access to improved sanitation, they struggle to scale-up and reach the estimated two and a half billion people who still do not have access to improved sanitation to this day.

After analyzing the challenges that these innovations face, we found that large corporations can play a crucial role in addressing them. For instance, consumer goods companies could leverage their marketing expertise to develop better sanitation marketing campaigns, construction companies can help manufacturing quality and affordable toilet units and chemical companies can help developing efficient solutions for odorless toilets.

While we acknowledge the role that the public and non-profit sectors need to play and continue to play, this Report is designed to highlight opportunities for business to contribute their distinct capabilities and resources to solving the sanitation crisis.

1 The Base of the Pyramid refers to the 3-4 billion people who live on less than $2.50 per day. This is the largest but poorest socio-economic group.

EXECUTIVE SUMMARY

THE GLOBAL SANITATION CRISIS

Over the past two decades, almost two billion people have gained access to an improved sanitation facility, bringing the sanitation coverage to 64% in 2011.

However, two and a half billion people are still without access to improved sanitation facilities to this day. 71% of them live in rural areas where the penetration of improved solutions has been progressing at a slow pace, as latrines often remain unaffordable or simply unavailable in villages. In urban areas, rapid urbanization challenges the capacity of cities within most developing countries to provide improved sanitation to all urban dwellers.

Lack of access to sanitation has dramatic consequences on health - the WHO estimates that diseases related to unsafe sanitation were responsible for 6% of global deaths[2]. But it also impacts other sectors such as education – girls are withdrawn from schools due to a lack of appropriate facilities – and livelihoods. The development community has been devoting increased attention to this crisis, but the two billion dollars spent yearly on sanitation is still not enough to reach the Millennium Development Goal target of 75% of sanitation coverage by 2015.

ABOUT THIS REPORT

Fortunately, a number of market-based models have emerged in both rural and urban areas to address the sanitation crisis. Although they differ in terms of approach and reach, they all serve the BoP in a financially sustainable manner, by offering improved sanitation solutions at a price that the poor are willing and able to pay.

In this Report we focus on two models that combine an aspirational value proposition for BoP families and a strong potential for financial sustainability. In rural areas, we analyzed projects that activate local rural sanitation markets. In urban areas, we analyzed initiatives servicing home mobile toilets.

Based on an in-depth analysis of both the best practices and greatest challenges from a pool of 12 representative projects, the Report suggests strategies to overcome challenges to sustainability and scale. Finally, we explore how these projects and business models would benefit from corporate and industrial expertise and resources, as well as highlight opportunities for large corporations to contribute to solving the sanitation crisis.

RURAL AREAS: CREATING AND ACTIVATING LOCAL SANITATION VALUE CHAINS AND MARKETS

Many projects globally work at facilitating the creation of local, rural sanitation markets. Mostly run by non-profit organizations, they work on both the demand side by increasing household awareness and motivation to invest in sanitation, and on the supply side by identifying and strengthening local businesses to take over the different stages of the supply chain (manufacturing, delivery and installation). These projects aim at building entire value chains that could be self-sustained after an initial intervention period.

These projects have demonstrated that there is a large untapped solvable demand for improved sanitation in rural areas. Indeed, low-income rural families are ready to pay for comprehensive and aspirational sanitation solutions, in particular when they are offered a financing solution. These projects also manage to enroll and professionalize local hardware stores, so that they can sustainably manufacture and deliver selected latrine components (rings and slabs) to neighboring villages. Consequently, and in part due to marketing approaches leveraging both community dynamics and more aspirational messages, some of these projects have generated considerable sales within just a few years.

However, the organizations that lead such market-activation projects do not manage to capture enough of the value they help create and are therefore mostly dependent on grants. In addition, their intervention is needed for much longer periods of time than initially anticipated. There seems to be no "tipping point" beyond which projects could exit the market without seeing a (sometimes significant) dip in demand for sanitation. To remain high, sales need to be constantly activated by hands-on (and costly) sales and marketing activities. These projects therefore need to find ways to generate revenue themselves, if they want to scale up further without requiring a large, unrealistic amount of grant support.

In addition, market-activation projects face a number of challenges to achieve high penetration. First, they focus more on household needs for hygienic solutions rather than wants for aspirational ones. Indeed, most projects only offer the 'under-the-ground' latrine components (i.e. rings and slabs) but fail to address the desire of families for the 'above-the-ground-structure' (i.e. shelters and sanitary equipment).

2 The global burden of disease: 2004 update, WHO (2008)

Besides, few market-activation projects manage to effectively provide end-consumer financing solutions even though this is a key hurdle to a purchase. End-consumer financing is generally provided by few partner MFIs to a limited number of clients, or through a complex and costly in-house credit scheme. Finally, projects face challenges in developing and maintaining large networks of hardware stores, as proactive and professional suppliers do not exist everywhere, and may prove difficult to retain when sales drop.

To overcome these challenges, we recommend evolving the current projects and models as follows:

- **Switch from a "market-activation" to a "social business" model**, by generating revenue out of the sale of products or services. Market-activation projects must find ways to capture some of the value they help generate, in order to finance their own operations and growth. However, they might struggle to capture any margins made by local latrine businesses on rings and slabs. The best alternative is to sell additional sanitation products, which are not available locally but are in high demand. Of all possible products, attractive shelters and sanitary equipment seem to be the most promising, although existing shelter solutions need significant improvements to be offered on a large scale. Another way to generate revenue is to systematically offer home delivery and installation services, which in addition to enhancing the project's value proposition, would also help develop closer customer relationships.
- **Evolve the relationship with local hardware stores** from that of a 'supported entrepreneur' to that of a 'preferred supplier' by selecting them upon stringent criteria, and proposing them contractual agreements that would encourage them to focus on the production of simple latrine parts.
- **Facilitate household purchases with a savings program** to make sanitation products more accessible and affordable: an alternative to MFIs partnerships or in-house financing is to offer consumers a saving solution through which they can split the purchase of latrines, shelter and sanitary equipment into modules, allowing them to save towards purchasing the full package but at their own pace.
- **Deploy a full-time dedicated sales force** as these are generally more efficient than part-time models (a finding consistent with Hystra's research in other sectors[3]). Sales strategies that would allow accelerating sales include triggering village-based referrals (e.g. community leaders, former clients) to introduce clients in exchange for a small commission as well as village events to reinforce group dynamics and conduct product demonstrations.

Our analysis suggests that such a social business would be financially sustainable at scale, assuming it could capture a high enough margin on the sale of low-cost, easy-to-assemble shelters and sanitary equipment. In that light, expertise and resources from ready-to-assemble, pre-fabricated housing and construction material companies would be extremely valuable, in order to better design and lower the cost of such ready-made products.

URBAN AREAS: SERVICING HOME MOBILE TOILETS

Home mobile toilets are compact, waterless and portable toilet units that can be used in homes. They offer the privacy, convenience and safety (no need to go outside at night) of 'modern toilets', without the investment into fixed infrastructures (i.e. septic tanks or sewers) – which most slum dwellers would be unable and unwilling to do, given that most of them rent their homes. These toilets are 'rented' for a service fee, whereby the toilet provider operates a regular collection service for the waste accumulated and stored under the toilet. This approach brings a constant source of revenue for the mobile toilet operators, as opposed to one-time sales, and ensures that customers do not try to dispose of the waste themselves or call on the services of informal waste collectors that might dump the waste illegally.

Despite their novelty, mobile toilets seem to be well adopted in informal urban settlements. Firstly, households are willing to pay a relatively high service fee when the mobile toilet is modern-looking, odorless, hygienic and comfortable to use. It has been found that families, including children, use them more systematically than public toilets or 'emergency' solutions (such as night pots or bags). Finally, despite demand is picking up faster in neighborhoods where dwellings have a separate space to install the toilet, some projects have managed to gain ground in areas where households live in a 3 by 3 m room.

However, there are a number of operational and financial hurdles to overcome before the provision and servicing of these toilets can be significantly scaled up. First of all, although some innovation has already taken place in terms of the toilet design, more hygienic and odorless solutions need developing to improve customer experience, lower the cost of waste storage (bags or liquid chemical) and allow for

3 See the Marketing Innovative Devices for the BoP report on www.hystra.com

easier handling and cleaning. The toilet servicing operations also present many challenges when scaled up. Waste collection at scale would require deploying very large teams of low-skilled, part-time workers circulating in informal urban settlements. In parallel, transport and logistics are challenging to organize in areas with poor infrastructure, especially under time, storage and accessibility constraints. As a consequence, toilet servicing requires having a certain density of customers in a given area to be profitable. Existing initiatives often fail to achieve this as most rely solely on word-of-mouth to grow their customer base, when more innovative sales and marketing strategies are required to accelerate adoption. Besides, renting home mobile toilets versus selling them implies operating frequent payment collection, which needs to be performed regularly by a dedicated team. Finally, home mobile toilets can only operate in areas where waste treatment facilities are available as the collected waste needs to be brought to a facility where it can be treated and disposed of properly. This is an ultimate challenge to replication as most large developing cities have either no treatment plants or poorly functioning ones.

To overcome those challenges, we recommend evolving the current models as follows:

- **Develop better waste container solutions** to improve the attractiveness of the product and reduce collection frequency and costs. Toilet units also need to be further improved, in terms of consumer experience, production and cost.
- **Deploy innovative sales and marketing approaches to accelerate penetration in target areas**, starting operations only when a certain threshold has been reached. In order to accelerate penetration, we recommend building upon community dynamics, by engaging local officials and community leaders and offering community-level benefits to encourage entire neighborhoods to adopt the service.
- **Develop alternative approaches to lower payment collection costs**. When available, home mobile toilet projects should collect money through mobile payment schemes or piggyback on existing payment platforms and services (e.g. utility bills or financial agents' networks). In the other cases, we recommend building a dedicated team of cash collectors and using their customer visits to generate additional revenue, in particular by selling a range of hygiene products (e.g. soap, detergent, etc.).
- **Use Information and Communication Technologies** (ICT) to optimize and manage sales, payment and waste collection operations at scale.
- **Require an initial down-payment**, paid by new customers upon toilet installation to repay part of the unit cost, therefore alleviating cash flow constraints.

Our analysis suggests that a home mobile toilet social business can be financially sustainable at scale. Key factors of sustainability are the sum of the servicing fee, the frequency of waste collection, and the number of toilets that can be covered by a waste collector in a given area. In that light, such a social business would greatly benefit from chemical and fragrance companies' expertise to design and manufacture better waste containers and toilet units. It would also require the help of Fast-Moving Consumer Goods (FMCG) companies to sell and distribute hygiene-related products, as well as of IT companies to develop automated management tools.

ALTERNATIVE SOLUTIONS FOR WASTE MANAGEMENT

Both models above do not directly deal with the disposal of the waste. In rural areas, where the severity of the waste management problem depends largely on soil conditions, sanitation businesses should tailor their offer to propose work-around solutions such as double and off-flow pits. In contrast, the waste treatment issue is much more acute in urban areas: open air gutters and lack of functioning waste treatment plants result in massive pollution issues and health risks.

To address the latter issue, we looked at two groups of solutions. First, we studied small, decentralized alternatives that could be coupled with waste collection schemes. In particular, we looked at technologies that process the waste with the objective of producing a by-product with a market value (e.g. biogas, animal feed, fertilizer, struvite, fuel). Our analysis revealed that these solutions, although promising, do not yet generate sufficient revenue to pay for the waste processing costs, let alone cross-subsidize collection operations. In addition, many of these by-products face important challenges to commercialization, ranging from lack of local markets (e.g. while there is a market for chemical fertilizers, farmers are less inclined to pay for compost), to regulatory hurdles (e.g. the use of human-based fertilizer for agricultural purpose is forbidden in many countries) and logistical issues (e.g. transport for urine or biogas). Finally, most of these technologies are still in the early stages. Their feasibility at scale, both in terms of processing operations and ability to sustainably source large

quantities of waste, remains to be seen.

To complete our overview, we looked at bio-toilets, a group of technologies that use living organisms in compact tanks placed directly under the toilet to feed on and process the waste with almost no outside intervention, dramatically reducing the need for emptying tanks, transporting and processing the waste. Hence, bio-toilets could be a disruptive solution in areas where households own their house and land and would invest in fixed infrastructure. Bio-toilets are already widely used as public toilets in some countries such as India. However, they have hardly been commercialized at household level, as there are a number of hurdles to do so on a large scale. Firstly, they may be less effective in an 'uncontrolled' household environment (where usage may vary over time, or aggressive cleaning chemicals may be used). And second, their average cost matches that of septic tank toilets, i.e. out of reach for most BoP families.

Given the challenge posed by the lack of waste management facilities in the world's rapidly developing cities, it is imperative to continue supporting the development of alternative waste management technologies. In particular, the private sector could play a critical role in testing and improving waste-to-value technologies, validating the effectiveness of bio-toilets in different environments, reducing the costs of these technologies, and developing market-based approaches to commercialize them.

CONCLUSION

While the global development community has been playing a major role in fighting the sanitation crisis for the last decade, these efforts are not enough given the magnitude and complexity of the problem. Market-based approaches could help develop more financially sustainable and scalable solutions to extend access to sanitation for all. To support the development of these innovative business models, the private sector has a major role to play. By bringing corporate expertise, assets and resources, it can help unlock the potential of many innovative projects seeking new ways to offer sanitation solutions, in a more commercial way. We hope this Report will inspire business leaders to engage along and in partnership with these pioneers, as well as public and development stake-holders to support such efforts.

Sewage connection in a slum in Nairobi, Kenya
Credit: Hystra

THE GLOBAL SANITATION CRISIS

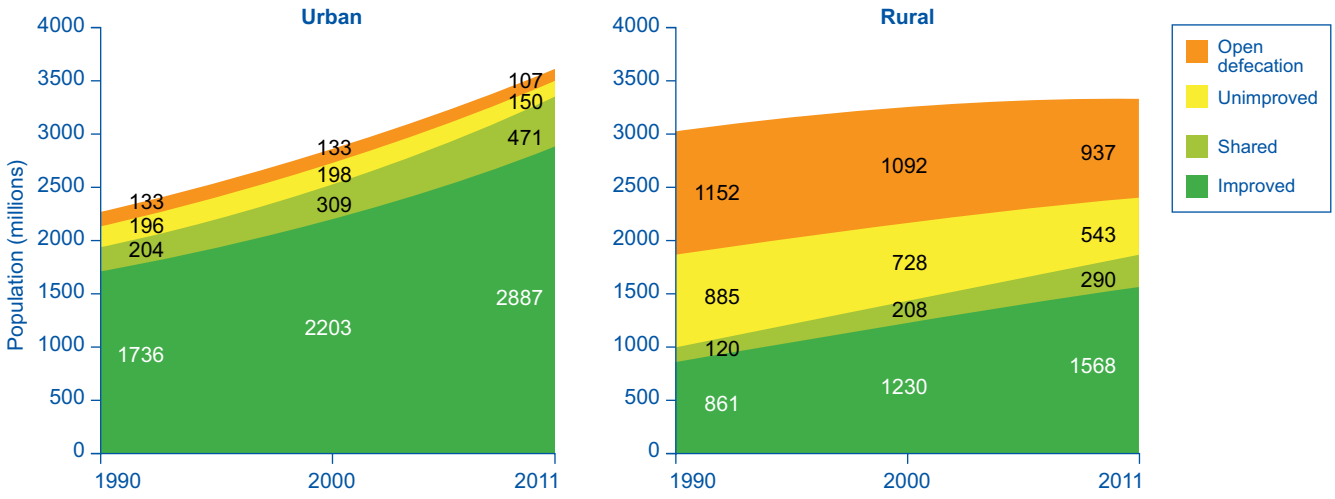
Over the past two decades, almost two billion people have gained access to an improved sanitation facility, bringing the global sanitation coverage from 49% in 1990 to 64% in 2011.

However, this remains far below the Millennium Development Goal sanitation target of 75% by 2015. To this day, two and a half billion people do not have access to improved sanitation facilities. Among them, 750 million use public or shared facilities, 700 million use unimproved facilities (i.e. that do not ensure hygienic separation of human excrement from human contact), and one billion still defecate in the open.

In rural areas, where the large majority of people without access to sanitation live, the penetration of improved solutions has been progressing slowly from 29% in 1990 to 47% in 2011, or less than one percentage point per year, as latrines often remain unaffordable or simply unavailable in villages.

In urban areas, while 1.1 billion people gained access to improved sanitation between 1990 and 2011, the urban population grew by 1.3 billion people. Consequently, there are still over 700 million urban dwellers without access to improved sanitation. Given the fast urbanization trend (by 2030, the population living in cities of Asia and Africa will have doubled from its 2009 level), it is expected that this figure will grow. In most developing countries, piped sewer systems in cities do not exist or are restricted to the richest areas. Only a small proportion of informal settlement dwellers can afford an individual pit latrine or septic tank toilet, and hazardous practices such as "flying toilets" (defecation in a plastic bag) are widely prevalent.

Global sanitation coverage and open defecation trends in rural areas by population (1990-2011)



Source: WHO, UNICEF, Progress on Sanitation and Drinking Water – 2013 update

The lack of sanitation has dramatic health consequences. The World Health Organisation (WHO) estimated that diseases related to unsafe sanitation were responsible for 6% of global deaths[4]. Inadequate sanitation, coupled with the lack of access to safe water and poor hygiene practices, kills more under-five children (620k annually) than AIDS and malaria together[5].

Beyond health impact, poor sanitation also has a dramatic impact on girls for instance, who are often withdrawn from schools when they reach puberty due to the lack of appropriate facilities, or on livelihoods as it results in days away from work when being sick and additional healthcare expenses.

The sanitation agenda is increasingly picking up in the development community, which long focused on providing safe water. Still, the two billion dollars spent on sanitation every year, is not enough to deliver long-term positive outcomes for all. In that light, the development of innovative, market-based approaches to providing sanitation could help attract more resources for more sustainable projects.

4 The global burden of disease: 2004 update, WHO (2008)

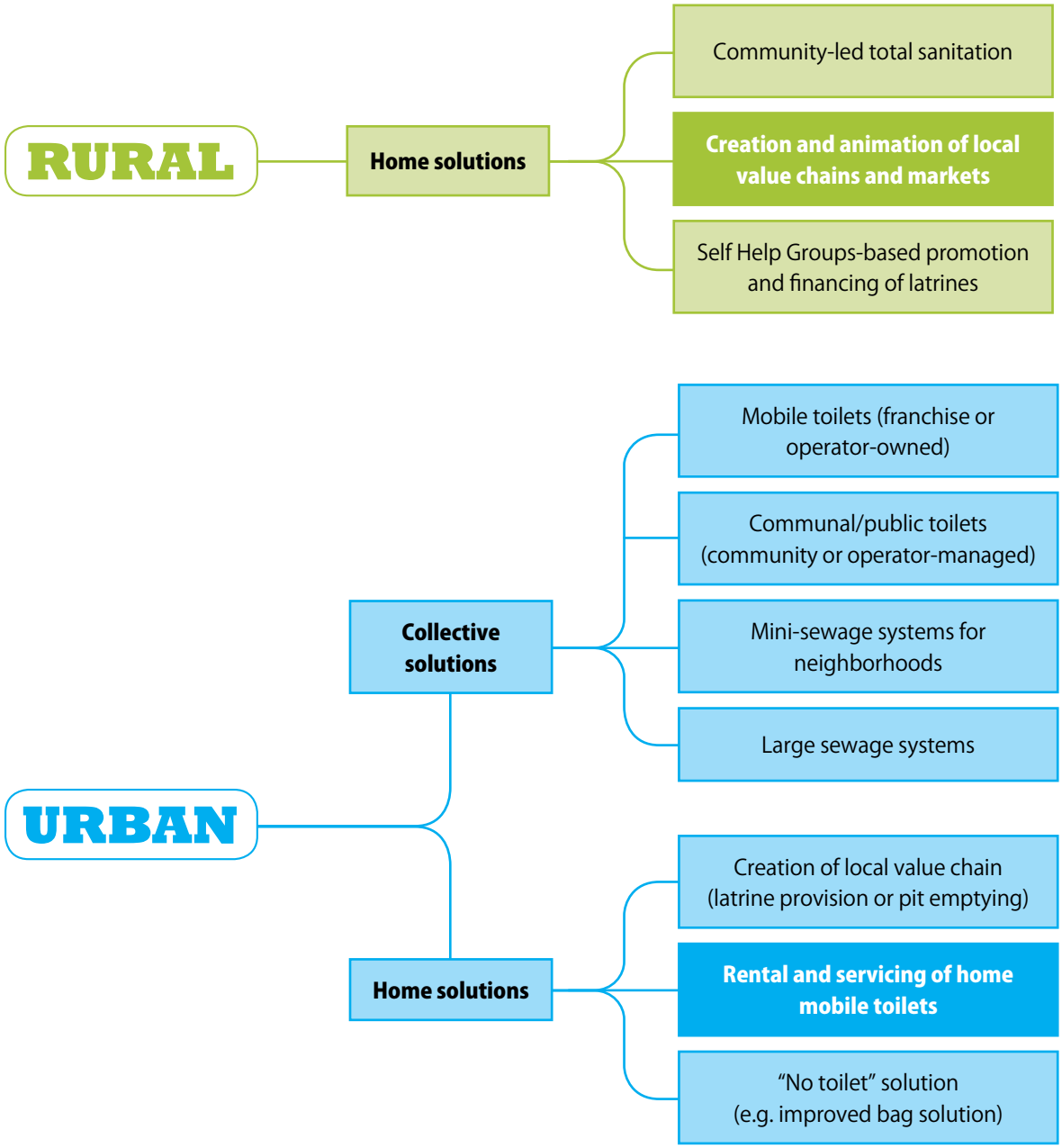
5 Hystra analysis from the 2012 data of the Global Health Observatory Data Repository, under the Mortality and global health estimates / Child Mortality / Causes of child deaths / Number of Death by causes section.

ABOUT THIS REPORT

Many different market-based approaches for sanitation exist in both rural and urban areas. Following a mapping of over 100 market-based sanitation projects across the world, we identified at least nine different and distinct models.

These models differ not only in terms of approach, but also in terms of financial sustainability and reach. The more commercial approaches are better able to grow and serve more users without the need for grants, but they will also tend to serve the better off segments first. At the other end of the spectrum, some interventions try to target all segments at once, but rely more extensively on grants and subsidies to operate.

Overview of the main existing market-based business models providing access to sanitation at the BoP



Sources: Hystra analysis

In this Report, we focus on two models in particular, one in urban and one in rural. We seek to understand how to bring these two business models to scale, by analyzing the obstacles they face and suggesting strategies to overcome them.

The two selected models are:

Rural areas: creating and activating local sanitation value chains and markets

This approach aims at leveraging the reach of local entrepreneurs to supply well-designed, affordable latrines in rural areas. A number of projects work at stimulating both the supply and the demand for local sanitation solutions. While these projects have shown promising results in reaching significant scale, they remain mostly grant-based. To become financially sustainable, the organizations doing market-activation need to evolve their business model, by creating new revenue streams and improving their value proposition to families.

Urban areas: servicing home mobile toilets

This approach develops rental services of modern-looking, mobile and compact toilet units that can be easily installed in a small space without connection to the sewer. A waste container, located under the toilet, is collected and disposed of every few days by a dedicated team for a service fee. Existing projects show that households are willing to pay relatively high prices provided the toilets look attractive, are safe and odorless. However, a number of R&D and operational challenges need to be solved for these small-scale pilot projects to scale up.

These two models were selected on the basis that:

- they have a potential for financial sustainability, which means they could be scaled up without unrealistically large grant support
- they offer aspirational, individual sanitation solutions to BoP families, representing an opportunity to develop consumer relationships with the large untapped BoP market
- they can be largely driven by private sector, which facilitates their replication in new geographic locations
- they would strongly benefit from additional corporate/ industrial expertise and support.

As part of this study, we selected 12 projects that are representative of these two models, in different geographies (see map on next page). We analyzed in detail their approach, innovations and best practices, as well as barriers to scale and replication. This analysis was possible through close collaboration with the management teams of these projects, through field visits and extensive expert interviews.

In addition, we did a number of deep dives on alternative waste treatment solutions for urban areas, which could be plugged to the proposed model of waste collection through servicing of home mobile toilets.

Technologies that process waste into by-products

- Waste into animal feed and biodiesel (centralized Black Solider Fly processing)
- Waste into gas and fertilizer (bio-digesters)
- Waste into fertilizer (composting)
- Waste into fuel pellets (centralized drying)
- Urine into fertilizer (struvite production)

Bio-toilet projects

- Banka Bioloo
- Biofil
- Mohan Rail Components
- Stone Biotech
- Tiger Toilets

OVERVIEW OF THE 12 PROJECTS SELECTED FOR ANALYSIS

SOIL – re.source
NGO providing home mobile toilets associated with a waste collection service and turning the waste into fertilizer.

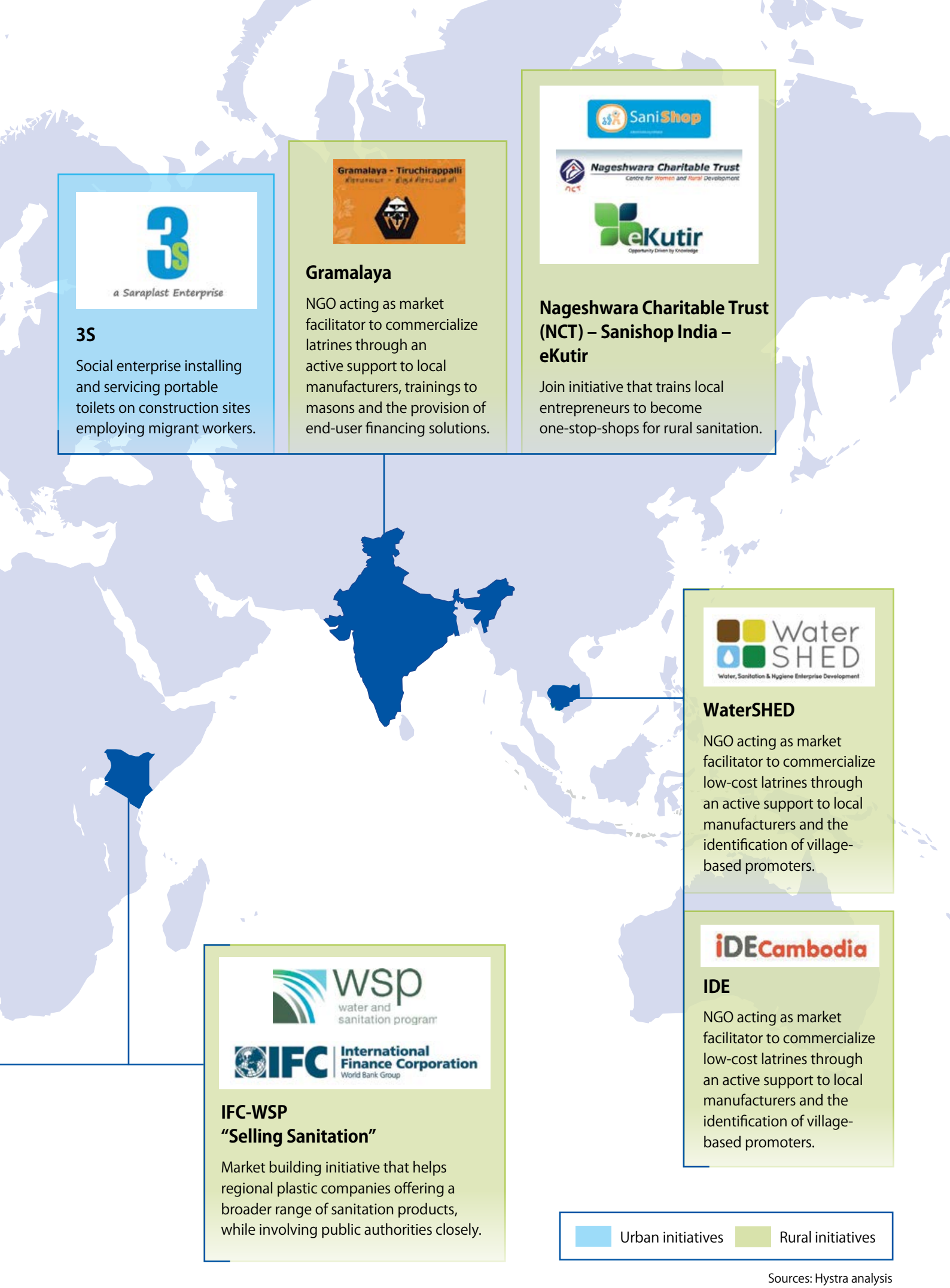
Clean Team
Social enterprise providing home mobile toilets associated with a waste collection service.

Ciudad Saludable
NGO federating informal waste pickers into recycling associations that can provide a free, door-to-door collection service for solid waste, and sell recycles in bulk.

Banza
Social enterprise providing home mobile toilets associated with a waste collection service.

X-Runner
Social enterprise providing home mobile toilets associated with a waste collection service and turning the waste into fertilizer.

Peepoo
Social enterprise selling hygienic, single-use, odorless and biodegradable bags to slum dwellers who do not have space in their homes for a toilet.



3S

Social enterprise installing and servicing portable toilets on construction sites employing migrant workers.

Gramalaya

NGO acting as market facilitator to commercialize latrines through an active support to local manufacturers, trainings to masons and the provision of end-user financing solutions.

Nageshwara Charitable Trust (NCT) – Sanishop India – eKutir

Join initiative that trains local entrepreneurs to become one-stop-shops for rural sanitation.

WaterSHED

NGO acting as market facilitator to commercialize low-cost latrines through an active support to local manufacturers and the identification of village-based promoters.

IDE

NGO acting as market facilitator to commercialize low-cost latrines through an active support to local manufacturers and the identification of village-based promoters.

IFC-WSP "Selling Sanitation"

Market building initiative that helps regional plastic companies offering a broader range of sanitation products, while involving public authorities closely.

Urban initiatives | Rural initiatives

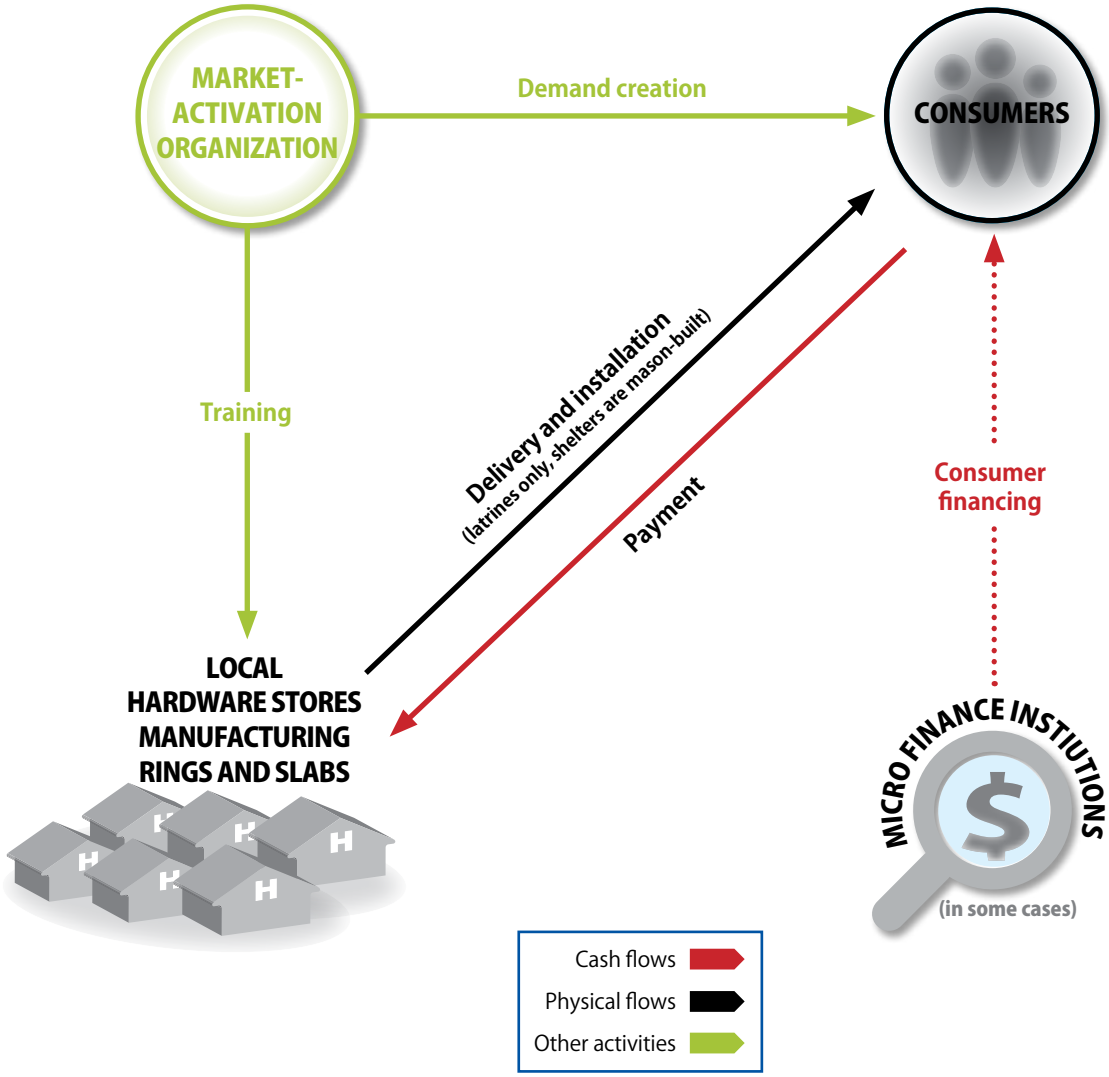
Sources: Hystra analysis

Latrine shelter
Credit: Hystra

RURAL AREAS: CREATING AND ACTIVATING LOCAL SANITATION VALUE CHAINS AND MARKETS

For a few decades, many projects have worked at creating and activating local, rural sanitation markets. Mostly run by non-profit organizations, they work on both the demand side by increasing households' awareness and motivation to invest in sanitation, and on the supply side by identifying and strengthening local businesses to take over the different stages of the supply chain (manufacturing, delivery and installation). These projects aim at building entire value chains that could be self-sustained after an initial intervention period.

Market-activation programs



Source: Hystra analysis

THE OPPORTUNITY

Some market-activation projects have generated considerable sales within a couple of years

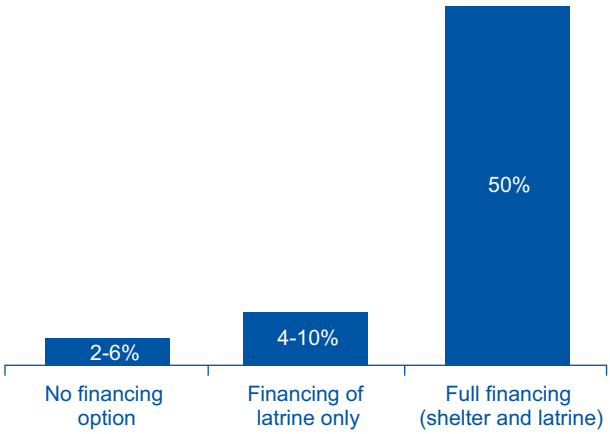
For instance, in Cambodia, WaterSHED and iDE interventions directly resulted in 60,000 and 80,000 latrine sales respectively at the price point of $30-50, over the past three to four years, contributing to an additional 5-15% sanitation coverage in their areas of operation. IFC-WSP in Kenya is working with two regional plastic manufacturers to produce and sell attractive latrine slabs for an estimated untapped national market of 2.3 million households.

These projects allow households to access attractive, quality sanitation products, in a way that is convenient. They use marketing material that leverage both community dynamics (e.g. shame of having the household's women defecate in the open, disgust with faeces, etc.), and more aspirational messages for households (i.e. around status and dignity). Without these interventions, households would often only consider investing in sanitation when forced to do so – increased urbanization means having fewer and fewer places to openly defecate. They would have to purchase and transport the various materials needed themselves, and rely on local masons for assembly and construction. As a result, they would often end up with sub-standard structures for a relatively high price. In contrast, as a result of market-activation projects, customers can purchase quality latrines at their doorstep (with installation often included) for a fraction of what they would pay otherwise (typically 30% less).

When they manage to provide end-user financing, these projects often unlock a large latent demand

As 'cash-at-hand' availability is often the main hurdle for households to actually invest in an improved latrine. Gramalaya manages to reach over 50% coverage in most villages in which it operates, thanks to a combination of cash sales (5-10% of households), microcredit through a partner MFI, and financing through Self-Help Groups. Financing solutions also dramatically improve the attractiveness of the product on offer (i.e. families can now afford one of the many products they aspire to have that would otherwise remain out of reach), making the investment opportunity appear as a 'good deal'. In fact, some projects show that when households are offered financing solutions, they are ready to stretch resources for the "best available solution". As Mr. Debasish Ray Choudhuri, CEO of Bandhan – a leading Indian MFI – explains "when provided with sanitation loans, people buy the best product they can afford".

Penetration achieved through different market-based projects after one year[6]



Source: Hystra analysis

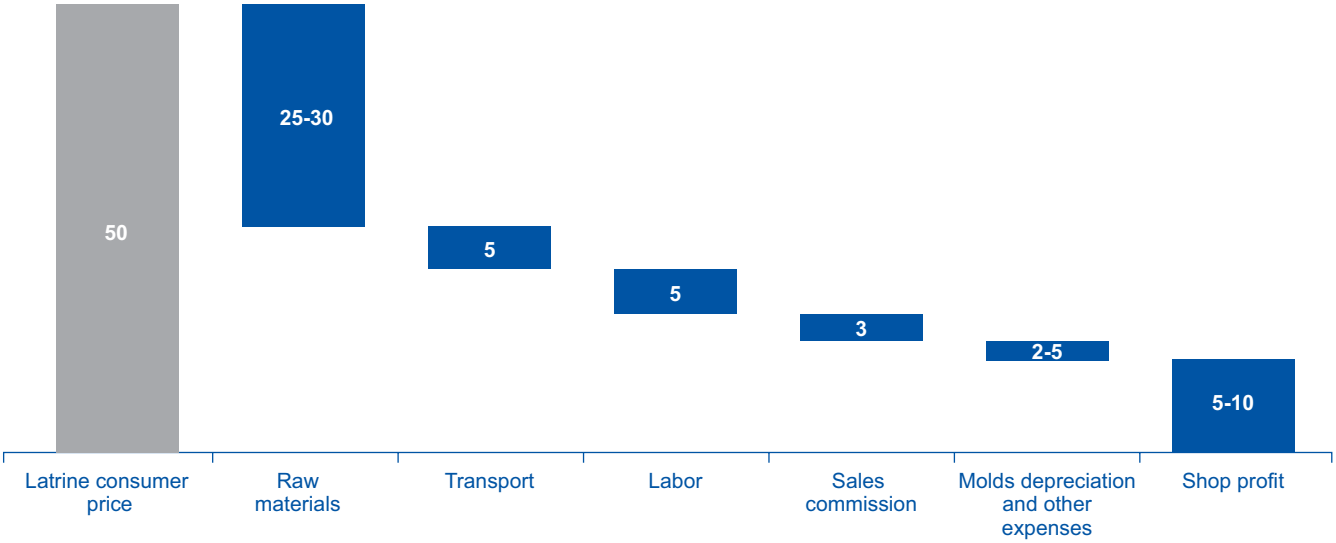
These projects manage to enroll and professionalize hardware stores as local latrine providers

On the supply side, a number of these projects have successfully engaged existing construction entrepreneurs, helping them to expand their product range to latrines or latrine components. The most successful projects in this regard are those who work in locations where there is a relatively dense network of hardware stores of a certain size, which not only retail materials but also produce items themselves (e.g. bricks, slabs, etc.). The production of latrines can represent an interesting revenue stream for such stores (up to 30% of their revenue). These projects then identify the larger, most professional and successful ones (an essential aspect to avoid investing in poorly performing businesses), train them in cost-efficient latrine production, and support them in various ways (e.g. offering free molds) until demand for this new product is stable enough for them to decide to invest in additional equipment and inventory.

A number of existing projects managed to enroll between 200 and 300 hardware stores in just a couple of years, showing there is an opportunity to build substantial networks of suppliers in a given geography. As each supplier covers 10-30 neighboring villages of 100 to 200 households each, this breaks down to a reach of up to 6,000 households.

6 Source: Evidence from three projects in South and South East Asia.

Economics of a larger hardware stores in Cambodia (USD)



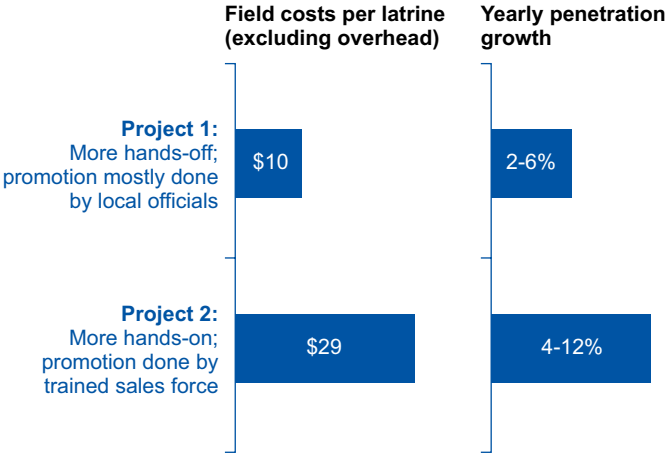
Source: Hystra analysis

THE CHALLENGES

Market-activation projects need significant grants to operate, and often fail to create sustainably growing markets

Many market-activation projects assumed they could progressively disengage from the areas where they were working, once hardware stores were active and promotion took place. The assumption was that sales would continue, as the market's 'dysfunctions' had been taken away. Hence, the grants financing these interventions were justified, as they would stimulate value chains and local markets that could in turn become self-sustainable. However, experience in the field reveals that there may be no 'tipping point' beyond which these projects could exit, without a significant dip in demand. The first main reason for this is that BoP households have limited resources for many essential needs and wishes. Hence products that do not necessarily top the list of household priorities over time need to be constantly 'pushed' to secure sufficient demand. In fact, it appears that the intensity of sales efforts often correlates with the level of demand; leading to even higher project costs. The second main reason for this is that the local hardware stores are not willing or equipped to carry on these promotion efforts by themselves. They are small, local entrepreneurs, who essentially run their business by waiting for customers to walk through their door.

Penetration results of two Cambodian projects operating in the same area, investing more or less resources in promotion and sales



Source: Hystra analysis

Hence, a major question for these projects to reach scale is how to generate revenue for themselves, permitting them to grow and replicate without requiring heavy grant support. By being active for longer and more sustainably, these projects can gradually increase their penetration to the poorer and poorer segments of villagers, who are the last ones willing and able to afford a toilet.

Some projects tried to do so. In Cambodia, SaniShop piloted a two-dollar "franchise fee" charged to hardware stores for each latrine sold – in exchange for support and branding. This proved however difficult to enforce, as margins on latrines are slim and the suppliers struggle to see the added-value of the project over time.

Another avenue for generating some project revenue is to provide in-house finance, and capture some of the interest payment margin. This is for instance the case for the Nageshwara Charitable Trust in India, which provides 12% interest loans. However, despite a very low 6% refinancing rate, the interest margin is hardly enough to cover the credit operations costs of the project.

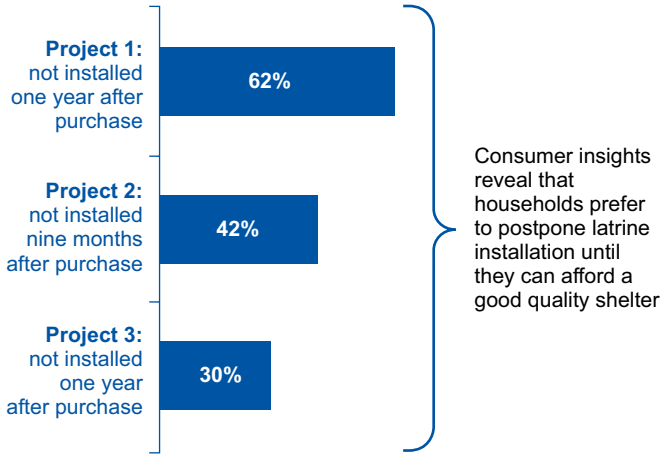
As a result, most market-activation projects remain fully grant-based. The level of grants required generally varies between $10 and $40 per latrine, i.e., 20% to 80% of the end user price.

Most market-activation projects focus on household *needs* for hygienic solutions rather than *wants* for aspirational ones

Market-activation projects have been driven mostly by development players, who understandably focused on the provision of 'lowest possible cost' latrines, comprising mostly of rings to support the pit, and easy-to-clean slabs, as these provide the most health benefits. However, health benefits are not enough to convince would-be users and most projects fail to address the desire of rural families for low-cost but attractive solutions. As purchasing a toilet is a significant investment to improve the house, many households would prefer investing in more durable solutions (i.e. concrete-based or concrete-like structure rather than zinc or bamboo), including a shelter – which provides privacy, comfort and dignity.

A finding of three Cambodian projects revealed that households are ready to postpone the installation of rings and slabs (even after full payment and delivery), until they can afford a quality shelter.

Percentage of latrines not installed after purchase



Source: Hystra analysis

Most market-activation projects do not offer the purchase of a shelter nor its installation. It is seen as non-essential to realizing health benefits, difficult to supply at scale and expensive. As a result, shelters available to villagers are often labor and material-intensive constructions, done by masons, which often lack the training to provide value and quality.

Few market-activation projects manage to effectively provide end-user financing solutions

Many projects try to work through MFIs, but struggle in doing so – often for the same reasons. MFIs still have relatively little reach in the areas where these projects operate. India has one of the highest MFI coverages, and despite 27 million active borrowers, this amounts to less than 15% of all BoP households. Very few MFIs provide sanitation financing as the loan amounts are low, there are regulatory ceilings for consumer finance and sanitation products appear hard and expensive to sell. As a result, less than one percent of MFI customers have a sanitation loan in India. And even when an MFI partnership is established, it turns out to be difficult and costly to maintain. In the MFI pilots tested by WaterSHED and iDE in Cambodia for instance, the MFIs required a higher percentage on product sales and relied heavily on the project team to enroll credit customers and do cash collection. Some earlier studies by Hystra show that up to 90% of partnerships with MFIs to provide consumer finance fail.

masons training in India
Credit: Hystra

An alternative to working with MFIs is to build an in-house credit scheme, but this is also extremely challenging. Main hurdles include:

- credit size and interest amount often does not sustain loan payment collection costs
- refinancing of consumer finance portfolios are equally as challenging as for MFIs
- credit operations are complex and require specific skills and team development, and
- country-specific regulation often limit the type of organizations that can provide such credit.

There are, however, a few exceptions to the above. Guardian, a spin-off of the NGO Gramalaya, is one of the very few successful sanitation financing projects. Guardian was created in 2007 as a non-banking financial corporation, under a status that allows providing loans that are not "income-generating". To date, Guardian has made more than 30,000 loans for toilets, with a 96% repayment rate. However, its success was built on favorable conditions that may not allow for replication in other contexts.

Projects face challenges in building and managing larger network of hardware stores

Firstly, 'ideal' hardware stores, i.e., relatively large stores with a diverse product line of materials and pre-fab items (and sufficient resources to invest and upgrade its production), can be hard to find in some geographies, such as Africa for instance.

Second, even among the larger shops, the level of professionalism and motivation may differ significantly among entrepreneurs, making it difficult for projects to invest in the right ones from the start.

Finally, many shops lose interest in latrines if sales drop for longer periods of time. All that results in a low retention of hardware stores (up to 30% of shops supported become inactive over time).

RECOMMENDATIONS

Current market-building projects offer a lot of promise, but face a number of obstacles. To overcome those, we recommend evolving the current projects and models as follows:

- Switch from the 'market-activation to the 'social business' model, by generating revenue out of the sale of products or services
- Evolve the relationship with local hardware stores from that of a 'supported entrepreneur' to that of a 'preferred supplier'
- Facilitate household purchases with a savings program
- Deploy a full-time dedicated sales force running sales events and leverage village-based referrals
- Establish close coordination with local authorities

Switch from the "market-activation" to the "social business" model, by generating revenue out of the sale of products or services

As we have seen, promotion efforts are required in the long-run to maintain sustained demand for sanitation solutions and reach further into poorer segments of villagers. But to finance these efforts over time, market-activation projects must find ways to capture some of the value they help generate, in order to finance their own operations and growth. They need to find ways to generate revenue from the sale of products or services. Possible avenues include:

Selling high margin products along with basic latrines

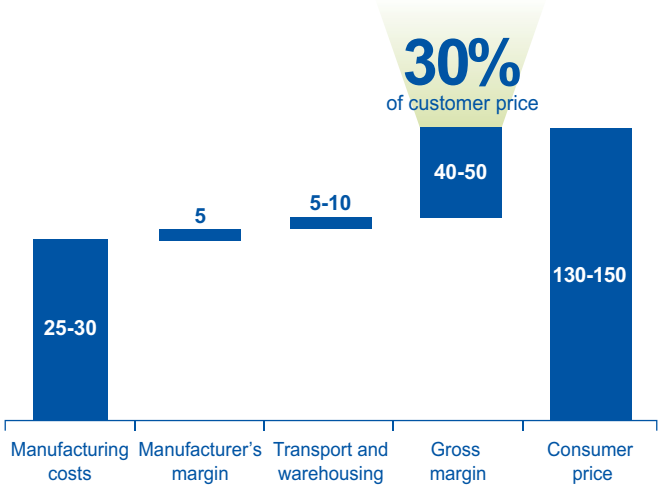
Projects can barely capture any of the margins made on the rings or slabs; the price of the product is low and sufficient margin needs to be built in for the latrine manufacturers to incentivize them over time. On the other hand, developing an in-house credit operation is complex, risky and costly. Hence, the best remaining option is to sell higher price and/or higher margin products, either to hardware stores or to households.

Of all possible products, attractive shelters and sanitary equipment (e.g. hand-wash or bathing facilities) seem to be the most promising: such products would answer an under-served demand; would boost latrine sales and use; and could be centrally manufactured so that production costs could be brought down enough to build in a sufficient margin.

Some pioneer organizations already started to invest in the development of shelter solutions. WaterSHED developed a zinc-based shelter priced at $75, which met limited demand however, as the material is perceived less durable than concrete. It is now exploring the possibility of designing a concrete shelter that would be cheaper than current alternatives. iDE recently invested in the development of an affordable ready-to-install corrugated iron shelter called "Easy Shelter", in partnership with the NGO GRET.

However, these shelter prototypes likely need significant improvements to be offered on a large scale: they must better meet consumer expectations with regards to appearance and materials; be offered in a range of options and prices to achieve maximum penetration; and allow for efficient delivery and installation (e.g. ready-to-assemble design, flat-pack transport, lighter but resistant material to reduce breakage during transportation). In terms of production, the manufacturing costs should hover around $70-90 for the end product to cost around $130-150. A WaterSHED consumer survey reveals that 80% of households want a concrete shelter costing over $150, even if that often means they have to wait before they can afford the whole solution.

Illustrative breakdown of shelter economics with centralized manufacturing (USD)



Source: Hystra analysis

A similar effort could be made with regards to sanitary equipment, such as bathing or hand-washing modules, that could easily be added to the shelter structure.

Offer systematic home delivery and installation

These services are extremely valuable to the end-user, but not systematically offered by local hardware stores. By offering these services and charging for them, sanitation projects can generate further revenue (e.g. up to 20% of the latrine price based on a benchmark of hardware stores), as well as develop closer customer relationships, track and improve their satisfaction (a WaterSHED consumer survey revealed that slow delivery was the primary source of dissatisfaction for 31% of consumers), and handle payments directly.

The coordination of installation teams at scale is complex however:

- Tight management is required to coordinate the orders, optimize logistics (warehousing locations and truck routes), ensure timely installation of the right components and monitor cash transactions
- The timing of delivery should be optimized, typically 2 to 3 weeks after households order, allowing enough time to complete preparatory work (e.g. hire a low-skilled worker to dig a hole for the rings or do it themselves) and gather cash
- The design of products is also key to drive cost-efficiency: ready-to-assemble, lighter weight components can reduce installation time and require fewer workers.

Evolve the relationship with local hardware stores from that of a 'supported entrepreneur' to that of a 'preferred supplier'

Given the extensive integration of business operations proposed above, it is essential for sanitation projects to develop an extremely close relationship with ring and slab manufacturers, who need to evolve into a network of dependable suppliers.

This firstly demands an improvement in identifying, training, and monitoring of hardware stores: Identifying the best possible businesses in given areas (and possibly forego some coverage where none are found) is key to offering a quality and timely supply (hence to have satisfied consumers), to limit costs and complexity (a better selection of shops reduces churn, and facilitates training and monitoring operations). The ideal suppliers already offer a diverse product line (e.g. pre-fab concrete elements and construction materials), has a sufficiently large size and outreach (serving at least 10-15 villages or 3-4k households), and has the necessary resources to invest in new production equipment and upgrade its production and warehousing capacity. Existing projects have developed best practices in this regard. iDE does supplier recruitment through regional events. Interested candidates need to fulfill a number of criteria with regards to production and investment capacity before they can join. Once selected, they benefit from intensive training and coaching. WaterSHED construction shops need to invest up to $400 into molds, carry 30 sets in stock anytime (about $500 inventory) and own a truck to be selected.

Second, appropriate contractual agreements need to be proposed: The projects should offer attractive terms for having the suppliers focus on what they know and do best: i.e. produce simple parts on-site. In this client-supplier relationship, stores are offered to increase their revenue without additional complexity. Incentives (and possibly penalties) should be built in to reward quality, timely production, sufficient inventory and the use of recommended production methods. In this way, shops can secure a stable source of business, from a client that commits to passing regular orders and ensures fast payment after delivery.

Facilitate household purchases with a savings program

As we saw earlier, addressing the lack of 'cash at hand' issue is a must to make these products more accessible and affordable. In areas where MFI partnerships are limited and restricting, and in-house financing is too challenging, an alternative is to offer consumers to pay over time allowing them to pay in smaller amounts, splitting the purchase of latrines, shelters and sanitary equipment into modules.

A possible approach would be to offer consumers to buy four or five modules worth $30-50 each, e.g.:

- Module 1 (three rings installed): $30
- Module 2 (slab and wash basin installed): $35
- Module 3 (shelter base and walls installed): $40
- Module 4 (shelter roof and front wall structure installed): $45
- Module 5 (shelter door and finish): $50.

This modular solution makes sense in many ways: it is common practice among BoP households to make bigger purchases piece by piece, when they have the cash and/or when an interesting opportunity shows up. Offering them to pay each module over time – with guaranteed quality and door-step service – is a clear improvement on current practices. Otherwise, households would purchase the rings and store them in the garden until they prioritize the building of a shelter by a local mason and spend a very large amount to do so.

The modular approach translates into a number of additional advantages: it allows consumers to purchase only the modules that they need and want, hence broadening the customer base (i.e. households wanting to buy their first basic latrine, as well as those wanting an upgrade from an existing installation). More importantly, the proposed modular approach will drive adoption by making sure households can avail the whole solution at regular intervals, with high quality and good value. Provided they can save regularly. Households can then access the full aspirational solution, but at their own rhythm, and following their own capacity to pay.

This modular approach would need to be tested in the field for latrines and shelters. In another sector, Patrimonio Hoy, an affordable housing program launched in Mexico (by the cement manufacturer CEMEX) successfully implemented a similar savings scheme, enabling urban households to build a new room step by step. Previous to this program, households took 4 to 5 years to build a small room, in a costly and ineffective way. Patrimonio Hoy offers its clients to build a 10m2 room in a bit more than one year against regular payments: households receive the materials progressively along with technical support, for a total price that is about 60% lower than what they would have paid otherwise. Since 2001, Patrimonio Hoy has served more than 380,000 families.

Deploy a full-time dedicated sales force running sales events and leverage village-based referrals

The active promotion and effective sales of products is central to the success of the whole endeavor. Without constant sales, suppliers will be less committed to deliver required quantity and quality on time, the project will struggle to cover its operational costs, and more importantly, the rate of penetration in villages will slow down – resulting in less health benefits for the whole community. 'Owning' the sales process also ensures that customer needs are better fulfilled. In flood-prone areas where water tables are too high for example, the sales agents should avoid promoting pit toilets; in areas where latrines tend to fill in quickly, the offering can be adapted to double or off-flow pits.

How to organize this sales force? An earlier Hystra study[7] found that full-time, dedicated sales forces are generally more efficient at promoting products. They require less training and oversight (one full-time staff requires less supervision than two part-time), and tend to perform better thanks to higher specialization and motivation. The second essential ingredient to success is that the remuneration structure ensures the agents generate sufficient revenue to make a good living if they engage full-time.

Hystra analysis across top performing social businesses suggests that frontline costs, including the compensation of sales and installation teams, should not exceed 15% of total sales revenue. Sales agents commissions need to be indexed on sales and KPIs (in particular, customer satisfaction scores). While the fixed salary needs to be high enough to ensure sufficient revenue during the take-off phase or seasons where sales may be lower, the commissions need to account for a large part of total revenue in order to create sufficient incentives for high performance.

The table below illustrates that each agent would have to sell about 600 sanitation packages per year to be financially sustainable, and thus needs to cover a territory of at least 30-40 villages of 200-300 households each[8] (selling 15-20 packages per village per year).

Frontline costs breakdown for $120,000 sales per year per sales agent (or 600 packages at $200)

Breakdown	Amount US$	Percentage of sales
Sales revenue	**120,000**	**-**
Frontline costs as % of sales	**18,000**	**15%**
Annual sales agent salary	4,000	3%
Other marketing expenses (flyers, referral commissions, etc.)	1,000	1%
Annual salary of a team of 3 installation staff	5,000	4%
Installation expense (truck lease, fuel, etc.)	8,000	7%

Source: Hystra analysis

7 Hystra, Marketing Innovative Devices for the BoP, 2013

8 In order to cover such a large territory, sales agents need to visit each village only a few times per year, e.g., three 2-day visits annually across 40 villages would correspond to 240 working days.

Given the relatively few visits they will perform in each village, projects should leverage two extremely effective strategies for the sales of expensive items:

Referrals: Sales agents can leverage village-based referrals (e.g. community leaders, former clients) to bring clients in exchange of a small commission

Toyola, a Ghanaian company selling improved cook-stoves, developed a marketing strategy that relies on early adopters to promote its products. These customers who convince people in their community to become clients get rewarded for these referrals: a free stove for 10 customers, and if they convince more than 10 people, they become "evangelists" who centralize the orders in their village and take care of individual payment collection for the agent, in exchange of a 5-10% commission.

Village events

Sales agents gather 10-50 villagers during a few hours in a central place in order to create reinforcing group dynamics and conduct product demonstrations. Many existing projects have developed best practices in this regard: iDE sales agents use village chiefs to gather 15-30 local villagers (against $0.5 out of the sales agent's margin). Out of these households, three to five end up buying the product (this number goes up by 400% when credit is offered).

Establish close coordination with local authorities

In this study, we promote more commercial approaches and set-ups. However, local authorities have a critical role to play in supporting the development of such projects:

Subsidies

Firstly, projects should avoid operating in areas where latrines are subsidized – as this typically distorts, if not 'kills' the market. There are however, some exceptions to the rule when subsidies are smartly designed to support the very poorest only. This occurred with BRAC in Bangladesh: the BRAC WASH program managed to reach over 80% penetration rates in 40,000 villages thanks to subsidies. The customer segments categorized as 'better off' are required to pay for their latrines, the 'poor' are offered micro-loans, and the 'ultra-poor' are given subsidies that amount to two thirds of the price of construction materials.

Promotion

Another important area for collaboration is around promotion campaigns. Many governments engage important resources to promote water, sanitation and hygiene among rural communities. Strong synergies can be generated by 'piggybacking' such campaigns. For instance, working with the Ministry of Health, the IFC-World Bank WSP Selling Sanitation program in Kenya is preparing to launch an ambitious campaign with three components: the first will focus on creating 'dissatisfaction' with prevalent unimproved sanitation solutions and stress the importance of improving them; the second will promote the advantages of plastic slabs over cement as well as household practices to improve their current sanitation solution; the third will build on the first two to promote selected branded products (large plastic slabs, which can be retrofitted on existing pits and basic home latrines).

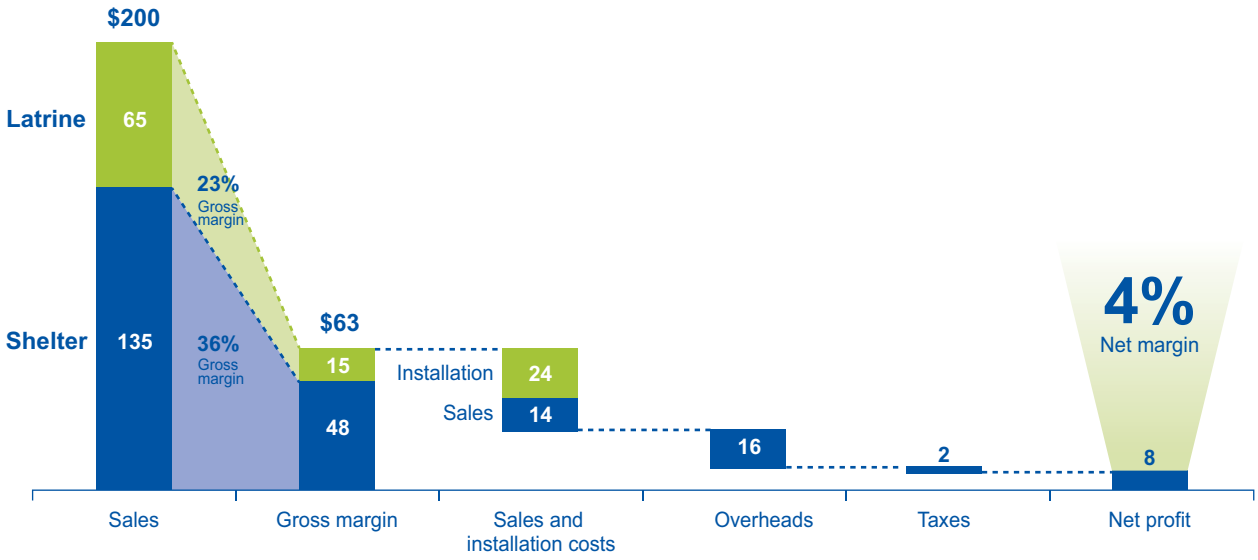
IFC sanitation product in rural Kenya. Credit: Hystra

ECONOMICS AND FUNDING FOR PROPOSED BUSINESS MODEL

Our analysis suggests that a social business selling sanitation products in rural areas according to the model proposed above could be financially sustainable at scale. Our assumptions are based on the detailed analysis of the five rural projects featured in the case study section of this Report (Appendixx1).

A project selling 150,000 latrines and shelters per year, hence providing access to sanitation to 750,000 people would generate over $30m of sales and a net profit of 4%.

Profit and Loss breakdown at household level of proposed model at a scale of 150k latrines (USD)



Source: Hystra analysis

A mix of grants, loans and equity will be needed to meet the financing needs of this social business.

The capital required in order to reach such scale would range from $5 to 8m. In the set up phase, capital needs for management team recruitment, consumer research, product development, pilot of activities, etc. will ideally be covered by grants and in-kind support for R&D. We estimate that $0.5-1m would be needed in the first year. In the scale up phase, capital for the deployment of sales and installation teams, creation of partnerships with hundreds hardware stores, working capital to produce and stock equipment, etc. will ideally be covered with debt and equity. We estimate that $3-5m would be needed for two to three years to reach breakeven at around 75,000 latrines per year, and another $2-3m investment would be needed to reach 150,000 latrines per year.

An analysis of the main sensitivities of the model reveals that the key factors of financial sustainability is the gross margin on sales, which can be mostly improved by increasing the gross margin on shelter/sanitary equipment (i.e. increasing the end user price or designing a lower-cost ready-to-install shelter with R&D partners). Our financial assumptions reveal that the project turns profitable with a gross margin on shelter/sanitary equipment over 29%.

Sensitivity analysis of proposed model

	Hypothesis	Sensitivity analysis ± 25% Hypothesis => Net profit as % of sales	Key risk factor	Risk mitigation
Gross margin on shelter/sanitary equipment	36% ($48) not incl. latrine	4% initially; -2% … 10%; Cutting point $36 (29%)	●	Introduction of a range of optional sanitary equipment to boost gross margin and stabilize profitability
Installation productivity (time to install one package)	1 technician work day	1% … 7%; Cutting point 1.4 workdays	◔	Process to ensure households are ready when installation team comes, and optimization of prefab shelter design for fast installation
Sales productivity (new households per 2-day village visit)	7 new households per visit	3% … 4%	◔	Conduct extensive testing and leverage best practices from consumer brands/ leading marketing practitioners
% households purchasing shelter only (vs. full package)	10% purchase shelter only (90% shelter + latrine)	3% … 4%	◔	Increased sales efforts on previous owners of improved latrine with poor quality shelters
% households purchasing cash (vs. modular layaway)	20%	4% …	○	Not a major risk factor: modular layaway improves the value proposition without hurting profitability
Deployment speed	+4,000 villages between year 4 and 5	4% …	○	Not a major risk factor: deployment speed can be adjusted to the financial resources of the project

Sources: Hystra analysis

STRATEGIC PARTNERSHIPS WITH CORPORATIONS

The private sector has a major role to play to help refine business models, bring new technologies, products, expertise and assets, as well as invest resources to grow more sanitation enterprises. Indeed, such social businesses would benefit greatly from the capabilities of strategic corporate partners.

As shown in the sensitivities analysis above, one key driver of financial sustainability is the ability of the social business to generate margin on low-cost shelters. However, existing shelters need significant improvements to be offered on a large scale. Therefore, ready-to-assemble furniture companies, construction companies and low-cost home manufacturers could become strategic partners and bring their expertise to design DIY, flat-pack, light, centrally-manufactured, robust and good-looking shelters. Beyond design, choosing the right materials for this ideal shelter would require the expertise of cement suppliers or cement additive powder companies. The same effort should be made concerning sanitary equipment, with the help of sanitation companies.

In addition to the commercialization of latrines, the social business could complete its offering (and possibly further improve its financial sustainability) by promoting hygiene behaviors and distribute products through local retail. To make this opportunity possible, support from FMCG (Fast-Moving Consumer Goods) companies would be important to select the right products, train sales agents to promote hygiene behaviors, and organize the distribution of products (in particular ensuring continuous supply).

Finally, corporate partners could contribute to the success of the social business by helping in the design and implementation of efficient sales and marketing strategies, sharing best practices and assisting in the creation of adequate materials.

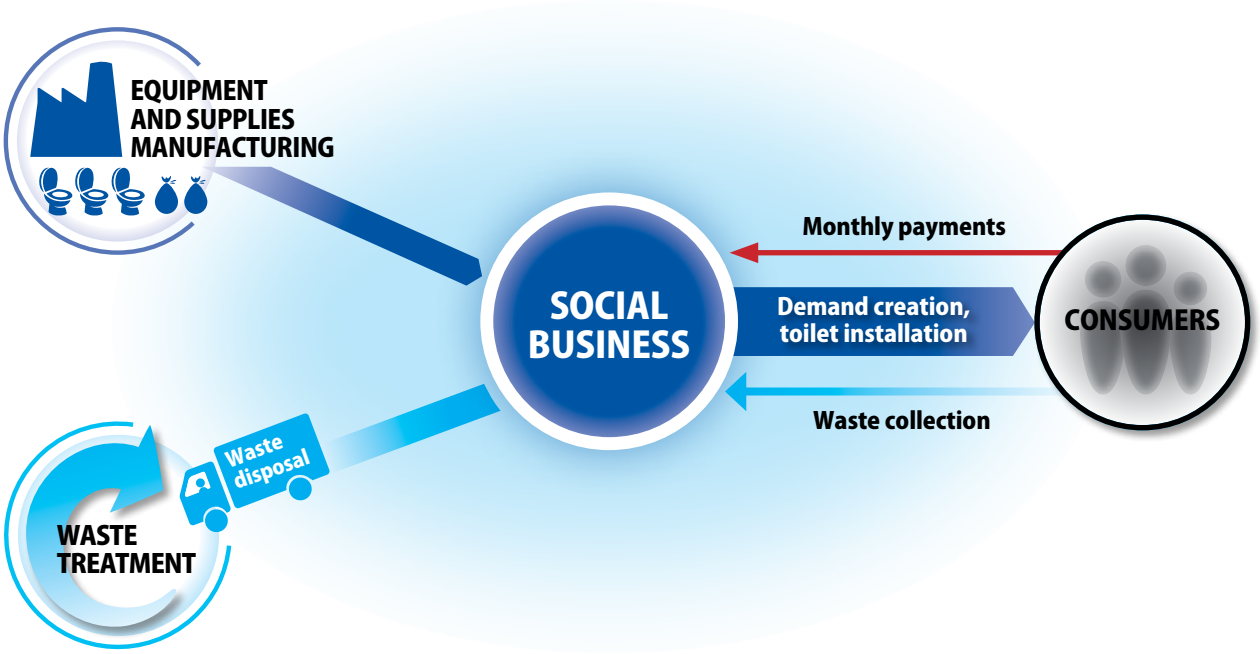
Home mobile toilet in Peru
Credit: Hystra

URBAN AREAS: SERVICING HOME MOBILE TOILETS

Home mobile toilets are compact, waterless and portable toilet units that can be used in homes. They offer privacy, convenience and safety (no need to go outside at night), without investing into fixed infrastructure – which most slum dwellers would be unable and unwilling to do, given their inability to pay and the fact that most rent their homes.

These toilets are 'rented' for a service fee, whereby the toilet provider operates a regular collection service for the waste accumulated and stored under the toilet. This approach brings a constant source of revenue for these projects (rather than one-time sales), and ensures that customers do not try to dispose of the waste themselves or call on the services of informal waste collectors that may dump the waste illegally.

Servicing of home mobile toilets



Source: Hystra analysis

While home mobile toilet projects are still relatively new and small (the largest one being Clean Team in Ghana, with 500 installed units and other rather smaller ones such as SOIL and Banza), they show a lot of promise.

THE OPPORTUNITY

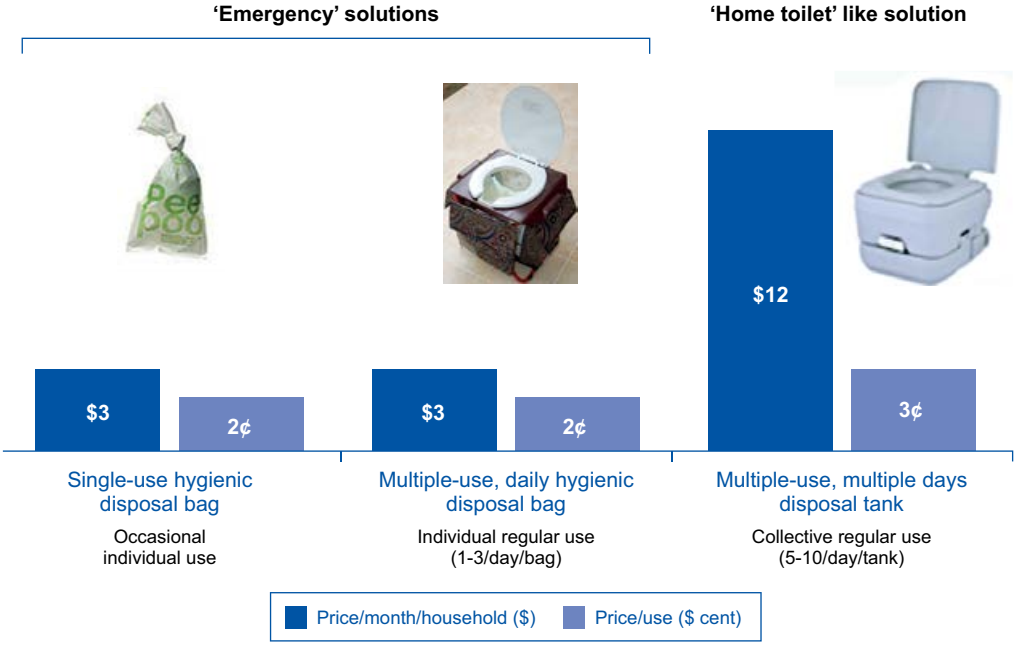
High willingness to pay and word-of-mouth show that these toilets fill in a gap in informal urban settlements

Home mobile toilets accelerate the demand for sanitation solutions in informal urban settlements as they offer attractive, quality products, in a way that is easily accessible for customers. Without such an offer, most households would tend to stick to open defecation and 'flying toilets', a term that describes how slum dwellers are obliged to defecate in bags (for instance at night), which they then throw around. The other alternative is public toilets, which are paying, often poorly managed, and can be unsafe to use after dark.

Contrary to public toilets, households seem to be willing to pay a relatively high service fee, when the mobile toilet design approaches that of a 'modern' toilet, limits malodor and contact with waste, is hygienic, as well as comfortable to use. Some existing pilots manage to charge up to $10-15 in monthly fees, representing 3-6% of the total household income.[9] Families also use the toilet more systematically, including the children, making it a more effective solution in terms of health and hygiene. Households seem less willing to pay (and systematically use) less attractive solutions that look more like 'emergency' devices, such as one-time-use defecation bags available for a few cents and are collected daily. In terms of cost per use however, all solutions are relatively comparable, as shown in the table below.

Another positive sign is that word-of-mouth seems to play an important role in the promotion of the toilets. For instance, in five months Clean Team doubled its penetration in areas where it operates, even with limited sales efforts. SOIL observed that demand outstrips supply in those communities where they are working, as word-of-mouth picks up. The main driver for word-of-mouth is the installation of actual toilets, which creates a buzz among the neighbors.

Range of home mobile toilet solutions



Source: Hystra analysis

9 Target families belong to the BoP but are probably not the poorest families, who in addition to having a lower ability to pay often live in the lowest accessible areas of the slums.

Finally, despite demand seems to be picking up faster in neighborhoods where dwellings have a separate space to install the toilet (e.g. settlements organized in closed compounds with small courtyards, 'better-off' areas where families live in more than one room), some projects manage to gain ground in areas where households live in a 3 by 3m room. Often starting with households that have small children or elderly people, for which the convenience of a home toilet is highly valued.[10]

Some innovation already took place in terms of product design

The cost of 'modern' plastic toilet units is already as low as $80 per piece, and projects are piloting various waste container solutions, ranging from bio-degradable bags to chemical liquid solutions limiting bacterial growth and malodor.

Kids discovering home mobile toilets in Ghana. Credit: Clean Team / WSUP Photo Librairy

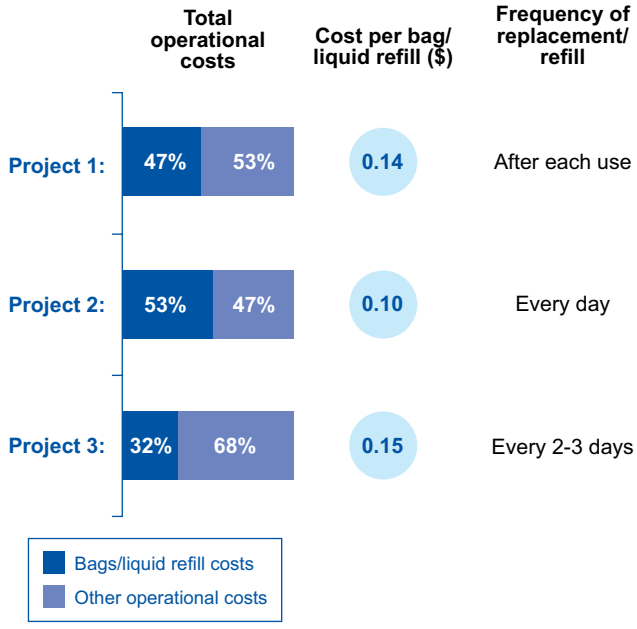
THE CHALLENGES

More product innovation is needed to develop even more hygienic and odorless solutions

The features of existing waste storage solutions (bags or liquid chemical solutions), as well as of the toilet unit itself, should be improved in a number of aspects to ensure faster adoption and financial sustainability:

- Bacterial growth and malodor (especially in warmer temperatures) are the most common reason for users' dissatisfaction; they restrict the market potential to areas where the toilets can be stored outside, and increase the need for more frequent waste collection, which in turn drives operational costs significantly
- The cost of the container bags or liquid refill represent 32% to 47% of total operational costs (actual costs per bag or refill vary between $0.10 and $0.15)
- The bags/containers design also needs to allow optimized waste collection operations (e.g. easier and safer handling and cleaning, lesser weight and volume)
- The design of toilets does not always prevent (physical and/or visual) contact with human waste, which represents a health hazard and also creates disgust with users.

Bags / chemical liquid costs and frequency of replacement/refill



Source: Hystra analysis

10 Some segments of the population may however not be targeted, in particular those families who are very low income, have too limited space, or live in areas that are not sufficiently accessible.

Innovative marketing and sales strategies are needed to accelerate speed of adoption

As home mobile toilets are new solutions, existing projects often rely on word-of-mouth to grow their customer base. While this is a sound approach, it translates into unprofitable operations until a certain level of penetration is achieved, as cost-efficient servicing of toilets requires having a certain density of clients in a given area.

Waste collection operations tend to turn rapidly complex

Waste collection operations employ unskilled people for a poorly regarded job. As a result, recruiting and motivating a large team of local waste collectors is difficult: the job is unattractive (human waste handling, low social status), often part-time (as collection often needs to happen in early hours of the morning) and yet requires regularity, discipline, and a customer service mindset. Existing projects have developed a number of strategies to motivate, manage and retain their waste collectors. For instance, Clean Team made the waste collector position full-time to make it more attractive: waste collectors visit the households in the morning and clean the containers in the afternoon.

A Clean Team waste collector. Credit: Clean Team / WSUP Photo Librairy

Waste collection operations are people intensive: according to existing pilots, a collector can service up to 50 households daily. If the frequency of collection is three times per week, a collector working six days per week can cover 100 different families. Even a mid-scale business would hence need a very large workforce.

Finally, mobile toilet servicing demands transport and logistics in areas with poor infrastructure. Routing and logistics are complex as there are time, storage and accessibility constraints. The collection service often needs to be performed in the few morning hours before users leave for work, as containers may not be left in the street to be picked up later. For instance, in the African pilots, collectors only have 1.5-2 hours in the early morning to do the servicing, which limits the number of households visited to 30-35 a day.

Moreover, finding intermediate storage points (waste is heavy and the collectors need to pile up the waste between batches of customer) in crowded slums can prove extremely challenging.

Lastly, steep and narrow lanes in informal urban settlements are difficult or impossible to access by motorized vehicles.

Cash collection operations are costly, when they need to be performed frequently by a dedicated team

In many countries, waste collectors cannot perform cash collection for issues of trust, status and reliability (the cash collected would represent about 10 times the collectors' revenue). Cash collection needs to be performed frequently enough to cope with the lack of savings discipline often observed among poor urban households (even though projects in other sectors have found ways to create better saving behaviors, e.g., by providing their clients with money boxes). For instance, literate and numerate Clean Team staff collect money at households at least twice a week, making it one of the largest project operational costs.

Home mobile toilet projects can only operate in areas where waste treatment facilities are available

Home mobile toilets are an attractive solution for households not connected to the sewage system. However, the collected waste needs to be brought to a facility where it can be treated and disposed of. The options to do so are few and far between in most developing world cities: a 2012 study on large African cities[11] shows that half of them have no treatment plant and

11 World Bank, Background Paper on Time to Act: Achieving Flood Resilience in African Cities, 2012;

that the remaining half have poorly functioning ones (e.g. Harare in Zimbabwe treats only 5% of its wastewater). And where waste treatment facilities exist, the dumping fees vary widely depending on local policies and infrastructure.

As a result, some projects try to pilot alternative waste treatment schemes, using technologies that allow processing the waste on a smaller, more decentralized scale. This is the case for Peepoo, which developed and patented a hermetic, bio-degradable plastic bag. The Peepoo bag decomposes into compost within a few weeks, without any further treatment required. However, these bags are still very costly to produce: $0.1-0.2 per one-time-use bag.

Home mobile toilet projects require large working capital at scale

Like most businesses, cash will be required in the start-up and growth phases to set up operations and invest into production equipment. However, working capital needs will be even more important at scale, as mobile toilets are rented rather than sold. Assuming a $15 monthly servicing fee and a 15% margin, the payback period of one toilet costing $50 is almost two years. As a result, a social business serving 20,000 households would require about $1m in working capital.

A Clean Team user in Ghana - Source: WSUP

RECOMMENDATIONS

Current home mobile toilet projects show a lot of promise, but face a number of obstacles. To overcome those, we recommend evolving the current models as follows:

- Develop better waste container solutions
- Deploy innovative marketing and sales approaches to accelerate penetration in target areas, and starting operations only when a certain threshold has been reached
- Develop alternative approaches to lower cash collection costs
- Use ICT to optimize and manage sales, cash and waste collection operations at scale
- Include an initial down-payment for new customers to pay at toilet installation
- Start in areas where waste treatment facilities are available
- Establish close coordination with local authorities

Develop better waste container solutions

Finding better waste container design would solve a number of operational and financial issues: lower collection frequency and costs, improve safety and handling for collectors, reduce costs and use of bags and liquids. At the same time, it would drive demand, making the solution more attractive for larger segments of users. Optimized waste container design could also help address the waste treatment issue, if for instance the technology would facilitate waste disposal or processing (as the Peepoo bag does for instance).

The ideal waste container solution would:

- limit malodor for at least three to four days, even in warm/humid environment
- contain 10-15kg of waste, be easy to seal and safe to handle
- likely consist of a bag for easy transport
- be biodegradable to facilitate waste disposal
- contain components that accelerate the decomposition of waste
- be centrally manufactured so that production could be gradually increased without necessitating massive upfront capex investments
- cost less than $0.50 per week (e.g. $0.20 to be replaced two times a week)

Toilet units could also be improved in terms of consumer experience (no visual or physical contact with waste), installation (components should be very few, easy to transport, and require limited assembly), production (centralized and scalable) and costs (target $50 per unit cost to limit working capital needs).

Deploy innovative marketing & sales approaches to accelerate penetration in target areas, and roll out operations only when a certain threshold has been reached

Leverage community dynamics

Using word-of-mouth is an effective strategy to introduce new products and technologies among poorer populations, who are typically averse to taking risks. However, this approach takes time, as speed of adoption is slow when the product is introduced in a new area. In order to accelerate penetration, we recommend building on community dynamics, by engaging local officials and community leaders to convince and refer other households, as well as help organize sales events.

Peepoo has been piloting this approach over the past months, and recorded an important sales increase. Peepoo sales agents organize around 10 to 15 community meetings every month, during which they explain both the basics of hygiene, hand-washing and safe sanitation, and promote Peepoo bags as a hygienic sanitation solution. Around five to ten participants end up buying the product but, more importantly, neighbors are encouraged to discuss the product and agree on how to promote safe sanitation practices in their neighborhood.

Offering community-level benefits is another way to encourage whole neighborhoods to adopt the service. For instance, home mobile toilet projects can offer free toilets to the local school if a sufficient number of households adopt the service. This creates additional incentives to join (e.g. if every household subscribes to the service, it will benefit the children) but also limits dropouts or payment delays once the toilets are installed. The Columbian tile manufacturer Colceramica, which sells construction materials to poor households, offered to provide the local school with free tiles. This significantly improved customer repayment rates.

Sequence sales and start of operations

Given waste collection operations require a relatively high geographical concentration of users to breakeven, toilets should be installed and collection teams deployed only when a minimum penetration threshold has been reached. This constraint can be turned into a marketing strategy. This is for instance what the Fundación Pro Vivienda Social does in Buenos Aires since 2000. Pro Vivienda is a social business providing gas connections to low-income communities. At least 70% of the local community has to register for a gas connection before one is installed for the whole neighborhood. It relies on neighborhood associations to convince potential customers to subscribe to the scheme, by appointing "block promoters" to lead the promotion efforts.

Develop alternative approaches to lower cash collection costs

Mobile money payment facilities

Mobile payments should be envisaged in countries where this practice is widespread. M-Pesa is a widely used Kenyan mobile money service, which has already been used by many social businesses to lower their cash collection costs. For instance, a company called Takamoto Biogas provides Pay-As-You-Go biogas systems: its customers – mainly smallholder farmers – pay a small fee to install the biogas system and then pre-pay using M-Pesa for the gas they use.

Piggybacking other payment platforms or services

Where urban settlements are serviced by larger operators, these can be piggybacked to bundle payments. The Colombian electrical utility Codensa, for example, encourages households to purchase electrical appliances on credit and includes the repayment of loans on their electricity bills. In Mexico City, Barared has developed a private network of service booths located in informal mom-and-pop shops, where customers can do basic financial transactions. In India, FINO PayTech Ltd deploys a network of "business correspondent agents" who provide financial services to remote customers on behalf of a group of banks, insurance companies and public authorities.

Leverage cash collector teams to offer more products and services

In the other cases, we recommend building a dedicated team of cash collectors and use their customer visits to generate additional revenue. Physical cash collection is a costly process. However, cash collectors can create trusted relationships with customers. Therefore, there is an opportunity to leverage these frequent customer visits

to encourage referrals (with incentives such as discounts on the servicing fee, or free hygiene products), and sell a range of hygiene products (e.g. soap, detergent, toilet paper). An example of that is IVDP, a non-profit organization which promotes the creation of Self Help Groups in India. It recently started using its network to promote health products such as water filters and sanitary napkins.

Use ICT to optimize and manage sales, cash and waste collection operations at full scale

Home mobile toilet enterprises are complex projects: they require rolling out large teams that interact frequently with customers, while maintaining a high, consistent quality of customer service. While this may be manageable on a smaller scale, ICT tools will be essential at full scale for:

- **sales and customer management**: to track would-be and actual customers, activities and performance of sales teams, customer profiles and penetration, cash collection operations, customer satisfaction
- **waste management**: to optimize routes and waste collection operations

Living Goods, a social business that uses a network of sales women to sell health products door-to-door in Uganda, successfully adopted ICT to optimize its business operations and impact. It uses a simple mobile phone platform to manage its business in real-time: product sales and inventory, its sales force; branch and agent activity, its marketing strategy; messages on time-bound promotions, and its customer relationships; customer segmentation, loyalty building and customer satisfaction.

Include an initial down-payment for new customers to pay at toilet installation

This down-payment is equivalent to the "connection fee" requested by most utility services. A down-payment helps ensure that only financially viable households will subscribe to the service, firm up client commitment, and acts as an incentive for regular payment (if a household does not pay its servicing fee, it might lose both the toilet and the money invested in the down- payment). Moreover, the down-payment improves the cash flows of the home mobile toilet business. We recommend setting the down-payment amount at about two-months-worth of subscription fee. X-Runner has recently started to include a small up-front "subscription fee" of about $35 (payable either in one or four times). This price was estimated through qualitative assessment of the willingness to pay for sanitation services and X-Runner did not report any drop in demand as a result.

Start in areas where waste treatment facilities are available

The social business should start operations only in those areas where solutions for waste disposal exist, currently this means central treatment plants. It may not be easy to find an appropriate area and treatment performance should be assessed upfront. New solutions will be required to broaden the replication potential of the model. Home mobile toilet projects could hence become a haven for piloting alternative waste treatment schemes (see Part 3: Alternative solutions for waste management).

Establish close coordination with local authorities

In this document, we promote a more commercial approach and set-up. However, local authorities have a critical role to play in supporting the development of such projects. Firstly, local authorities should allow the commercialization of these new sanitation products and solutions, and evolve the regulatory framework accordingly.

Local authorities can also help in the promotion of such a service, participate in the organization of sales events, convince households to subscribe to the service or help recruit cash and waste collectors.

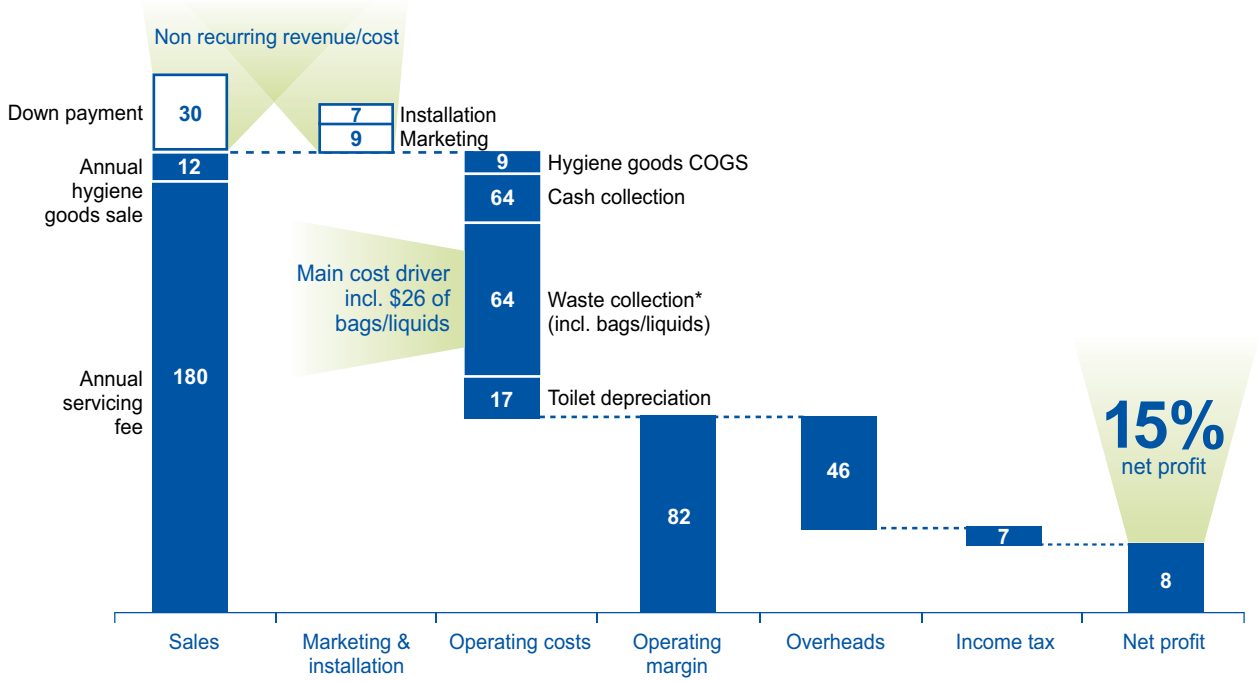
Finally, municipal water and sanitation authorities may further subsidize gate fees for such sanitation businesses. In addition, close coordination will help find more complementary ways of covering areas without sewers.

ECONOMICS AND FUNDING FOR PROPOSED BUSINESS MODEL

An analysis based on data gathered from case studies suggests that a social business renting home mobile toilets in urban areas could be financially sustainable at scale.

A project renting 20,000 home mobile toilets per year, providing access to sanitation to 100,000 people, would generate over $3m of sales and a net profit of 15%.

Profit and Loss for urban project renting 20,000 home mobile toilets per year (USD)



* Waste collection costs include gate fees for treatment at central plant.

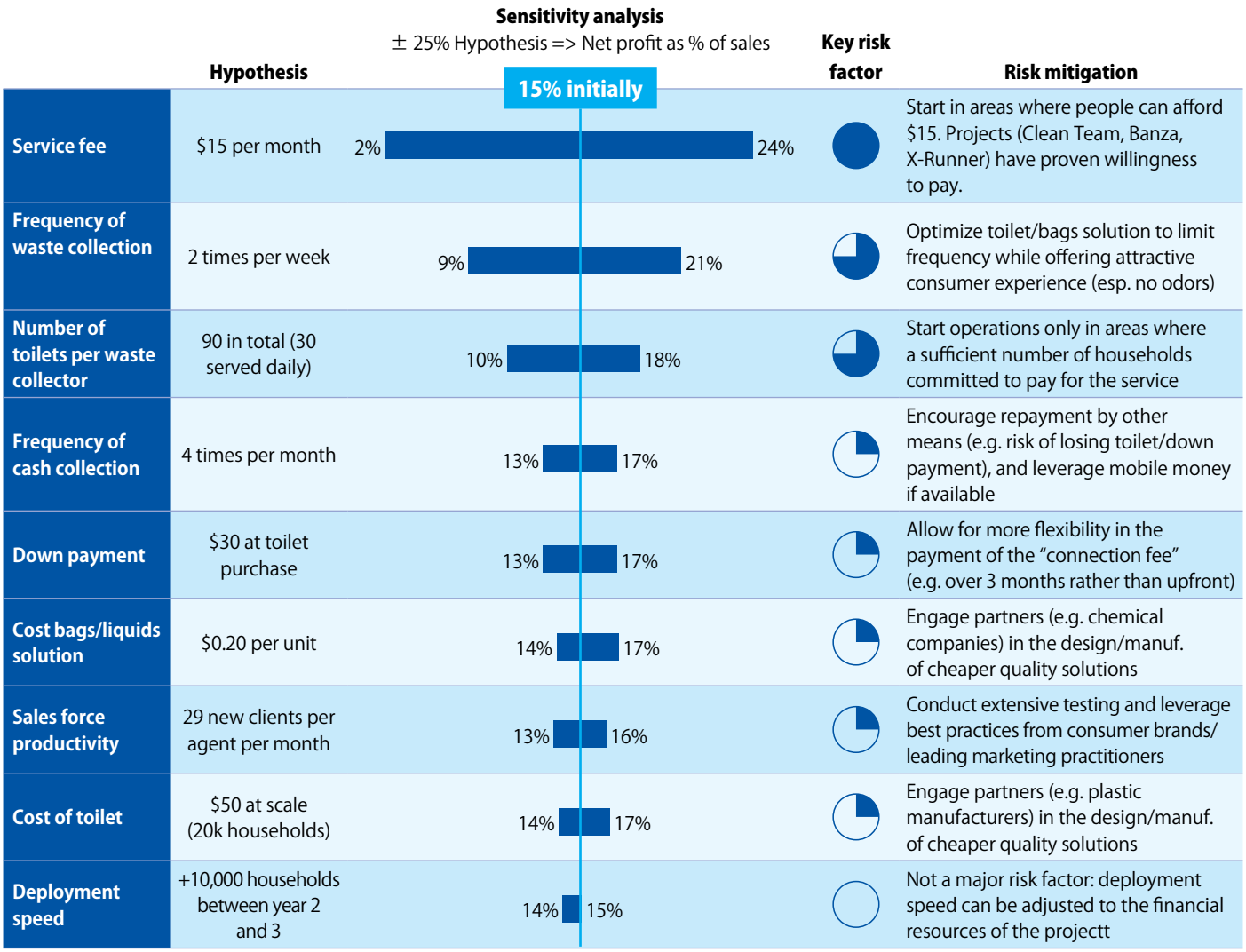
Source: Hystra analysis

A mix of grants, loans and equity will be needed to meet the financing needs of this social business.

The capital required in order to reach such scale would range from $2-3m. In the set up phase, capital for purchasing molds, management team recruitment, consumer research, product development, activity pilot, etc. will ideally be covered with grants and in-kind support for R&D. We estimate that $0.5m would be needed in the first year. In the scale-up phase, capital needs for the deployment of the service at a large scale and working capital requirements will ideally be covered with debt and equity. We estimate that $0.5-1m would be needed for one to two years to reach breakeven at around six thousand home mobile toilets per year, and another $1-1.5m investment would be needed to reach 20,000 home mobile toilets per year.

The key drivers of financial sustainability for such a model are the servicing fee, the frequency of waste collection, and the number of toilets that can be covered by a waste collector in a given area. Under our financial assumptions, the project needs to charge at least $11 a month service fee to be profitable, assuming the frequency of waste collection is two times per week, and each waste collector serves 30 households per day.

Illustrative sensitivity analysis of proposed model



	Hypothesis	Sensitivity analysis ± 25% Hypothesis => Net profit as % of sales	Key risk factor	Risk mitigation
Service fee	$15 per month	2% — 24%		Start in areas where people can afford $15. Projects (Clean Team, Banza, X-Runner) have proven willingness to pay.
Frequency of waste collection	2 times per week	9% — 21%		Optimize toilet/bags solution to limit frequency while offering attractive consumer experience (esp. no odors)
Number of toilets per waste collector	90 in total (30 served daily)	10% — 18%		Start operations only in areas where a sufficient number of households committed to pay for the service
Frequency of cash collection	4 times per month	13% — 17%		Encourage repayment by other means (e.g. risk of losing toilet/down payment), and leverage mobile money if available
Down payment	$30 at toilet purchase	13% — 17%		Allow for more flexibility in the payment of the "connection fee" (e.g. over 3 months rather than upfront)
Cost bags/liquids solution	$0.20 per unit	14% — 17%		Engage partners (e.g. chemical companies) in the design/manuf. of cheaper quality solutions
Sales force productivity	29 new clients per agent per month	13% — 16%		Conduct extensive testing and leverage best practices from consumer brands/ leading marketing practitioners
Cost of toilet	$50 at scale (20k households)	14% — 17%		Engage partners (e.g. plastic manufacturers) in the design/manuf. of cheaper quality solutions
Deployment speed	+10,000 households between year 2 and 3	14% — 15%		Not a major risk factor: deployment speed can be adjusted to the financial resources of the projectt

Source: Hystra analysis

STRATEGIC PARTNERSHIPS WITH CORPORATIONS

The private sector has a major role to play to help refine emerging business models, bring new technologies, products, expertise and assets, as well as invest more resources. Home mobile toilet projects would benefit from partnering with strategic corporate partners:

- Chemical and fragrance companies could be strategic partners to design better biodegradable bags and additives to contain waste. The design and manufacturing of the toilet itself could be improved by involving sanitary equipment manufacturers
- FMCG companies could help leverage their network of cash collectors to sell and distribute hygiene-related products (product selection, training, distribution operations)
- IT companies could help develop management tools to optimize field operations (customer management, sales, logistics)
- Finally, corporate partners could contribute to the success of the social business by helping in the design and implementation of efficient sales and marketing strategies, training the sales force, and creating cutting-edge marketing campaigns.

Human waste composting site in Haïti
Credit: Vic Hinterlang

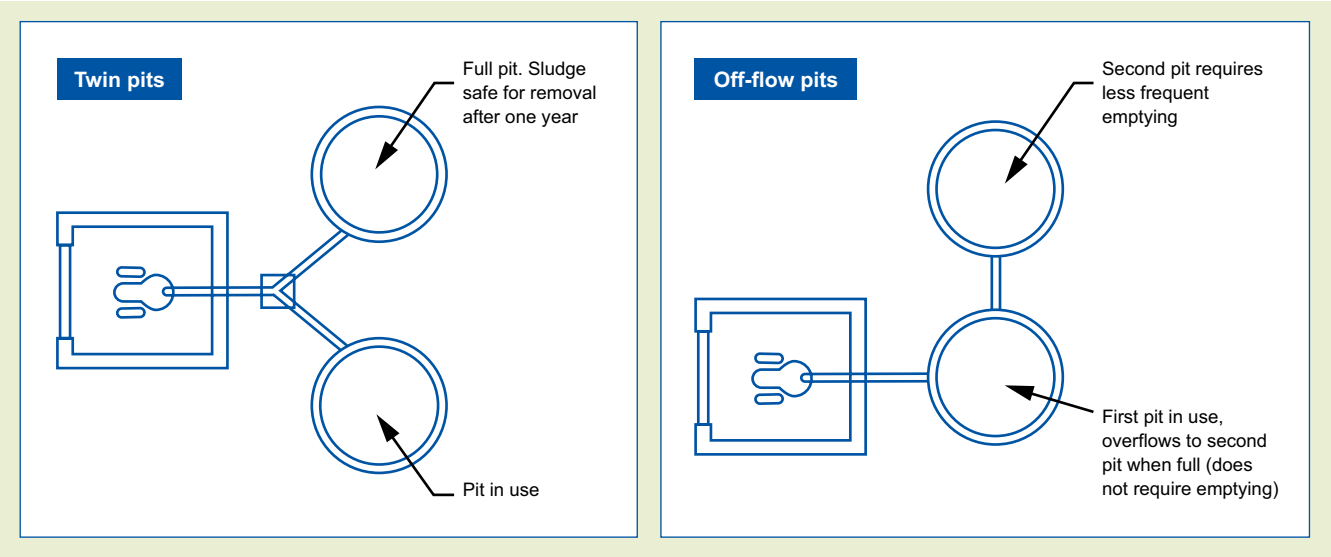
ALTERNATIVE SOLUTIONS FOR WASTE MANAGEMENT

Waste management can be an issue in rural areas, particularly in geographies where one-pit latrines were installed on a massive scale following public or philanthropic programs – which then filled up simultaneously. However, the acuity of the problem depends largely on the soil conditions, which influence the speed at which pits fill up and risk of water table contamination. In some areas, pits take over 10 years to fill up, while in others only two.

Today, there exists no financially sustainable business model that offers pit emptying services in rural areas. There are, however, technical workarounds such as double and off-flow pits.

A more commercial approach to rural sanitation would allow offering better tailored solutions, depending on geographies and preferences of populations. For instance, in the rural model discussed above, 6 ring packages could be proposed, rather than 3 rings, in areas where pits fill up quickly.

Twin pits and off-flow pits to address pit emptying issues in rural areas



Source: www.sswm.info

The waste treatment issue is even more acute in urban areas: open air gutters and lack of functioning waste treatment plants result in massive pollution issues and health risks. Large centralized treatment plants are costly to build and not always managed well enough to be functioning sustainably at full capacity.

For this reason, we looked at smaller, more decentralized alternatives that could be coupled with waste collection schemes, with limited investment and lower operational costs. We looked in particular at technologies that process the waste with a view to capture a by-product with a market value (e.g. fertilizer, biogas, fuel pellets or animal feed). These technologies are promising as the commercialization of the by-products could in turn cover some of the operational costs.

In addition, we looked into bio-toilets, a group of technologies that allow breeding living organisms in compact tanks placed directly under the toilet. These organisms feed on and process the waste with almost no outside intervention, reducing dramatically the need for emptying the tanks, transporting and processing the waste.

WASTE BY-PROCESSING TECHNOLOGIES

Decentralized solutions to create value from waste, although promising, do not yet generate sufficient revenue to pay for waste processing costs, let alone subsidize collection operations

We looked into a wide range of emerging technologies that seek to process waste into by-products. These are often piloted by scientific teams, social businesses or non-profit organizations, thanks in particular to the spur of innovation triggered by the Bill and Melinda Gates Foundation 'Reinvent the Toilet' Challenge.

We looked in particular into the following group of waste by-processing technologies (more details can be found in Appendix 3):

BSF larvae
Source: blacksoldierflyblog.com

Waste into animal feed and biodiesel

Black soldier fly (BSF) processing

The London School of Hygiene and Tropical Medicine has explored the use of BSF larvae in human waste treatment in a project funded by the Gates Foundation. The larvae are fed with human waste and transformed into animal feed and biodiesel. A few projects have emerged from this research, including a promising South African venture called BioCycle, which is now exploring the sustainability potential of BSF processing. The key questions on the sustainability of BSF processing at scale concern the sourcing of fresh waste, need for specific waste properties or conditioning, and the difficulties in breeding fly colonies at scale.

Biodigester
Source: Takamoto Biogas

Waste into gas and fertilizer

Biodigester

Biodigesters are tanks using anaerobic digestion, i.e., degradation of organic matter by bacteria in the absence of oxygen, to transform waste into a digestate that can be used as fertilizer, and biogas. Biodigesters have been used for centuries mostly with animal waste. Projects have started exploring the applicability of this technology for human waste, assuming large volumes of faeces could be collected and transported to the bio-digester. The key questions regarding this technology concern the low value of the by-products and the difficulty in monetizing them: The limited amount of biogas produced can only be used on site and the commercialization of human waste-based fertilizer faces perception and regulatory hurdles.

Composting facilities
Source: X-runner

Waste into fertilizer

Composting

Composting has also been practiced for centuries, although large-scale composting only became widespread in the second part of the 20st century. It consists in the controlled decomposition of organic solid matter carried out by aerobic microorganisms, mainly bacteria and fungi. Fecal waste composting, or mixed composting (e.g. fecal and green waste) can take from a few weeks up to a year depending on temperature and humidity. The by-product can be used as fertilizer. Similarly as for bio-digester by-products, fertilizer from fecal waste composting may face hurdles to commercialization, plus the volume per household is very low while collection costs remain high.

Sludge in transition to granular fuel
Source: waste-enterprisers.com

Waste into fuel pellets

Centralized drying

The centralized processing of human waste into fuel pellets, serving as clean renewable fuel for industry, is an innovative technology that has been developed in particular by Waste Enterprisers, a company launched in Ghana in 2010. Fecal sludge coming from septic tanks/pit latrines is dewatered, dried up in specially designed greenhouse facilities, and as a final step sterilized in a thermal dryer. The output is a fuel in granular form that can then be sold to for combustion in kilns or certain biomass boilers. Granular fuel has multiple advantages: carbon neutral, good calorific value and available all year. However, the financial viability of such a model still needs to be proven, as the technology is investment-intensive, and the installation requires large volumes of waste to be financially sustainable.

Small struvite reactor
Source: Eawag

Urine into fertilizer

Struvite production

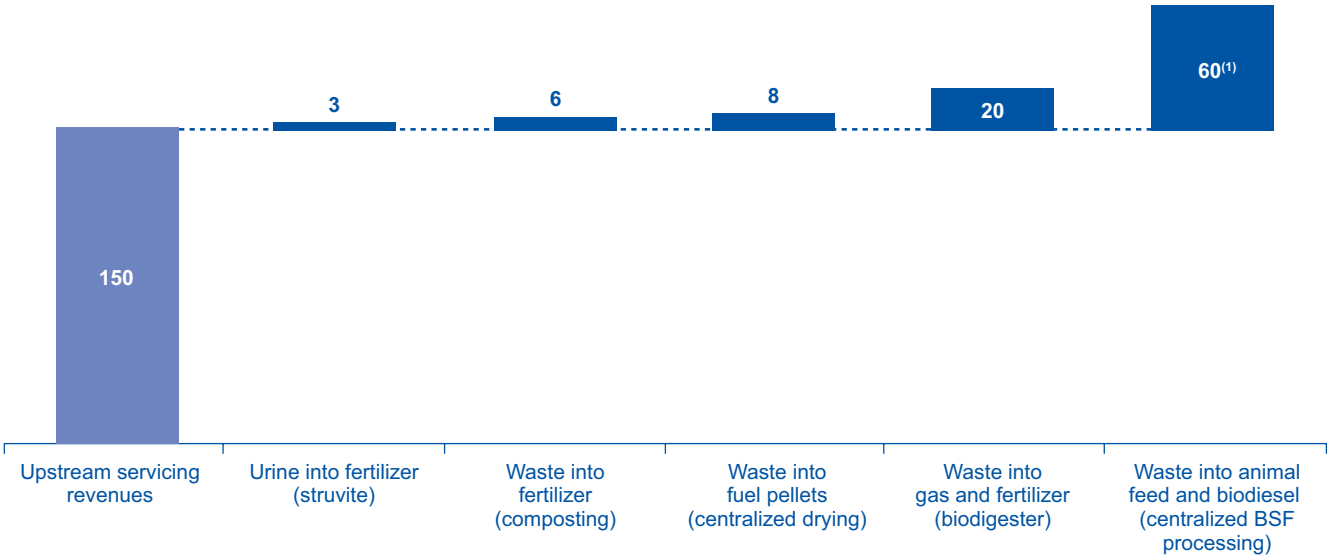
Urine can be used as a valuable fertilizer, either in its original form (one to six months storage is necessary to eliminate remaining pathogens) or after being processed into a nutrient-rich powder called struvite. Struvite has many of the fertilizer properties of urine and several additional advantages: it can be stored and transported easily, it is odorless, and its granulated form is convenient to use. Struvite processing requires a reactor, whereby the reaction is forced by adding magnesium. However, the low prices of struvite compared to the quantity of urine required to obtain it (one kilo of struvite obtained with 500L of urine) dramatically limits the sustainability potential of this technology.

To understand the market potential of these technologies, we focused on the potential revenue that such projects could generate by selling the by-products. We did this by assessing market value of equivalent substances the by-products could replace; e.g. chemical fertilizer for human waste-based compost or wood pellets for fuel pellets made out of human waste.

As illustrated in the graph below, the value of by-products generated from the yearly waste of one household ranges from $3 for struvite (a form of fertilizer based on urine) to $60 for animal feed (made by processing black soldier fly larvae). While the range of values is large, the amounts are relatively low, in light of the revenue a mobile home toilets project could generate per household (around $120-150 a year).

It is difficult to estimate the actual profitability of these technologies as current cost levels are not representative of what these models could achieve with optimized operations at scale. But assuming an optimistic 20% profit margin, this would translate into a modest $0.60 to $12 profit per household per year. Furthermore it would barely cross-subsidize the costs of a waste collection operation such as home mobile toilets (requiring $110 operational costs per household per year).

Value of processed by-products* vs. servicing revenue generated by a home mobile toilet project ($ per household per year)**



* Value based on price of alternatives: animal feed ($1000/ton), biodiesel ($1000/m3), NPK20:10:10 fertilizer ($200/ton), wood pellets ($60/ton), struvite ($500/ton)

** Hystra computations based on yearly inputs of 550kg waste and 2500L urine per household

(1) Interview with Bear Valley Ventures, and Agrawal et al., Assessing the Commercial Viability of BSF as Biodiesel & Animal Feed, University of California Berkeley Haas School of Business, London School of Hygiene and Tropical Medicine, 2011

Source: Hystra analysis

In addition to the poor economics of most of these technologies, many of these by-products face important challenges to commercialization: lack of local markets (e.g. while there is a market for chemical fertilizers, farmers are less inclined to pay for compost), regulatory hurdles (human-based fertilizer for agricultural purpose is forbidden in many countries), or transport issues (e.g. for urine or biogas).

Finally, most of these technologies are still early stage. Their feasibility at scale, both in terms of processing operations and ability to sustainably source large quantities of waste, remains to be seen.

BIO-TOILETS TECHNOLOGIES

Bio-toilets could offer a disruptive solution to the waste problem, as they would address two major bottlenecks in urban sanitation: collection and treatment of human waste

In addition, we looked into bio-toilets, a group of technologies that allow breeding living organisms in compact tanks placed directly under the toilet. These organisms feed on and process the waste with (almost) no outside intervention, reducing dramatically the need for emptying the tanks, transporting and processing the waste.

Hence, bio-toilets could become a public and home toilet solution for informal urban areas that are not connected to sewer and which have the space to install permanent toilets. Bio-toilets could replace in particular traditional pit latrines, where the raw waste needs to be regularly emptied.

We looked in particular into the following variations of this type of technology (more details can be found in Appendix 3):

Source: biotoilet.in

The bacterial bio-toilet technology

The bacterial bio-toilet technology was initially developed by the Indian Defense Research & Development Organization 20 years ago and has been commercialized by over 15 Indian companies for a few years. It allows enhanced anaerobic digestion thanks to the introduction of special pre-bred bacteria in the toilet tank. Once the waste is flushed, it goes through a batch process of several containers. It is thus similar to a regular bio-digester but the pre-bred bacteria allow for a more efficient and complete degradation. The by-product is biogas (in small quantity, vented out) and innocuous wastewater. Different versions exist for households (500-1000L tank, about 2 x 2 x 1 m) and for railway coaches (500L tank, regular maintenance required).

Source: Bear Valley Ventures Ltd

The Tiger Toilet technology

Developed by the London School of Hygiene & Tropical Medicine with a grant from the Gates Foundation, the tiger toilet technology uses tiger worms to process the waste. Once waste is flushed into the toilet tank, the solids are captured on a bedding layer with the worms, and the liquid goes into a drainage layer below. The worms process the solid part of the waste. After treatment in the drainage layer, a safe effluent can be discharged into the soil. The tank is about 1 m in diameter by 1 m high.

Source: biofilcom.org

The Biofil Toilet

Developed by the Ghanaian company Biofilcom in 2007, the biofil toilet uses a combination of micro-organisms – tiger worms, black soldier flies, dung beetles, and cockroaches – in a batched tank to process the waste. The by-product is a liquid effluent. The tank is about one by one by two meters large. Biofilcom also designed a micro-flush system that is combined with a hand-washing station and reuses hand-washing grey water for flushing.

Bio-toilet technologies function in controlled environments

Bio-toilet technologies have been piloted and commercialized in different contexts:

- Bacterial bio-toilets have historically been commercialized as public toilets in Indian trains. These tanks are however different from the household versions as they require regular maintenance. Household bacterial bio-toilets have been developed recently and are still mostly distributed through give-away programs
- Tiger toilets are currently being piloted at small scale in Bangladesh, India, Myanmar, and Uganda in different contexts (urban, semi-urban, rural areas and a humanitarian camp)
- Biofil Toilets have been sold to households and NGOs in Ghana since 2007. Biofil Toilets are also currently piloted in Bangladesh in the informal settlements of Dhaka.

Hence, bio-toilets have been sold as public toilets (to be actively managed and maintained), but scarcely commercialized with households. But presumably, there would be a number of hurdles to offering bio-toilets as home solutions at a large scale:

Effectiveness of biological solutions varies greatly depending on the environment

Living organisms are sensitive to the temperature, humidity, quality and quantity of waste available, chemicals, etc. Further research is needed to understand how bio-toilets would perform in an uncontrolled household environment, in terms of: waste reduction (i.e. how often the tank needs to be emptied), the ability of microorganisms to survive and breed even in case the toilet is not used (or over-used) for longer periods of time, or with the use of cleaning products or other hazardous materials.

High cost of technology

Bio-toilets are an attractive alternative to septic tank toilets, which are typically the solution adopted by better-off families living in areas not connected to the main sewage system and owning their property.

To date, their cost also averages that of septic tank toilets:

- Family-size bacterial bio-toilet tanks cost a minimum of $150 minimum. The total solution including slab, walls, and installation is sold at $500. Companies like Banka BioLoo or Mohan Rail have sold only a few hundreds of these packages, mostly to richer households or small businesses.
- Tiger toilets cost $350, including the tank, a squat toilet with pour-flush and a water seal.
- The Biofil Toilet tanks cost $390. The total solution including walls, washbasin, and installation is sold at around $1,000. Biofilcom has sold 4,000 systems to date, including 2,500 direct household sales, but mostly to the middle-class.

RECOMMENDATIONS

Given the challenge posed by lack of waste management facilities in the world's rapidly developing cities, it is imperative to continue supporting the development of alternative waste management technologies.

In particular, the private sector could play a critical role by engaging their industrial R&D capabilities to:

- Test and improve emerging waste by-processing technologies with the highest potential for commercialization
- Validate the effectiveness of the various technologies in different environments, in terms of waste disposal, safety, and maintenance required
- Reduce the costs of the emerging technologies and solutions, while improving their design

Private sector expertise would also be needed to develop business models to commercialize the most promising technologies to households on a large scale, as well as marketing approaches to address the perception barriers surrounding the use of by-products processed from human waste.

CONCLUSION

Two-fifths of the global population does not have access to a safe and clean toilet. Addressing and resolving sanitation issues can improve health, life expectancy, educational opportunities, environmental quality and developmental progress.

The development community has been playing a major role in fighting the sanitation crisis for the last decade, with many global aid efforts and grant-based projects undertaken by public organizations, NGOs, and donors. Even though these interventions have experienced many successes, especially with regard to large-scale community-led total sanitation projects, they have failed to achieve the MDG target. A shortage of resources has limited the reach of programs dependent on continued grant support. Health benefits were limited because many projects promoted un-improved sanitation facilities. Many latrines also fell rapidly into disuse, as they were not meeting the wants of these populations (in addition to their needs), and for the lack of sustainable value chains.

Achieving MDG targets thus requires the development and growth of commercially sustainable sanitation enterprises. Across the world, several projects have been exploring innovative business models. But these projects need more resources and expertise to reach their full potential. The private sector has a major role to play to improve, develop and scale these commercial endeavors.

More specifically, large corporations can provide expertise and assets that would be essential to this new breed of sanitation entrepreneur. For instance, FMCG companies could share their distribution networks in order to help sanitation businesses distribute hygiene-related products in addition to latrines, and so enhance their source of revenue. Ready-to-assemble furniture companies, construction companies, and low-cost home manufacturers could be strategic partners to design both affordable and aspirational shelters, solving one of the main hurdles to the rural model we described in this Report. Corporates could also help drive sales, by supporting the design of cutting-edge marketing campaigns. Finally, business partners can invest into financially sustainable enterprises, and provide them with the necessary growth capital.

The authors of this Report hope that the involvement of the private sector in bringing these solutions to a large scale, will lead to a change in paradigm among the global sanitation community. By demonstrating that market-based solutions can work and do generate large positive social impact, we hope to inspire and advocate more private sector involvement, but also help evolve practices among the development community, and encourage governments to play an enabling role in having such approaches flourish.

Kids in rural Ghana
Credit: Hystra

APPENDIX 1:
RURAL CASE STUDIES

GRAMALAYA

Project	Gramalaya
Organization	Gramalaya
Geography	Tamil Nadu, India
Areas	Rural areas
Solution	Individual
Date started	1987
Stage	Scape-up
Scale	100,000 toilets (500,000 users)

Gramayala toilet user. Source : www.gramalaya.in

Project description

History of organization

Gramalaya is an Indian organization created in 1987 and dedicated to rural development in Tamil Nadu. It is working on health and hygiene education, latrine construction and safe water supply, in partnership with community-based organizations (CBOs). Since 2005, Gramalaya has adopted a new approach to sanitation: they stopped providing direct subsidies to households, focusing instead on the promotion of sustainable supply chains. Gramalaya itself is mostly grant-funded by local and national governments (e.g. the Ministry of Drinking Water and Sanitation, Government of India) and international NGOs/donors (e.g. Arghyam, Bangalore, WaterAid, Water.org).

Since 2005, Gramalaya had also been looking for financing solutions for households willing to purchase a toilet. They started to offer micro-loans through their network of SHGs. As of December 2007, Gramalaya had loaned nearly $200k, with an average loan of $91 per borrower. The performance of the program gradually improved – from 2004 to 2007, Gramalaya had an average repayment rate of 82%, reaching almost 100% in 2007 thanks to extensive investments into capacity-building and processes/software. Building on this success, Gramalaya decided to create its own financing entity in 2007 named Guardian, a non-banking financial corporation which, thanks to its status, is not required to ensure a minimum of 70% income-generating loans. Guardian gets money from local and governmental banks at 9-14% and lends at 21%.

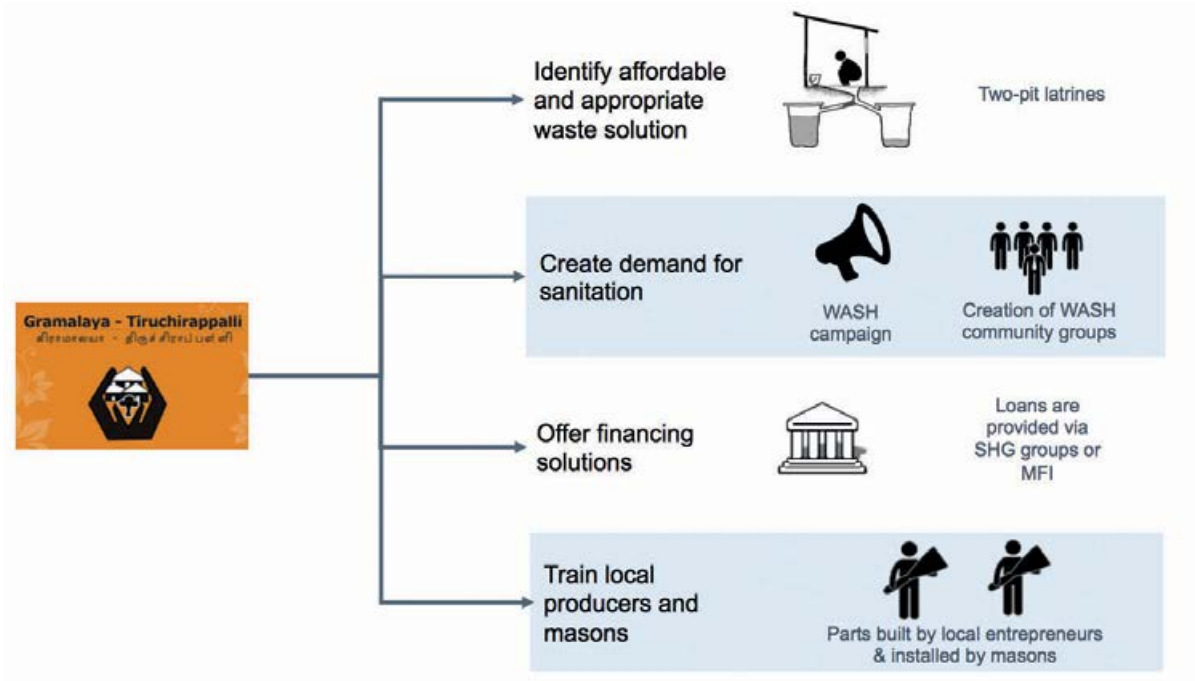
Value proposition and profile of customers

Gramalaya promotes a range of toilet models to households, supports local producers in manufacturing better quality latrines at lower cost, trains masons in installing them, and offers end-user financing. From 2005 to 2010, Gramalaya mainly promoted single-pit latrine packages ($150 including shelter), twin-pit latrine packages ($200 including shelter), and Ecosan composting latrine packages ($250 including shelter), as well as septic tank packages ($500 including shelter). Today they mostly promote the twin-pit model. Households can pay upfront, take out a loan through Guardian, or borrow from SHGs (Self-Help Groups[12]). Guardian restricts its loans to married women who own their house. It verifies that each borrower spends the loan on sanitation within the first month after disbursal.

Before purchasing latrines, most customers practiced open defecation. In a typical village, less than 5% of people already have a toilet, 5-10% are able to purchase a toilet upfront, 50-70% will borrow money to purchase one, and 20-40% ultra-poor will not have enough space or be able to borrow for a toilet.

12 SHGs are savings groups of up to 20 women. SHGs can become eligible to receive external funding from commercial banks. Historically, Gramalaya has been promoting SHGs (over 4k since inception).

Value chain



Marketing & sales strategy and organization

Gramalaya is active in every village for a period of 1-2 years. They start with awareness-raising activities through Community Health Workers (CHWs) organizing village events and going door-to-door. In the first two months in a village, the CHWs promote the creation of AWASH[13] (Associations for Water, Sanitation and Hygiene) among villagers. These committees take over the promotion and monitoring of toilet usage within their community. The CHWs survey the sanitary conditions of households and measure the demand for toilets. Then, after drafting a list of households that would require a loan to build toilets, they involve Guardian's credit officers.

Financing

- Upfront payment (5-10% of village population): Typically some of the wealthier households.
- Loans from Guardian (30-40% of village population): Gramalaya shares the demand assessment with Guardian who then provide loans to eligible households. Only 10 loans are provided in each village during the first three months of activity, to test the repayment capacity of the villagers. Guardian restricts its loans to women under 55 who own their house and belong to a Joint Liability Group[14]. Guardian also assesses the cost of construction and provides a list of materials.
- Loans from SHGs (20-30% of village population): Households that are not eligible for loans from Guardian can rely on women SHGs to obtain loans for toilet construction. These loans are issued from SHG members' savings.

Manufacturing

After Gramalaya promotion, households interested in toilets ask a local entrepreneur to build the necessary parts for the construction of toilets (slabs and cement rings). An entrepreneur typically covers 10 villages and is referred either by Gramalaya or the local village masons (who have been trained by Gramalaya in most cases). Most entrepreneurs are pre-established small producers who already make slabs for doors and windows. Gramalaya trains them to construct quality slabs, adapted to local demand (e.g. twin pit latrines), and encourages them to make the necessary investments.

Installation

Households purchase construction materials themselves from the local entrepreneur and retail stores. A mason trained by Gramalaya staff handles the building of the latrine, assisted by an unskilled worker or a member of the household. There can be up to 5 such masons in every village of some 200 households.

13 AWASH committees promoted by Gramalaya are non-profit organizations of voluntary members, focused on sanitation and hygiene. They promote and monitor usage of sanitation in their community, and Gramalaya trains them to continue doing so even after it leaves the village. Over 500 such committees have been formed since 2005.

14 JLGs are informal groups of 4 to 5 individuals who agree to share liability on loans taken out by members, thus offering collateral to credit institutions such as Guardian, which only loans to members of JLGs.

Payment collection by Guardian

The leader of the JLG does the monthly collection of payments and then hands it over to the Credit Officer from Guardian. Late repayments are first handled by CHWs, then Credit Officers Guardian writes off 3 to 4% of loans on average.

Usage and hygiene

Gramalaya's strategy is to spur the emergence and monitor the progress of AWASH committees dedicated to the promotion and sustainable usage of sanitation and toilets. AWASH committees promote both the toilets and good hygiene practices.

Maintenance and cleaning

Households clean the toilets themselves. There is very little maintenance needed. There is no guarantee offered on the toilets.

Waste storage and collection:

- Single-pit toilets fill up typically after 7 to 10 years. They must be emptied manually or by waste-collecting trucks before they can be refilled again, which few households did. As some users were going back to open defecation, Gramalaya has gradually stopped promoting single-pit toilets.
- Twin-pit toilets allow switching pits when one is full. After 2 years, the full pit can be manually emptied and the pathogen-free and nutrient-rich humus used for soil amendment and fertilizing.
- Ecosan toilets feces are composted in vaults and then used as a fertilizer. Urine can be infiltrated in the ground or collected for fertilizing.

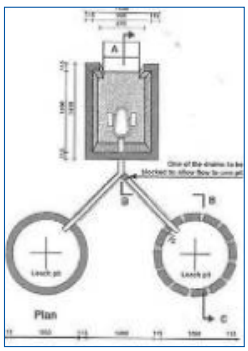
Waste treatment, disposal and recovery: Twin-pit and Ecosan toilets allow composting of waste and use as fertilizer.

Technology

Description of toilet-related technology

The two main technologies currently promoted by Gramalaya are:

1. Twin-pit toilets

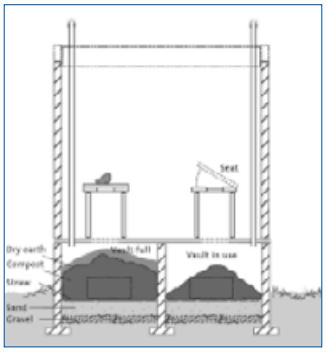


Source: www.goodcleantech.pcmag.com

Key features:

- Cost: ~$200 for a brick model including toilet shelter.
- Design: A concrete or brick cabin is equipped with a cement slab, which includes a squatting pad and water trap. PVC pipes link the slab to two identical pits, 1 meter in diameter and 1.5 meter in depth. These can be made of stonework, honeycomb brickwork or perforated concrete rings to allow infiltration of liquids into the ground. The United Nations Development Program (UNDP) designed the model promoted by Gramalaya.
- Durability: Circular pits are unlikely to collapse when well built. One household can use a two-pit latrine for decades by rotating from pit to pit.
- Water and energy efficiency: One bucket of water (1.5 to 2L) is required per flush. No energy required.
- Malodors and safety: The water trap prevents odors from escaping the pit and flies and mosquitoes from entering it. There is no direct contact with excrements and very little risk of contamination. To avoid any groundwater pollution, pits should be dug a safe distance from water sources, and only in regions where water tables are low enough and where floods are uncommon.
- Waste storage: Once the first pit is filled, it is sealed and left to compost, while the flow of excrements is redirected to the second pit by a connecting chamber.
- Waste collection: After composting, the pit must be opened and manually emptied. The composted humus can be used as organic fertilizer.
- Potential and limitations: Twin-pit latrines are a relatively cheap and reliable way to treat excrement. However they do require some investment and materials along with some space. They can be ill adapted to certain soil structures. End-consumers also need to be convinced of the necessity to build an extra pit, which won't be used before 7 to 10 years.

2. Ecosan toilets



Source: www.unesco.org/education/fresh

Key features:

- Cost: ~$180 including toilet shelter
- Design: Ecosan toilets are waterless composting toilets, made of a toilet shelter built above two slabs covering twin vaults. Each vault is used alternately: when one is filled, the slab hole is plugged and the excrement is left to compost. Urine is diverted to a reservoir where it is infiltrated into the ground or used as fertilizer. Anal cleansing water is collected and infiltrated into the ground through a separate circuit.
- Durability: When well built and maintained, these structures can potentially last decades and resist floods.
- Water and energy efficiency: Ecosan toilets require no flushing and no energy.
- Malodors and safety: In order to prevent malodor, vaults must be equipped with a ventilation pipe reaching out over the top of the structure. The end of the pipe is covered in mesh wire to prevent insects from entering the vault. Additives such as ash or sawdust must be added after each use. Fully composted excrements can be considered pathogen-free.
- Waste storage: Urine is stored or drained using a mud pot. The feces is collected in the vaults and undergoes aerobic treatment to become fertilizer. Once it is filled after 3 to 4 years, the vault is left to compost.
- Waste collection: After composting, a door on the side of the vault is opened and the vault is emptied.
- Potential and limitations: This aboveground technology is ideal for areas with high water tables, frequent droughts or rocky terrain. Its waterless functioning also makes it well adapted to places where water is scarce. However, the absence of flushing and water seal may also be perceived as less convenient and be a barrier to adoption by customers.

Social impact

- Penetration: Since 1987, Gramalaya has built over 100,000 toilets in over 1,000 villages. In a typical 150-household village, only 2 to 10 households are initially equipped with latrines. The first 10 latrines are quite difficult to sell (typically requires a 2-3 months period). AWASH committee members are often the early adopters, and within 4 to 5 months demand starts picking up. After 12 months, over 50% of the households are equipped. Maximum penetration (up to 90%) can sometimes be reached in less than 2 years.
- Acceptance and usage: Out of the 100k latrines by Gramalaya, 30% are out of use, most of which are single-pit toilets, which were built thanks to subsidies. Now that households are paying for the installation, they maintain the toilets much better than when subsidized.
- Customer satisfaction: Gramalaya runs a baseline user survey in every prospective area. The same survey is run 3 years later to assess the impact of toilets on health and behaviors, both quantitatively and qualitatively. Satisfaction among toilet-owners reaches over 90%.
- Evidence of impact on health: A report by WaterAid and Gramalaya[15] found that significant impacts have been observed on the incidence of diarrhea (up to 63% less in some communities), along with subsequent reduction in medical expenses.
- Promotion of related behaviors: AWASH Committees ensure the promotion of general hygiene in villages.
- Waste collection and disposal strategy: Both Ecosan and twin-pit models offer effective and clean disposal of waste. Gramalaya is now promoting these specific technologies.

Economic sustainability

End consumers

- Affordability for end users: The Ecosan or twin-pit toilets costs around 5-10% of the annual household income, which explains why only 5-10% of village households are able to purchase a toilet upfront. The vast majority requires financing solutions.
- End consumer financing: for the construction of a new toilet, Guardian loans a fixed amount of $160 at a 21% diminishing interest rate, over 18 monthly payments. It also charges a 1% loan processing fee and a $1.6 charge for insurance and administrative cost. The Indian government has been providing subsidies for individual toilet construction, which can influence households' ability to borrow or repay[16].

Organization

- Gramalaya: is mostly supported by local and national governments (e.g. the Ministry of Drinking Water and Sanitation, Government of India) and international NGOs/ donors (e.g. Arghyam, Bangalore, WaterAid, Water.org). The program costs are approximately $10 per latrine.
- Guardian: has made more than 30,000 loans for toilets to date, with a 96% repayment rate. It has reached

15 Tiruchirappalli Shows the Way, Community-Municipal Corporation-NGO Partnership for City-wide Pro-poor Slums' Infrastructure Improvement, WaterAid India, September 2008

16 The Indian government provides subsidies for the construction of individual toilets through the "Nirmal Bharat Abhiyan" (Total Sanitation Campaign). The NBA subsidy amounts to $75, with an added $15 for the poorest citizens. The National Rural Employment Guarantee Scheme (NREGS) also provides a subsidy of $72 for labor costs. It should be noted that authorities are increasingly providing direct transfer of subsidies to households after completion of installation, allowing more flexibility in design and costs and the emergence of competitive value chains.

breakeven, although its financial sustainability relies on demand creation and customer identification operated and funded by Gramalaya.

- Staff: Gramalaya employs 12 people for management and administration at its headquarters, and 50 Community Health Workers (CHWs) in the field, mainly in charge of training and monitoring AWASH committees, local producers and masons. Each CHW can start up, train and open bank accounts for 20 AWASH committees per year. As it takes committees 1-2 years to become autonomous, one CHW can follow up to 40 different committees simultaneously.
- Local producers: are independent entrepreneurs who receive training from Gramalaya. To manufacture toilet parts, established local producers only need to purchase iron or wood molds for about $300. They make a 10-15 % margin on components, roughly $15 per toilet. The construction itself lasts 3 to 4 days, with the mason making about $8 a day, and the unskilled worker $3 a day. There are over 100 such entrepreneurs active today.
- Local masons: Masons are also trained by Gramalaya to install latrine components, and paid around $8 per day. Over 1,000 masons have been trained to date.
- AWASH committees and other CBOs: Their 20 members are equally divided between men and women, and usually include social health workers, school teachers, as well as a minimum of two masons. They are all volunteers.

Innovations

- Promoting a dedicated microfinance institution: Gramalaya promoted Guardian, the first MFI to focus exclusively on water and sanitation. This enabled transitioning to a more sustainable model without direct household subsidies. Guardian is currently on the right path to sustainability, even though it relies on demand creation efforts by Gramalaya which are fully grant-based.
- "Aspirational" marketing: Gramalaya's approach has evolved from using a 'peer pressure' based approach to a more aspirational model. By promoting quality models which can be customized in terms of design and decoration, Gramalaya allows toilets to become a more desirable investment. According to Gramalaya, customers prove more satisfied than under the previous subsidy-based model where they often ended-up with poor quality toilets not meeting expectations.

Remaining hurdles and bottlenecks

- Ensuring long-term usage: out of 100,000 toilets built by Gramalaya, only 70% are still in use. A primary challenge to long-term usage is durability. Most derelict toilets are old, overflowing single-pit models. Gramalaya expects to improve usage rates by promoting twin-pit and eco-san models instead. Another challenge has to do with Gramalaya's exit stategy: after 1-2 years of monitoring and intervention, Gramalaya leaves the market and AWASH committees take over the monitoring of sanitation activities in the village; it will be a key challenge to ensure that these community-based structures remain active after a few years without support or monitoring.
- Coordinating with government subsidy schemes: distribution of new subsidies for toilet construction may be implemented in the coming years by the state administration of Tamil Nadu. This could help Gramalaya reach a higher proportion of households in each village. Since subsidies would only be granted a minimum of 3 months after construction, loans from Guardian would still be required but for a shorter period of time, which could undermine the profitability of its lending activities.
- Finding sustainable growth channels for Gramalaya as an NGO: Contrary to Guardian, Gramalaya still relies mainly on grant funding, which limits its ability to grow. Guardian's profits could not be used to finance Gramalaya under the current regulatory framework.
- Guardian's challenges: Guardian is facing its own challenges, especially to reduce its operating costs and attract commercial funding. And as Guardian's growth increases much faster than Gramalaya's, it will need to extend its activities beyond the areas where the latter is operating. The MFI will need to prove its ability to be sustainable without strong grant-funded support in the demand creation phase, or find new partners to scale up.

Contact information

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Appendix

Sources: Interviews with Mr Damodaran, Founder and Director, Gramalaya (December 2013), Mr Elangovan, Executive Director, Gramalaya (December 2013); Mrs Geetha, Advisor, Gramalaya (December 2013); and Mr Sathianathan, Chief Executive Officer, Guardian (December 2013);

www.gramalaya.in; www.guardianmfi.org; www.acumen.org/investment/guardian

Andrew Barenberg, Microfinance for water and sanitation: A case study from Tiruchirappalli, India, 2009

Sophie Trémolet, Evaluating the potential of microfinance for sanitation in India, 2013

Market Led Approach to Rural Sanitation, Monitor Inclusive Markets, 2013

Exchange rate: 1 USD = 60 INR

IDE CAMBODIA

Project	SanMark
Organization	iDE
Geography	Cambodia
Areas	Rural
Solution	Individual
Date started	2008
Stage	International scale-up
Scale	~80,000 latrines sold directly, ~380,000 users

Installation of an iDE 'Easy Latrine'. Source : IDE Cambodia

Project description

History of organization

iDE is an international NGO which started its sanitation operations in Cambodia in 2008. After conducting an initial market assessment, it piloted a new latrine design in 2 provinces, the 'Easy Latrine'. In 2009-2011, it refined its road-to-market approach, leveraging local concrete manufacturers to produce and sell 12,000 latrines. In 2011, with technical support from the Water and Sanitation Program of the World Bank, the Bill and Melinda Gates Foundation and the Stone Family Foundation financed a 3-year scale-up program in Cambodia. To date, iDE has expanded the sanitation marketing approach to a number of countries including Bangladesh, Nepal, Zambia, Vietnam, and Ethiopia.

iDE is now focusing on ensuring an efficient supply of latrines, and offering consumer credit (notably thanks to partnerships with two local MFIs). In 2014, it will explore the possibility of introducing smart subsidies to target the poorest. iDE is currently active in 7 of the 21 rural provinces across Cambodia (52 districts in total), where it also runs programs in agriculture extension and clean drinking water.

Value proposition and profile of customers

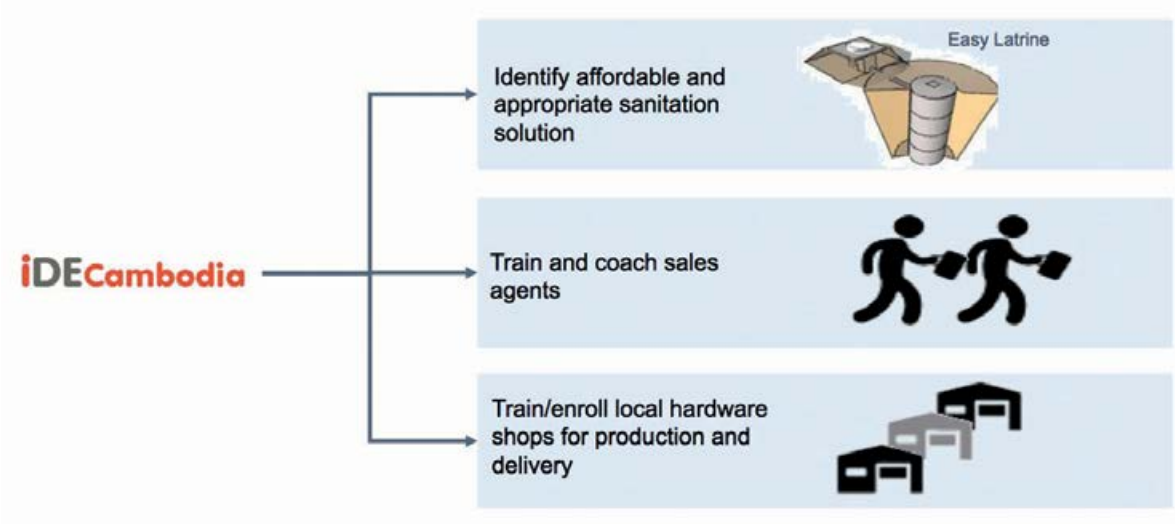
iDE acts as a market facilitator to help commercialize the 'Easy Latrine' through a network of latrine manufacturers and sales agents, at a retail price ranging from $40 to 55. This is roughly 20-30% cheaper than a latrine made on the spot by a local mason, sourcing materials from a number of sources. The Easy Latrine uses thinner rings, removable inner molds (accelerating ring production), drier concrete mix (using rice husk ash) and includes a prefabricated chamber box (cheaper than brick and mortar hand-made constructions). The end product is an easy-to-install, modular, aspirational product for rural households, delivered to their door step. iDE is also currently field-testing an aspirational shelter product.

Hence, iDE promotes a product that presents a number of advantages over alternative solutions. The latrine is:

- easy to build (do-it-yourself, without the help of a mason)
- easy to buy (one-stop-shop, affordable, delivered at home)
- easy to use (pour-flush latrine with ceramic slab, easy to switch to second offset pit and can be combined with different shelters)

iDE works in villages where the population lives mostly off farming. In rural Cambodia, open defecation is prevalent (63% national average) with wide variations between areas. According to anecdotal evidence of one area where iDE operate, monthly household net cash income would approximately range from ~25-30$ for the 20% most vulnerable without much or any land, to $50-75 for the 50% of families cultivating their own plots, and >$75-100 for those 20% families who have a member earning cash income. Across the 7 project provinces, 16% of iDE customers are categorized as poor to very poor on average.

Value chain



Manufacturing

iDE works with existing local hardware shops that sell construction materials and have experience with construction and concrete production, including concrete rings. To identify such businesses, iDE invites local shops at provincial information events. Interested candidates for the program need to fulfill a number of criteria before they can join. These include: current capacity in or willingness to invest in molds, labor, land and transport. In addition to this, selected producers must own a truck to do the deliveries. Once selected, businesses receive intensive training and coaching (3.5 days/week for 3 months) on how to ensure reliable and fast delivery of orders and how to market their products via sales agents. A key part of the training includes technical training geared towards improving their production processes. Once the producer is enrolled, iDE's Monitoring & Evaluation team visits each entrepreneur every two weeks to record their sales. This team also does spot tracking to ensure accuracy of data.

iDE counted ~120 active producers as of end 2013, of which ~110 would sell more than 100 latrines a year. In 2012, it started phasing out the less active manufacturers (i.e. producing less than 12 latrines/month) to focus operations and improve supply, resulting in 30% more turnover among them every year. There are in average 2-3 producers per district (i.e. each of them covers typically ~25 villages).

iDE initially tried to leverage the producers to promote the latrines, however this proved difficult as few of them were willing and able to manage mobile sales agents – as they were mostly used to running a small production operation, waiting for customers to come and order. As a result, iDE started engaging more actively with independent sales agents.

The producers' network is managed by iDE Business Development Counselors (BDC). BDCs maintain limited relationships with manufacturers—which are few and have little incentives to develop the more committed or able suppliers further—as they are heavily incentivized on sales (therefore focusing on coaching their sales agents) since iDE shifted the focus away from developing manufacturers to drive sales.

BDCs have a university degree in marketing, business management or other relevant areas, combined with over three years work experience. To be considered, they must have a motorcycle and mobile phone for daily travel within their assigned area.

Marketing & sales strategy and organization

Sales agents are independent entrepreneurs or local officials who sell latrines on commission. To identify potential sales agents, iDE advertises a position through word-of-mouth and gathers recommendations from local authorities. Producers are given the opportunity to participate in the selection process, though few choose to. The vast majority of sales agents are linked directly with a specific producer, unless they are able to cover larger areas. Their sales are also recorded and independently verified. Out of the 400 sales agents attached to the ~130 active latrine manufacturers in 2013, iDE counted ~130 active sales agents (or about 1 per latrine producer, covering about 25 villages), on which it focuses most of its support.

Sales agents conduct direct sales through either group sales meetings or door-to-door sales. For group sales meetings, the sales agent usually enlists the support of the village chief to help mobilize 15-30 villagers. The village chief usually receives

$0.5 for his efforts. Usually 3-5 villagers decide to buy out of the group. Close rates significantly increase when credit is offered. In a randomized controlled trial, iDE found that credit increases sales by 400%. After a group sales meeting, sales agents often follow-up with those who did not buy or did not come through door-to-door sales. iDE has tested radio marketing campaigns in the past, but stopped doing it as it found that below-the-line activities were more effective.

During the 30 minute group sales presentation, the sales agent uses a 'site seller', a selling tool that is a bound set of posters to help them remember the talking points. The sales agent often invites testimonials from existing latrine owners, seek to create shame and dissatisfaction with open defecation, and finally promote the latrines. The selling is based on the CLEARTM methodology. It is a human-centered approach and stands for Connect – Learn – Educate – Ask - Resolve. Rather than merely selling the product, they seek to understand the problems the audience is facing and position the product as a solution to those problems.

Once the sale is made, the sales agent transmits the order to the producer. The sales agent's commission is paid directly by the producers.

The sales agents are managed by iDE Business Development Coordinators (BDCs), who train and coach them. BDCs receive training by senior management and Regional Managers through in-classroom training and in-field coaching. BDC's remuneration is based on a high share of variables – mostly linked to sales level. As a result, they may tend to focus on the best sales agents in their pool.

Installation

Delivery is usually organized by the latrine producers and included in the price. The model for the latrine installation varies. Some latrine producers partner with local masons and coordinate delivery and installation; others use their own in-house laborers, but this reduces time available for production. When installation is not provided, households have the choice between doing it themselves (based on easy-to-understand instructions), or call for the services of a local mason. While few masons knew how to install the latrine properly at the start of the program, this issue is gradually improving as the Easy Latrine becomes more mainstream.

Cash/payment collection

For clients buying cash, it is collected upon delivery. For 9 months, iDE has been collaborating with 2 local MFIs (Vision Fund, Kredit) in 2 provinces. In this case, loan repayment collection is done by MFI credit officers. However, branch repayments do not seem to be a viable option and demand increases when repayments can be made locally. Hence, the MFIs increasingly rely on village officials to do the cash collection.

Maintenance and cleaning

No maintenance is required. Cleaning is made easy as the slabs are covered with tiles, rather than cement.

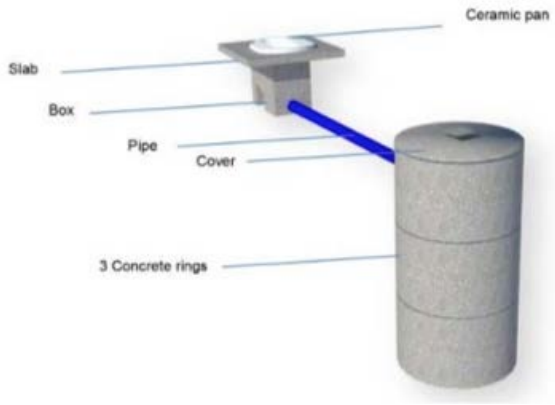
Waste storage and collection

Most households buy 3 rings (up to 4 if large family). The average pit depth is 1.2 m. An off-set pit can easily be added to the latrine design.

Waste treatment, disposal and recovery

Given the quality of the soil, pit latrines fill up slowly (7-10 years). When full, the owners typically empty the latrine themselves manually and spread the waste onto their fields (hiring specialized labor costs ~$40, i.e. the cost of the latrine). iDE is currently looking into using lime as a way to treat the waste for hygienic household handling.

Technology



One-pit Easy Latrine model

Description of toilet-related technology

Key features:

- Cost: The toilet production cost is estimated at ~$30.
- Design: The latrines include a squat pan, a chamber box with a PVC pipe connected to 3 concrete stacked pits. The design was supported by IDEO. All elements, except the pipe and slab are made of concrete. The slab is covered

with ceramic tiles and includes an imported ceramic pan.

- Durability: Ranges depending on number of users and soil conditions, but field experience shows up to 20 years.
- Water and energy efficiency: Pour-flush toilets (1.5-3 liters per flush).
- Malodors and safety: Malodor and safety issues are very limited, given the design of the slab and use of the goose neck, which ensures a water seal and reduces smells.
- Waste storage: Waste is stored in the pit. Given the nature of the soil, the rings are not cemented, and waste is slowly filtered in the ground.
- Potential and limitations: Most customers perceive that the latrine itself is only a part of the toilet, and invest considerable sums for a concrete shelter. iDE is exploring the possibility of developing low-cost, pre-fabricated concrete shelters.

Social impact

- Scale and penetration: From the beginning of the scale-up program in 2011, iDE facilitated the sale of over 80,000 toilets, serving an estimated 380,000 people in 3,300 villages. This translates into a penetration rate of ~ 12% in the project provinces (for latrines installed by iDE supported manufacturers), or an actual pour-flush latrine coverage of 22% to 57% (with an average 37%), when taking into account existing latrines. Penetration rates have picked up dramatically since 2009: about 1% a year in 2010, 3% in 2012, and 7% in 2013. The team estimates that the maximum additional penetration it could drive per year hovers around 13%. In addition to the sales made by businesses trained by iDE, iDE noticed that the market experienced a growth of activity via businesses joining the latrine market without any training by iDE. Today, iDE has measured a 'leverage ratio' of 1:1 on average across its area of operation. This means that for every latrine sold by an iDE-trained business, another latrine is sold by a non-iDE trained business who likely decided to join the market due to observations of its profitability.The current sales rate is of 7500 latrines/ month. iDE estimates it will plateau at around 8000 given the current level of resources deployed.
- Acceptance and usage: Most customers were practicing open defecation before buying their latrine. The program allowed them to access a quality, off-the-shelf product, delivered to their door step, 30% cheaper than using the services of a mason. However, only 58% of latrines were installed 6 to 9 months after purchase. iDE believes that this delay is due to a variety of factors, including the lack of a packaged shelter product and its financing (iDE has plans to develop both aspects). In addition, the MFI pilot showed that financing the latrine shelter would likely increase installation and adoption rates.
- Customer satisfaction: Satisfaction is assessed through focus group discussions. The main object of complaint is the lack of installation services.
- Evidence of impact on health: N/A
- Promotion of related behaviors: Hygiene and hand-washing are not actively promoted. However, iDE is exploring the possibility of combining its household water filter promotion program with its sanitation activities. It is also developing a hand-washing device.
- Waste collection and disposal strategy: iDE is exploring the use of hydrated lime to make household waste collection more hygienic.

Economic sustainability

End consumers

- Affordability for consumers: The observed latrine price is $40-55, to which an optimal $10-20 is added for digging and sometimes installation. The biggest expense though comes with building the shelter (>$200), as 80% of families prefer a concrete one. In the areas where iDE operates, the latrine price corresponds to 0.5-2 month cash income for a family. Rural sanitation seems to be an 'all or nothing game' in Cambodia. Households choose between open defecation and improved sanitation (with a durable shelter). Very few households go for an intermediary step of 'unimproved sanitation'.
- End consumer financing: iDE is piloting sales with consumer credit in two provinces, in partnership with two local MFIs. Cumulative sales done through MFIs amounted to ~2000 latrines from January to November 2013. The MFIs provide 4 to 12-months, group-liability and individual loans for the latrine itself, with a 2.6-2.8% monthly interest rate. MFIs require a $4.5 non-refundable down-payment from customers. The loan amount is paid directly to the latrine manufacturer by the MFI. iDE also experimented with offering a shelter loan, but this was discontinued for a variety of reasons, the main one being that no packaged shelter was then existent.

In a randomized controlled trial, when offered credit at sales events, uptake increased by 400% (i.e. close to 50% of villagers attending the sales event decide to purchase a latrine), pointing at the fact that credit is a way to have households prioritize some expenses when the 'opportunity to borrow and buy' is there. The 'one-time-offer' factor also explains some of the increase in sales, again driven by the same opportunistic nature of the purchase. As a result, the sale/credit offer needs to be closed shortly after the household expresses interest, for risk of losing many initial commitments. Interestingly, credit sales do not 'cannibalize'

cash sales, as households prefer not contracting debts if they do not have to.

On the other hand, the MFIs' operating costs decreased dramatically as field operations improved (down to 1-3% of gross loan portfolio). MFIs recorded no defaults or very late payments. The majority of clients were new (60-80%), making sanitation a good source of customer acquisition.

Last but not least, for iDE, financing decreased marketing and sales cost per latrine by 70% as the 'hit rate' per sales event went up significantly.

Despite these encouraging results, the roll-out of the credit scheme will bring a number of questions, notably:

- in which district will the MFIs be able to deploy credit officers to ensure thorough processing of the loans (during the pilot, participation of loan officers to the sales events can be challenging, resulting in iDE staff possibly processing the necessary documents on their behalf).
- given the range of socially-beneficial products they could be financing, how long will they include latrines in their consumption lending program (capped at 15% of their portfolio).

Other iDE studies indicate that installment payments could also be an alternative strategy to increase likelihood of purchases. When households can pay in smaller, multiple payments (rather than a one-time large payment) they feel the purchase is within reach. This strategy could be particularly relevant in countries like Cambodia, where there is an 'all-or-nothing' attitude, i.e. as long as households do not have money to build a nice shelter, they will forego buying the latrine altogether.

Upstream organization

- Main organization:
  - *iDE does not generate any revenues for its organization.* The current average program cost per latrine installed is about $35. It is currently exploring options to further evolve the model, including a social business.
  - *iDE's work force in the field consists mostly of 28 district-level BDCs.* The BDCs train, coach and monitor the latrine producers and sales agents, help liaise with local authorities and gather data, as well as 4 engineers who train the producers on production techniques. BDCs earn $350/month plus a substantial % bonus depending on sales performance. There is limited turnover among BDCs (only a few a year leave), which can be explained by the high salary levels (base and variable), and the fact that half of the variable salary is locked into an account which is paid only at the end of the project. In addition, there are 19 M&E research assistants who monitor performance and conduct research. The BDCs are supervised by 4 regional managers, 1 sales manager and 1 MFI manager. All employees, from top to bottom, earn a base salary as well as bonuses based on quarterly targets which evolve regularly depending on the project lifecycle.
- Non-staff actors:
  - *Latrine manufacturers:* iDE provides them with training and business support. Manufacturers earn approximately $5 to $10 per latrine (10-20% margin). Most of them sold 2-3 latrines per month prior to the program and now sell an average of 12 latrines per month for the better performing ones, which is estimated to be about 20-30% additional profit on top of their other product lines for the larger/more diversified ones. The initial investment to start a sanitation business is around $3,000 (including $2,000 for a delivery vehicle, $440 for concrete molds and $650 for raw materials).
  - *Sales agents are incentivized through a small commission.* Commissions range from $2.5 to $5 (directly negotiated with the producer). Given that sales agents sell between 5-25 latrines per month, this may represent an interesting, though limited, additional income opportunity for a part-time job.

Innovations

- Complete, off-the-shelf, home-delivered sanitation solution with transparent pricing and maximum convenience.
- iDE rolls out its operations by adopting a face-to-face, human-centered approach: the products and processes are developed from the users' perspective, and are therefore better adapted to local conditions.

Remaining hurdles and bottlenecks

- While the focus has shifted from latrine producers to sales agents, it remains to be seen whether the latter are better suited to sustainably create demand, if and when iDE would limit its involvement. iDE is exploring whether it should transform into a social enterprise to continue its activities until 100% coverage is achieved.
- While the MFI pilots proved promising, iDE still needs to find a way to scale-up these partnerships and solve current operational issues.
- Most households prefer a concrete shelter for their toilet, but these are significantly more expensive than the latrine itself (usually >$200). As a result, households often wait to be able to afford the shelter before installing the latrine to avoid constructing a temporary shelter. iDE is currently testing a pre-packaged, concrete shelter that is cheaper than existing market options.

Contact information

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Appendices

Sources: Project visit on 16 and 17th of December 2013; www.ide-cambodia.org; www.makingsanitationeasy.com

Exchange rate: 1 USD = 4000 KHR

IFC-WSP "SELLING SANITATION" PROGRAM

Project	Selling Sanitation
Organization	IFC-WSP
Geography	Kenya
Areas	Rural
Solution	Individual
Date started	April 2012
Stage	Pilot
Scale	-

Testing consumer preferences on slab design
Source: www.ifc.org/Sellingsanitation

Project description

History of organization

Selling Sanitation is a joint initiative of the International Finance Corporation (IFC) and the World Bank Water and Sanitation Program (WSP). Funded by multiple donors, it is a market transformation program aiming to improve access to individual sanitation products in rural Africa. Helping local and regional companies expand products and services to the BoP, while closely involving public authorities. The approach has been developing in Kenya since April 2012 and will be piloted in 2014, with subsequent expansion planned into other African nations.

Value proposition and profile of customers

The Selling Sanitation program helps manufacturers design, produce, promote and distribute improved sanitation products. The initial focus has been plastic latrine slabs, allowing large segments of the population to upgrade their current latrines, which are often un-hygienic and unsafe to use. The slabs are an off-the-shelf product that can be manufactured centrally and distributed through local retail channels, rather than produced by local masons, who are small, informal entrepreneurs. The products consist of different sized plastic slabs, which can be retrofitted on existing pits and basic home latrines. The products offer a number of advantages over current unsanitary latrine designs including:

- Health benefits due to a plastic lid which can be easily placed over the latrine to keep flies away
- A well-proportioned hole that makes it safer for children to use An easy-to-clean, hygienic surface which will help take away malodor, and
- Edges that make it easy to install.

Its durability and the fact it can be moved around when a latrine is full or collapses (or for rented properties) are other key selling points. With an estimated recommended price of $60, $37, $28 and $17 (depending on the size), it compares attractively to a concrete slab ($94), which is the only durable alternative to plastic (ceramic pans are designed for flush toilets, while most rural houses use dry pits).

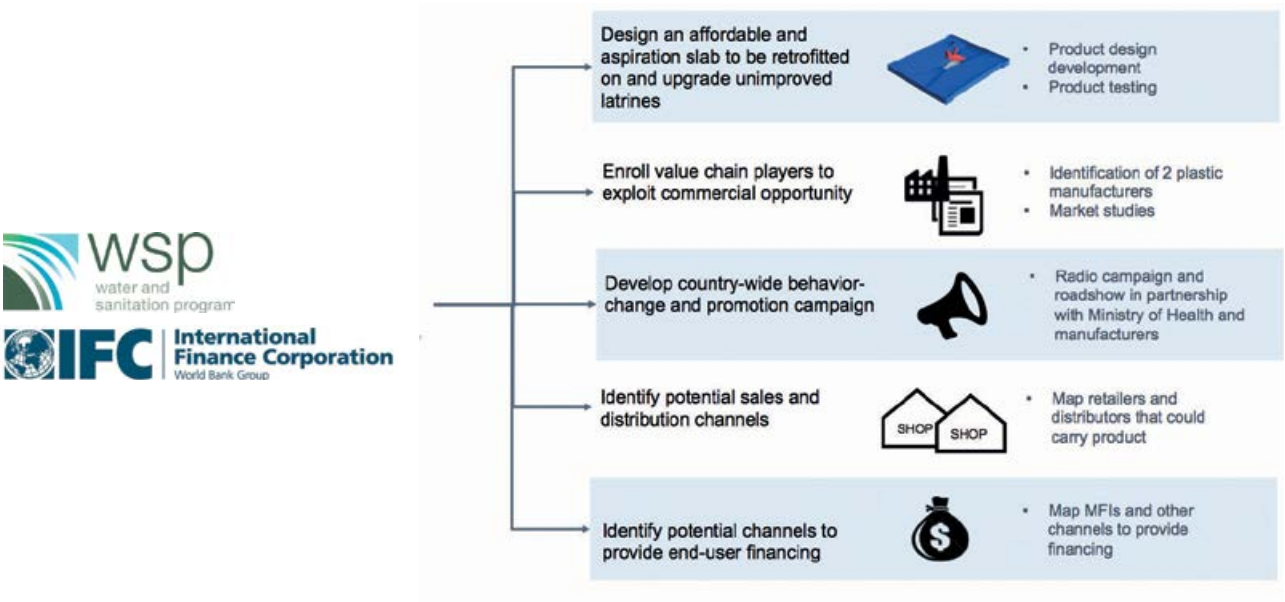
The two local manufacturers involved since the beginning of the project are currently setting up the production to launch the product, along with a marketing campaign, in April 2014. IFC-WSP will help pilot different road-to-market approaches and sales channels, so as to identify the most effective and scalable option, carrying out an impact evaluation starting in October 2014.

The slab is specifically designed for rural and peri-urban areas, where households have already invested an estimated $70-110 in some form of basic, unimproved sanitation solution (i.e. a deep, hand-dug, non-lined pit with a basic toilet shelter usually consisting of planks and/or mud).

Value chain

In order to offset much of the first-mover costs for this new product and market, and therefore catalyze the participation of local value chain players, Selling Sanitation provides technical assistance:

- On the supply side; with market studies to inform value chain players on commercial opportunities and market intelligence, product design, road-to-market strategy and collaboration with public authorities to create the necessary support locally
- On the demand side; with end-consumer financing solutions, and behavior change material and awareness/ promotion campaigns



In addition, the project works on the enabling environment and has supported the Ministry of Health to develop a national definition for improved sanitation, national guidelines for pit standards and latrine options and work on accreditation of improved sanitation options produced by local manufacturers.

Manufacturing

At the early stage of the project, discussions were held with a large number of Kenya-based plastic manufacturers, out of which two decided to move forward. Others expressed interest in engaging later, based on indication of project success. These two manufacturers are Silafrica (a company focusing on serving large multinationals with hard plastic packaging, materials handling, water tanks) and Kentainers (a company used to produce goods for large development organizations). Both are present across East Africa. These two companies have an interest in developing their product range and networks so as to make better quality products available at affordable prices, using their trusted brand. However, they have limited experience working in BoP markets, and B2C in general. While Selling Sanitation invested throughout the R&D process, the final design guidelines were given to each manufacturer (and will be given away to future interested manufacturers), for them to add their own design touch and make a final selection of the range they want to produce. The manufacturers then invested capital for new molds and equipment, as well as in some cases investing further in independent proprietary design modifications. The support of the project in developing the product was essential to these manufacturers: as B2B players, they have little understanding of the needs and wants of BoP end customers, and as the sector is vulnerable to imitations, no manufacturer is willing to invest much in the design costs to start with. The project also gives them valuable government support, the Ministry of Health will be involved in disseminating and accrediting the product.

Marketing & sales strategy and organization

At national level, Selling Sanitation works with the Ministry of Health to develop and roll-out a behavior change campaign promoting improved sanitation. The campaign is comprised of three components:

- A generic component, which will focus on creating 'dissatisfaction' with current, existing unimproved sanitation and stress the importance of improved sanitation
- A plastic category component, which will promote the advantages of plastic slabs over cement, but which also

talk about the practices households can adopt to improve on their current situation

- A manufacturer-specific component, which will be mostly managed by the manufacturers themselves and focus on promoting their range of products.

The three components will unfold over several weeks and will include interactive radio programs that tell the story of a marriage that is called off because the groom has an unsanitary latrine. The story will be enacted during a roadshow consisting of village trigger events and one large final event with popular actors, culminating in a 'happy end' wedding, possibly attracting tens of thousands of villagers. Before and during the roadshow, printed material will be made available on the different sanitation options available and manufacturer stands will be set-up. The campaign will be orchestrated on a national level and will be open source, accompanied by a toolkit for other organizations or governments to copy and brand themselves. It is expected that the roll-out of the campaign will reach out to over half a million people and will cost $1-1.5m.

The product will be positioned as very aspirational, with a zero-subsidy policy. The main adoption triggers will focus on social status and the importance of a latrine that does not smell, without flies, which is clean and private. The main challenge of the promotional effort will be to create dissatisfaction with the current, unimproved solutions. While the wide majority of the targeted population prefers some form of latrine to open defecation, 78% express a lot of pride and satisfaction with their current toilet. Another challenge is that matters related to sanitation are considered very private matters in Kenya.

As for sales, the Selling Sanitation team will provide technical assistance to the manufacturers for them to explore the potential and hurdles linked to different sales and distribution channels, including:

- Market hawkers specialized in plastic items who tour weekly regional markets and permanent market stall owners specialized in plastic; while many are very small traders carrying low-quality goods, some are more established businesses, which could carry more bulky and expensive items. However, most of these micro-entrepreneurs are not viable partners as slabs are likely to be slow-moving products, take up too much space and weigh too heavy to allow hawking
- SACCOs (formal savings and credit associations often linked to trade associations, out of which 2,500 are deposit taking groups) and Chamaas (informal women's savings groups, estimated at 500,000 across the country), which help their members jointly save and withdraw loans from the group. Though very fragmented they can help aggregate groups of clients, ensure financing, and are an alternative to MFIs, where SHK5000 is the minimum loan size and which have high interest rates. In general these channels are attractive as they can cover the last-mile and promote the product directly to the customers
- Hardware stores carry construction materials. While the ones located in towns are reasonably well stocked, the smaller ones have very limited inventory and do not do any proactive selling. Hence, while being the more natural route for plastic manufacturers, this channel is passive and has limited interaction with the households. The clients for these stores would most be the local masons, who are the most influential source of information on the store's inventory
- Community Health Workers are volunteers attached to the local health ministry division. They are the most trusted source of information regarding health in their communities. Well connected with villagers (about 1 community health worker for 20-50 families), they could be federated and trained to channel inventory and do quality control of the local masons' installation work. With their volunteer status, they can be given a commission to promote public health products
- NGOs and CBOs, which may struggle to sell the product on a purely commercial basis, given the history of subsidized product distribution in the country.

The project will also explore how to engage local masons (fundis), with their prominent role in the consumer latrine purchasing process.

Depending on the channel, the added retail cost would amount to 15-45% of the end consumer price.

Installation

Plastic slabs are easily transportable and require limited installation, more often than not by a local mason when it needs to be retrofitted on an existing structure. The price of the labor and possibly additional material such as wooden off-cuts is estimated at roughly $10. The product will come with instructions to guide masons and/or household members in the process.

Cash/payment collection

Selling Sanitation is exploring financing mechanisms reducing initial customer upfront payment, possibly by channeling products through SACCOs, Chamaas and MFIs.

Usage and hygiene

The program does not promote hygiene more broadly.

However, it will be rolled out with the support of the Ministry of Health, whose local officials are actively involved in the promotion of broader WASH efforts. The project also developed a hand washing station, which is being tested and refined by the two manufacturers.

Maintenance and cleaning

Users can easily clean the slab thanks to the plastic, inclined surface

Waste storage and collection

The product can be retrofitted on any type of pit (with the exception of the largest slab, which is exclusively for newly built latrines). Many pits are not lined up, which results in frequent repairs during the rainy season, if not collapses

Waste treatment, disposal and recovery

N/A

Technology

Description of toilet-related technology

Key features (example "large and small slabs"):

- Recommended retail price: $60 for large and $17 for the smallest one
- Design: 14 – 16 kg, 1.15 m x 1.15 m (for the large slab); 6 – 10 kg 70 X 90 cm (medium slab); 3.2 – 5.1 kg, 60 cm x 80 cm (small slab). The product was designed following extensive user consultations and feedback on affordability, durability, cleanliness and ease of installation and use.

- Durability: 5 - 10 years (with warranty)
- Water and energy efficiency: No energy/water required
- Malodors and safety: Product can prevent malodors and flies thanks to the plug that can be fitted on the hole
- Waste storage: Waste is stored in the pit
- Waste collection: N/A
- Potential and limitations:
  - » Re-usable once the pit is full or collapses
  - » Health benefits will mostly be captured if the plug is properly and systematically used

Social impact

- Penetration: N/A. However, the product has a large potential - about 47% of all Kenyan households own basic, unimproved sanitation facilities, and 16% have no latrine at all. Unimproved latrines typically comprise deep unlined pits, packed mud or timber floor slabs, and simple natural shelters.
- Acceptance and usage: N/A. However, it was designed following extensive rounds of customer preference surveys and feedback. The plastic slab is an attractive option in-between the traditional dry pit and the much more expensive poured concrete dry pit slab and shelter. Both options generally offer poor value for money, provide little guarantee of durability or quality and involve a complex purchase process for the consumer
- Customer satisfaction: N/A
- Evidence of impact on health: N/A. However an impact evaluation is planned, with baseline data collection commencing in October 2014
- Promotion of related behaviors: The project is also developing a hand-washing device that may be promoted in the future along with the slabs
- Waste collection and disposal strategy: None

Economic sustainability

End consumers

Depending on the product size and design, the recommended end-user prices for the products range from $17 to $60. The lowest price points fit more or less into the price range that customers announced they are willing to pay, while the most expensive product may be out of range for most respondents.

In comparison, the average cost to build a concrete latrine is $150-170 ($90-100 for the slab alone), while wood or packed mud latrines would cost $70-100 ($20-25 for the slab, $36 for the shelter, and $24 for the pit digging labor cost). As mud or wood latrines regularly collapse or get damaged, households tend to pay high recurring costs for these sub-optimal solutions.

The project is also exploring financing mechanisms for consumer lending and upfront payment reduction as 86% of targeted consumers do not currently spend any of their income on building or improving their toilets. But potential customers could save $1-8/month, depending on whether a family member earns a living or not.

Upstream organization

All project costs are covered by grants. However, now that the market opportunity is identified and the product is developed, selected manufacturers will be producing and distributing the slabs as a commercial product line. No information is available yet as for the expected profitability of their operations, nor the sales volumes required for them to break-even. None of the manufacturers envisage significant investment in a dedicated sales force, but rather plan to distribute their products via existing channels.

Innovations

- Off-the-shelf, aspirational product, that brings higher health benefits and an 'upgrade' vs. the prevalent unsanitary solutions.
- Initial investment into developing the product and business model should be offset by the expected sustainability of operations going forward, once manufacturers start producing and distributing the product.
- In addition to providing industry-wide support, and so facilitating the emergence of strong private players, the program is also working closely on the enabling environment (promotion campaigns, national product standards, etc.).

Remaining hurdles and bottlenecks

- The sales and distribution strategy is still not fully developed, as many existing channels present the disadvantage of being either very fragmented, or too 'passive' when it comes to actively pushing new products. The plastic manufacturers, on the other hand, have limited B2C experience, as their traditional business is done B2B
- The installation of the slab as a 'retrofit' on an existing structure can be complex enough for some households to require the help of a mason, driving the final price up
- There is no social stigma attached to owning poor quality latrines; unimproved latrines are the social norm and have been promoted by extensive CLTS efforts over the years. Hence, to create demand, the project will first need to create dissatisfaction with current solutions and aspiration for better ones.

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Appendix

Sources: London School of Hygiene and Tropical Medicine in collaboration with Domestos, Mapping Sanitation Solutions; www.ifc.org/Sellingsanitations; In-field visit to project and IFC-WSP team in December 2013.

Exchange rate: 1 USD = 87 KES

NAGESHWARA CHARITABLE TRUST (NCT), SANISHOP INDIA, EKUTIR

Project	Rural Sanitation Programme
Organization	NCT and Sanishop (with partner eKutir, WTO and Unilever with implementation support from local consultancy Sattva)
Geography	India
Areas	Rural
Solution	Individual
Date started	2009
Stage	Scale-up
Scale	7,000 toilets

NCT-Sanishop toilet. Source: Hystra

Project description

History of organization

SaniShop is an initiative of the World Toilet Organization (WTO) started in 2008 in Cambodia to promote the sales of affordable home toilets. The initial pilot launched in late 2009 was purely grant-based (funded by USAID), before SaniShop decided to start a new market-based initiative using a franchise model, piloted in 2012 in Cambodia. Sanishop started to expand in India in 2010, and is currently also building school toilets in South Africa with support from local players for funds and technical assistance.

In 2012, WTO partnered with eKutir, an Indian social enterprise, which manages the funds and implementation of Sanishop in India. eKutir selects local partners who can implement the project in various Indian states, among organizations that are trusted by the communities, have contacts with masons and often enable consumer funds for sanitation. Sattva, a project management unit engaged by eKutir for coordination, is further tasked with strengthening the sanitation supply chain and building the capacity of the local partners in various Indian regions.

Nageshwara Charitable Trust (NCT) is the partner to eKutir for sanitation in Maharashtra, with funding from Unilever. NCT is an NGO started in 1999 to form and support Self-Help Groups (SHGs) in Maharashtra and Madhya Pradesh.

Between 2002-2013 the NGO has formed around 12,500 SHGs of 12 persons on average, or 150,000 women. It counts today 67 field officers exclusively for its sanitation initiative out of its total 125 field officers supporting SHG. Initially focused on organizing the groups and financing entrepreneur loans, NCT conducted a study in 2008 on the key needs of its members and found that 77% did not have access to toilets, and that the main reason was unavailability of consumer finance. NCT thus tested a toilet loan in 2009 (100 loans, financed by the National Bank for Agriculture and Rural Development - NABARD). The pilot proved conclusive and NABARD increased its amount of refinancing lines to reach a total commitment of $1.6m at end 2013, while NCT trained masons in toilet design to ensure quality latrines would be built and used its SHG officers to spread the word on sanitation (and availability of toilet loans). Today NCT has financed 5,790 toilets directly, and guaranteed loans provided by the State Bank of India and the Bank of India together for another 1,200 of their SHG members.

Value proposition and profile of customers

» *Initial NCT model:* The real value that NCT brings to its SHG members is (1) making financing available for latrines, which no bank or MFI would otherwise fund (as this is not a productive investment), for families for whom a latrine corresponds to 2-3 months of household income; and (2) conditioning release of the funds to the construction of the latrine, to ensure the loan is used for that very purpose.

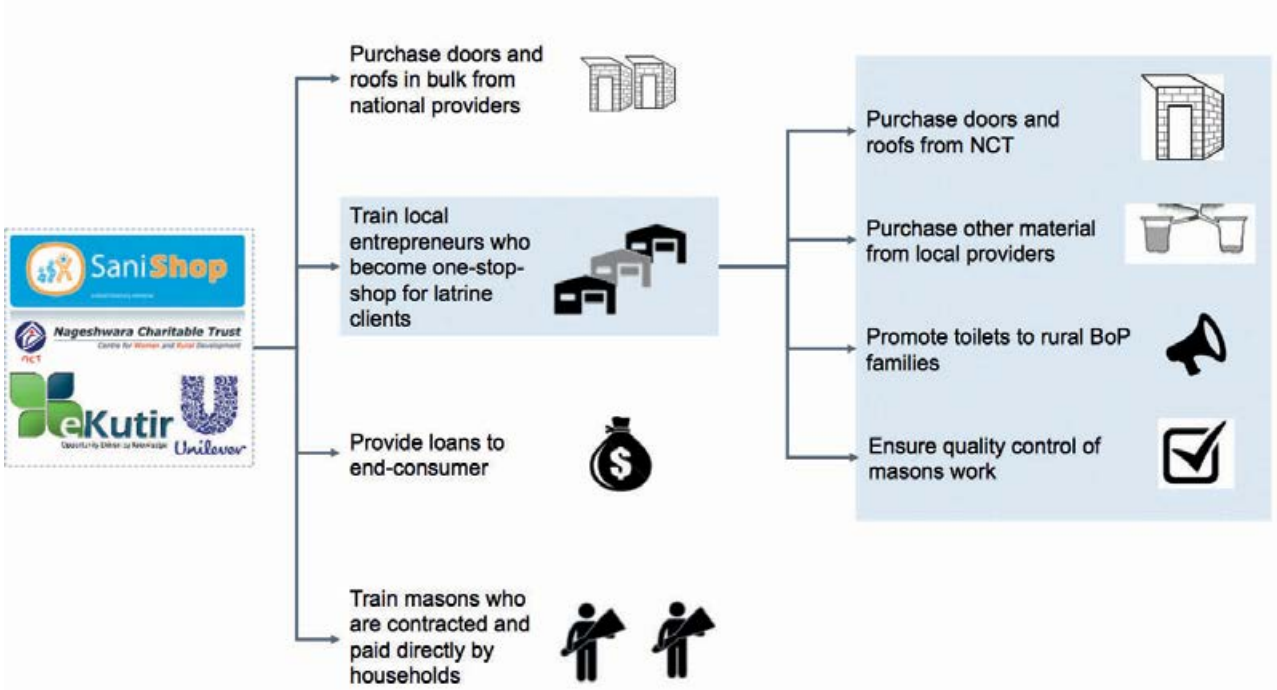
1) SHG members are offered a loan to build a pit latrine outside their home. Clients must dig the pit themselves (or pay masons to do it, a ~$20 job), which counts as 'down payment' to avail a loan of $167-250, sufficient to pay for the labor and material for the latrine itself (including toilet shelter in bricks or concrete). Depending on local conditions and their preference, clients can build an ecosan toilet, a septic tank toilet or a twin-pit toilet, with or without bath. NCT gives clients a sheet with their chosen toilet design, so that they can follow the right guidelines for construction. The households can contract any mason for the work, but NCT recommends the masons it has trained in the agreed designs.

2) To ensure quality of execution (and appropriate use of the loan for the toilet), an NCT officer oversees the construction of the latrine. The loan is disbursed to the family in 3 stages: a first part once the pit is dug to pay for purchase of materials, a second part once the outer walls are up to pay part of the masons' work and buy the remaining materials, and the last part once the latrine is completed to finish paying the masons. Clients then have 2-3 years to repay monthly at a 12% yearly interest rate.

Customers are families that include one woman who is part of an SHG; the families earn about $67-100 per month. They previously had no choice but open defecation (for lack of financing solution to build a latrine). Most live in rural areas relatively close to cities, so they have already seen and used a latrine, simplifying the awareness challenge met in more remote places.

» *New Sanishop- NCT model:* Sanishop is building an entrepreneur model where the entrepreneurs (i.e. a toilet sales person, selected and trained by NCT and eKutir paid commissions on each toilet sold) will become a one-stop-shop for latrine clients. Entrepreneurs will link them with NCT to access financing and ensure provision of quality raw-materials (via NCT that will order in bulk on behalf of the entrepreneurs), mason oversight and verification of the completion of the toilet to avail the last loan disbursement. This will significantly simplify the process of building a toilet for end-clients, who until now had to coordinate masons and material suppliers themselves, with no guarantee on total price. It should also help guarantee a fixed, lower price of toilets for clients through bulk purchase of materials and bulk mason hire. In addition, this system will serve villagers who are not yet part of an SHG, on which NCT will conduct a due diligence before deciding to offer them a loan.

Value chain



Manufacturing

» *Initial NCT model:* NCT has trained over 160 masons in building latrines with one septic tank, two pits or ecosan (dry) toilets, with grants from various organizations as well as with the interest rates earned on the loans to clients. NCT selects artisans who have been working as labor/ masons in the local area (so that their need for investment to start building latrines is nil) and who are interested in this training. Field staff working in the area spreads the word and motivates them to join the training. The training lasts for five days during which masons are paid normal daily wages, given food and travel allowance. Construction is monitored by NCT field staff who oversee and validate the three phases of construction for each partial disbursement of the loan (once the pit is dug, once the wall and interior structure are finished, and once the toilet is complete).

» *New Sanishop-NCT model:* eKutir and NCT have started organizing additional trainings for local masons (10 so far) to teach them to build two-pit latrines (the same ones as those previously recommended by NCT, as these are well accepted locally). The training lasts two days. eKutir also conducts refresher training for masons already trained by NCT, to reemphasize on quality of construction and the type of toilet that they should construct. They train more masons than needed as not all masons are available at any given point of time. eKutir and NCT are arranging bulk orders for doors and roofs from Tata and other national providers, and in the future plan to also order slabs in bulk (the most commonly used pans are Hindustan's).

Marketing & sales strategy and organization

» *Initial NCT model:* NCT field staff (48 social workers paid $42/month and 19 field supervisors paid $83/month) promote good WASH practices, along with toilets, during SHG meetings (with a 30-min video in local language) and advertise the availability of loans. Typically 10-20% of SHG members asked for a loan on the same or next day and close to 100% would decide to buy within 3 months if they had enough space to build around their house.

» *New Sanishop-NCT model:* With grant funding from Unilever, eKutir and NCT are setting up Toilet academies. They are now training local entrepreneurs to become a one-stop-shop sales force for toilets, centralizing orders from clients as well as purchase of materials and orders for masons. To do so they hired dedicated management to monitor the entrepreneurs (one master trainer and two field managers for 25-30 entrepreneurs).

Entrepreneurs are selected among local villagers based on their motivation, mobility, prior experience and business skills. Entrepreneurs are required to invest at least $167 (for example in storage space, transportation vehicle etc.) to get NCT support. NCT then orders materials on behalf of entrepreneurs, and resell them to the latter as clients pay.

Once trained, the entrepreneurs work in 2-3 villages at a time and depending on demand they start the construction process. They go door-to-door offering their services and refer interested clients who need a loan to NCT loan officers who come back to assess client solvability and decide to offer a loan or not (entrepreneurs also look for clients who can pay without loans). When a client is approved, NCT, along with the entrepreneur, plans a schedule for completion of construction. Entrepreneurs procure materials available locally and coordinate with NCT to arrange for standard doors and roofs. They also arrange masons to complete the construction process in the 5-7 days required for construction of standard twin-pit latrines. The customer must then dig the pit to activate the first installment of the loan from NCT. Upon completion of the full latrine, NCT staff along with the consumer will do a quality check, and disburse the remaining balance of loan to the consumer, who can then pay the masons at the agreed rate, and pay the entrepreneur the remainder of the agreed toilet price (which includes materials costs and commission of NCT and the entrepreneur). The entrepreneur then brings back the full amount to NCT, which redistributes commissions to entrepreneurs at the end of the month.

Installation

Once the pit is dug, masons come to install the pit, close it, install the slab, build the walls, and add the roof and door, under supervision of NCT field staff or SaniShop entrepreneurs. Clients used to organize transport of materials themselves, but transport is now taken care of by SaniShop entrepreneurs who can group transport for several clients at once. Masons are paid a maximum $58 for 5 days work for two people, spread over a maximum of 2 weeks.

Cash/payment collection

The loan is disbursed in 3 phases: $83 when pit is dug, $83 after the pit and walls are built, and the balance when the works are completed (toilet shelter plastered and painted, door and roof installed and toilet tested). A completion certificate is then issued and signed by the SHG president, secretary, beneficiary and NCT supervisor. For loans financed by NCT, NCT agents then visit the SHG once a month to collect the monthly installments. Loans given by the State Bank of India ($167 loan max, 13% interest rate, 3-5 years duration like any consumer loan) have quarterly to bi-annual payments, which clients must go and pay at the bank branch. In case of late payment; NCT supervisors take care of ensuring that payment is made promptly (as they guarantee the loan), which has so far resulted in 0% defaults (late repayments are occasional).

Usage and hygiene

NCT promotes hygiene and sanitation more broadly through its field officers at SHG meetings.

Maintenance and cleaning - NA

Waste storage and collection

The project does not organize for pit emptying. When the pit is full (an estimated 3-5 years), households call for local contractors ($17-42 depending on areas, depending on the depth of the pit and local prices for this service). Sanishop is now building 2-pit latrines which do not face this issue.

Waste treatment, disposal and recovery - NA

Costs breakdown

Inputs	Cost split	Cost change brought by Sanishop with bulk purchase
Raw materials	$75-120	Up to $8 reduction or 6-10%
Roof	$11	30-40% reduction: up to $4
Door	$20	30-40% reduction: up to $8
Seat (ceramic pan)	$5-6	5-10% reduction: up to $1
Pipes, plumbing and ventilator	$4-6	
Transportation cost	$5	
Labor	$33-47	10-20% (if sufficient guaranteed work for masons): up to $7
Total cost for client	$175-200*	Up to $28 cost reduction, to split between entrepreneur, NCT and client

*including transportation costs

Technology

Description of toilet-related technology

Key features:

- Cost: varies depending on type of toilets built (e.g. with or without bath, septic tank or twin-pits) and locations (in some areas, the cost of sand and cement can be double or even more; masons also do not have the same rates). At time of writing, eKutir was working with NCT and material providers to minimize and standardize prices across the organization. Typically, a twin soak pit toilet without bath costs clients $175-200, split as follows:
- Design: Design prior to SaniShop: two-pit latrines, one septic tank (when two-pit latrines were not appropriate for the soil) or Ecosan. Current design: two-pit latrines with ceramic slab (available locally, soon to be purchased in bulk by NCT), cement or brick walls, metal door and roof. Designed and field tested in Orissa by eKutir team.
- Durability: Made of cement or bricks (slab, chamber box and rings) and ceramic (pan, tiles and slab). Neither guarantee nor maintenance required (though SaniShop plans to provide a 1 year warranty). 8-10 years lifetime.
- Water and energy efficiency: Small buck of water needed to flush out the toilets manually. No energy use.
- Malodors and safety: Small aeration window in the toilet cabin. Limited malodor due to being a flush toilet.
- Waste storage: Lined pits, not watertight (waste can filter progressively in the soil).
- Waste collection: Done manually by contractors in the one pit option ($16-42 per emptying). Current two-pit latrines do not require emptying.
- Potential and limitations: The two-pit system recommended by SaniShop is not appropriate in flood-prone areas (or in areas where the water table is too high), so the project will probably continue offering septic tank technology as well. So far this has represented 25% of people who installed latrines.

Social impact

- Penetration: From a survey conducted in 2008, NCT found that for the 8,500 SHGs it had supported at the time, 77% did not have toilets at home. Since then, NCT has directly extended loans to 5,800 families for the construction of toilets and has supported the State Bank of India and Bank of India in providing consumer loans to an additional 1,200 of its SHG members, which in total represents 6% of families without toilets in its SHG pool. However, only around 8% of NCT SHGs have actually been offered loans, for lack of refinancing lines and of human resources on NCT's side. So far, due to funding limitations, only 67 out of 125 field staff support sanitation, for 12,500 SHGs.

With more funds, NCT could involve more of its staff in sanitation. Support from other organizations like Sanishop also help further promote toilets while reducing the burden on NCT's own field staff. In SHGs that were offered the loan, they reached close to 100% penetration in 3-6 months. NCT SHGs typically represent 1% of a district population. There are other SHGs set up by other support organizations, but NCT already has sufficient demand for toilets with its own SHGs compared to its operational capacity and fund availability.

- Acceptance and usage: All toilets are still in use four years after first sales.
- Customer satisfaction: Not measured as such but loan repayment rate currently stands at 100%.
- Evidence of impact on health: NCT conducted a study in 2012 on over 20% of its SHG members who had received a loan. Regarding health impact of having a toilet, 73% said it had helped them a lot and 23 % says it has helped them moderately.
- Promotion of related behaviors: NCT staff promotes hygiene and sanitation jointly to its SHGs.
- Waste collection and disposal strategy: None at this point, yet this has potential for livelihood generation. The project hopes to have 120 entrepreneurs doing waste disposal by June 2015.

Economic sustainability

End consumers

- Affordability for end users (% of total household income): According to a 2012 NCT study, the average cash income per SHG household is $67-100, counting revenues from farming and other work by other family members (many however produce most of their food for home consumption). A toilet priced $200 to $300 represents 2 to 5 months of household income, or with a 2-year 12% interest rate loan about 10-20% of the family income per month. Before SaniShop masons and material providers could charge any price, but eKutir and NCT are now working on centralizing orders to get fixed, lower bulk price for all materials and ensure maximum affordability and transparency on prices (including masons' fees). They have hence also agreed with the masons they trained to lower their prices by over 25% in exchange for the promise of considerable business in the years to come.
- End consumer financing: NCT offers its SHG members a 2-3 year, 12% annual interest rate loan of $167-250, against a $33 down payment (or pit digging by clients themselves). SHG members can also get a consumption loan from the State Bank of India of $167 at a 13% interest rate, repaid quarterly or every 6 months, for a duration of 3-5 years (like any consumer finance loans). NCT guarantees the loan amounts for SBI and takes care of repayments for SBI in case of problems.
- Savings from lower health expenses: NCT conducted a study in 2012 on over 20% of its SHG members who had availed a loan back then. Regarding economic impact from lower health issues since they had installed toilets in their home (at most 3 years back), 52% of them said they had saved between $8 to $33, 38% said they saved $2-8 and 10% said they had saved less.

Upstream organization

- NCT: NCT gets refinancing at 6% interest rate from NABARD (total $1.6m committed until end 2014, with $330,000 outstanding loans as of end 2013 and $303,000 in the bank ready for disbursement). The 6% differential on interest rates does not cover the full costs of running the program (i.e. salary of field staff and other field related costs, as program overheads are covered by other programs). The organization field costs represent $7-10 per toilet installed (more in years when there are many loans to service and few new installations). Interest revenues bring in $10-16 (depending on amount of loan) per toilet installed, over 2 years (i.e. $5-8 year, creating a need for working capital of about $2 per toilet during the first year while the program grows to cover field costs, so far covered by grants).
- Sales entrepreneurs: In India, the SaniShop model is designed so that sales entrepreneurs get a margin of at least $7 (3%) on each latrine sold, taken from the cost reduction that bulk purchase should allow. Targeting to sell, organize and monitor the construction of 25 latrines per month, bringing them an income of $167 per month (twice the local average household income).
- Masons: Masons are paid at a standard rate of $5-7/day for skilled or semi-skilled labor.
- eKutir / WTO: They fundraise and function based on grants. In the case of NCT, they have raised funds from Unilever: a working capital revolving fund of $50,000, sufficient to fund bulk material purchase for an initial group of 60 entrepreneurs ($833 each), plus $108,000 for program management (to set up two "toilet academies" in Orissa and two in Maharashtra, training entrepreneurs, including consultant costs, partners' costs etc). They do not make any revenue from this model.

Innovations

- NCT innovation was to create an enabling ecosystem for villagers to purchase quality latrines, thanks to the provision of financing to end-clients, training of masons in adequate building techniques and quality control via its own staff.
- SaniShop is now trying to make this ecosystem self-sustaining, with a central organization building and retaining a network of local entrepreneurs and masons. The key for success will be to keep some central functions in-house, such as the provision of consumer finance to end-users coupled with quality control on the toilets built. The provision of material at preferential rates that will enable to keep a margin for the sales entrepreneurs.

Remaining hurdles and bottlenecks

- While SaniShop aims at setting up sustainable, local ecosystems, it has not yet found a way to recover its initial investment, and is still testing ways to cover for its ongoing costs.
- NCT, as an NGO, will need to make sure it embraces this initiative with a business-oriented mindset to make it sustainable (i.e. price the toilet with a sufficient margin to cover all costs).
- The contractual link between entrepreneurs and NCT, as well as their compensation scheme once they are mature enough to sell on their own, remains to be defined.
- Defining a process to ensure that clients can be served well and quickly (in terms of getting consumer finance, receiving the materials and getting masons' support for 1-2 weeks to build the toilet) will also be key to client's satisfaction and hence to the project success.

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Appendix

Sources: Field visit to Nagpur district on December 12-13, 2013, with Tripti Naswa, Sattva Associate Principle and Mukund Dhok, Senior Project Coordinator, Nageshwara Charitable Trust; Rita Bhoyar ritabhoyar@yahoo.com; interview with HMB Murthy, Secretary, Nageshwara Charitable Trust; www.worldtoilet.org/wto/index.php/our-works/sanishop

Exchange rate: 1 USD = INR 60

WATERSHED

Project	*Hands Off* Sanitation Marketing Program
Organization	WaterSHED (NGO)
Geography	Cambodia
Areas	Rural
Solution	Individual
Date started	2009
Stage	Scale-up
Scale	61k toilets (287k persons) since 2011

WaterSHED sanitation training event
Source: www.watershedasia.org

Project description

History of organization

WaterSHED (Water, Sanitation and Hygiene Enterprise Development) is an NGO whose mission is to create demand and supply for low-cost sanitation, water and hand-wash products and services in Cambodia, Laos and Vietnam. The "Hands-Off Sanitation Marketing Program" seeks to facilitate the sustainable development of a local rural sanitation market. In Cambodia, WaterSHED started as a USAID-funded WASH umbrella program, which supported a number of local organizations (including WTO, iDE, East Meets West, Lien Aid). When the program began winding down in 2011, WaterSHED registered as an NGO and continued operations independently. Its current 3-year 2012-2014 sanitation program is funded by the Stone Family Foundation, Diageo Foundation, Waterloo Foundation, the Global Sanitation Fund, and Grand Challenges Canada. It is currently active in 7 of the 21 rural provinces of the country (59 districts in total).

Value proposition and profile of customers

Leveraging local market players, WaterSHED helps create demand and supply for rural latrines priced in average between $45 and $50. These latrines are ~25%-35% cheaper than other designs, as WaterSHED trains producers in how to increase production volumes using improved molds, and encourages them to produce all parts, thereby reducing the complexity and the transport costs in sourcing components from different workshops. As a result, consumers can now purchase a cheaper, 'off-the-shelf' product with one single supplier, for a fixed price, with maximum convenience (delivery often included and installation service available). This represents a considerable improvement over previous alternatives, whereby consumers would rely on the advice of local masons, have to purchase and transport materials from many suppliers, and pay high labor costs to have their latrine and shelter built manually.

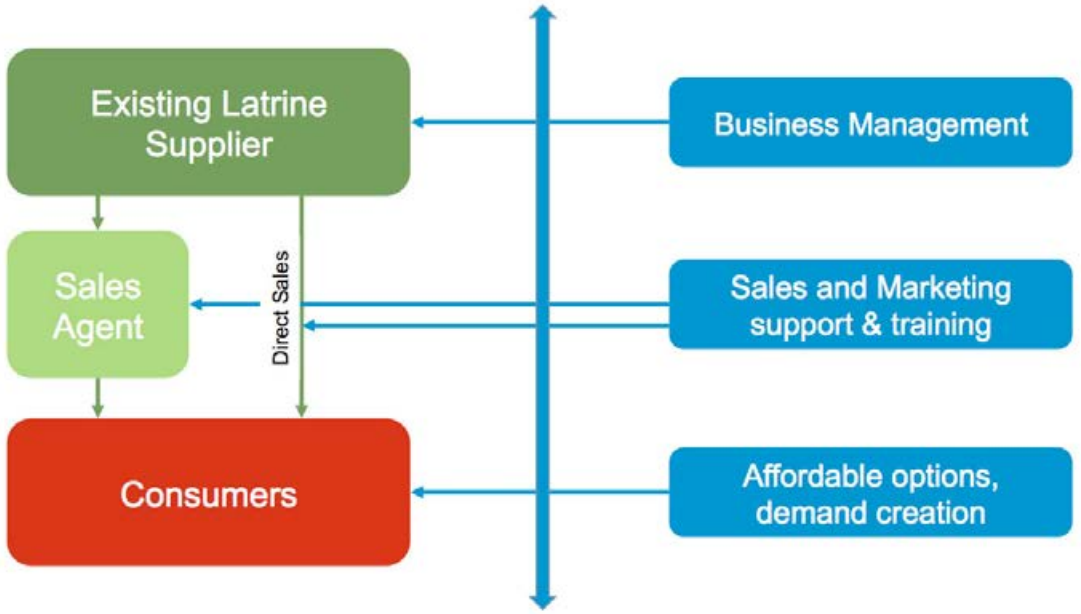
WaterSHED also developed a corrugated zinc-based shelter priced at $75 – which met limited demand as the material is perceived as less durable than concrete. It is now exploring the possibility of designing a concrete shelter that would be cheaper than current alternatives that cost ~ $200-250.

WaterSHED works in villages where the population lives mostly of farming. In rural Cambodia, open defecation is rather prevalent (63% national average) with wide variations between areas. In the areas where WaterSHED operates, monthly household net cash income ranges from ~25-30$ for the 20% most vulnerable without much or any land, to $50-75 for the 50% families cultivating their own plots, and $75-100 for those 20% families who have a member earning cash income. The main drivers for product adoption are word-of-mouth (30%) and family situation (children become physically mature, sick/old relative). The main reasons why customers chose the WaterSHED-supported supplier are the price and home delivery arguments.

Value chain

WaterSHED adopts a 'hands off' approach to developing local supply chains. It does not seek to replace any single player in the chain, but rather introduces and engages new agents (e.g. WaterSHED recruits new suppliers to the toilet business) into it. It focuses in particular on latrine manufacturers, and seeks to support them in successfully developing and maintaining a customer base and network of promoters.

Role of WaterSHED in the value chain



Manufacturing

WaterSHED supports 165 local active latrine manufacturers willing and able to participate in the program. The conditions to participate to the program include: investing up to $385 into molds to produce at least 3 sets latrine sets/day, carrying 30 sets in stock at any point of time (or roughly $500 in inventory), and owning a delivery vehicle or truck. The area covered by each manufacturer (typically 8km radius) is decided after consulting with the local communities (depending on the distance and preference). The very large majority of the manufacturers used to produce (parts of) latrines prior to the program, but in very low volumes. There is in average of one manufacturer for every 20-30 villages.

WaterSHED trains the manufacturers in marketing (1 day in-class and regular support and visits afterwards), and establishes links with local officials, who support the project and promote the product in their respective constituencies.

The latrine production costs ~$30-35, including roughly $5 for labor, $25-30 for input material. In addition, the manufacturer adds 3-5$ for transport and delivery, 10$ margin for himself, and a $1.25-2 margin for the sales agent, as well as in some cases 1$ for the MFI. Producers are typically able to deliver the latrines within 1-3 weeks.

Production, driven by demand, is very much seasonal (low in July-November and high from December to March). Active producers sell in average 9-13 latrines/ month (5-10 in low season and 10-15 in the high season). Among producers, about 20-30% fall inactivate in the low-season, and the 40% most successful ones account for 80% of the sales. The team evaluates the potential of existing and new suppliers on a rolling basis (rather than as a once-yearly process). In the process, it seeks to balance i) overall sales volume and ii) achieving full supplier geographical coverage. Since many remote areas offer little choice in terms of potential suppliers, WaterSHED will try support the less successful ones for some time.

For the producers, most sales are directly driven by the work of sales agents (see below), who trigger and/or close ~15 sales/ month, vs. 5-7 latrines sold to walk-in clients.

Marketing & sales strategy and organization

WaterSHED helps identify a network of promoters, including ~280 commune officials (often the dedicated WASH officer) who promote the latrines more or less actively, and ~270 village chiefs (who mostly do referrals, remind villagers about the importance of improved latrines, and facilitate the organization of community meetings).

The local officials are identified through meetings with provincial and district authorities, where WaterSHED presents the project and encourages officials to actively promote the product. Community meetings are the main avenue to sensitize the local population to the need for improved sanitation and sell the product (65% of sales are done through sales events, which leverage community dynamics and bring a shared sense of what should be the 'norm'). Typically, commune officials organize 4-8 community meetings a year.

Promotion materials are made available to other organizations on an open-source basis. Developed by professional marketers, they use real-life, provocative visuals explaining the dangers of open defecation and creating disgust with current practices. The last part of the presentation presents and promotes the product, highlighting its convenience and price (systematically lower than what the audience expects it would cost).

Promoters are trained by WaterSHED on how to conduct the presentation and the sale, during a 1 day training (together with the manufacturers), and 'on-the-job'. WaterSHED seeks to establish an active relationship between the suppliers and sales agents (typically 3-4 agents per producer). In addition, 65 public officials were invited to join the 'Civic Champions' project, a year-long training course whereby they are trained over 10 days and coached on the job to improve their leadership skills. Officials need to submit an application and pay a training fee of $30. This program receives a lot of interest.

Installation

WaterSHED encourages the producer to offer a package to the consumers (latrine + installation) – even though only 32% actually do. The transport and installation is estimated to amount to ~5-10$ of the total price. Where it is provided for, the installation is typically performed by a staff from the producer, together with the household men. Even though most prefer this solution, the installation is simple enough to be realized by the household himself.

The installation does not include pit digging, which is performed by the household or paid for ($7.5 to $10 per pit), if performed by a local laborer.

Cash/payment collection

Very few manufacturers offer installment payments (though many accept part of the payment to be done after a couple of weeks). Given that cash availability is a major issue for most would-be customers, WaterSHED negotiated partnerships with two local MFIs - Vision Fund and Kredit in December 2012. WaterSHED helps organize a direct relationship between the producers and these MFIs, and the former actually pay the MFI for some of their operational costs (set at 1$/sale). The MFI staff either attends the sales event to register the loan applicants, or ask the village chief to establish a list, which is then verified by a loan officer. The village chief is also facilitating monthly cash payments collection by the loan officers. In this case, the MFIs remunerate them with 30% of the loan interest amount.

Usage and hygiene

WaterSHED works closely with the government to encourage latrine adoption and usage among potential consumers. Its marketing material focuses mostly on educating customers about the need for improved sanitation and provoking an emotional motivation for adoption. It also trains provincial staff in monitoring latrine usage, as it seeks to improve data collection on sanitation coverage.

Maintenance and cleaning

The latrines do not require any maintenance. Cleaning is done by the household.

Waste storage and collection

60% of customers purchase in 3 rings (single latrine), and 30% purchase 6 rings (double latrine), which line and help support the pit. The average pit depth is 1.5 m.

Waste treatment, disposal and recovery

Given the quality of the soil, pit latrines fill up slowly (7-10 years). When full, the owners typically manually empty the latrine themselves and spread the waste onto their fields.

Technology

Description of toilet-related technology

Key features:

- Cost: The toilet production is estimated to cost ~$30-35.
- Design: The latrines include a squat pan and a slab which sits atop a chamber that is connected by pipe to an offset lined pit. The design was supported by IDEO. All elements are made of concrete. The slab is covered with ceramic tiles.
- Durability: 20 years.
- Water and energy efficiency: Pour-flush toilets (1.5-3 liters per flush).
- Malodors and safety: Malodor and safety issues are very limited, given the design of the slab and use of water
- Waste storage: Waste is stored in the pit. Given the nature of the soil, the rings are not cemented, and waste is slowly filtered in the ground.
- Waste collection: Most pit emptying is done manually by the owners. WaterSHED is exploring the possibility of developing a market for additional absorption pits (also lined with three rings) to be linked to the primary pit through a draining pipe.
- Potential and limitations: Most customers perceive that the latrine itself is only a part of the toilet, and invest considerable sums for a cement shelter, in addition to it. WaterSHED is exploring the possibility of developing low-cost, pre-fab shelters.

Social impact

- Penetration: Since January 2011, WaterSHED helped install 61k toilets, serving an estimated 290k persons in 3800 villages. Penetration ranges from 5 to 13%, which translates into average actual latrine coverage of 50-63%, if taking into account existing latrines penetration (estimated at 45-46% in 2013, with a natural growth rate of 1.8%). Penetration grows approximately 2-6%/year, depending on the province. Hence, 100% sanitation coverage could be attained in 3-10 years, if the program would be extended to all provinces. WaterSHED tracks sales events and actual sales, while the monitoring team verifies randomly delivery and installation.
- Acceptance and usage: Most households were not using latrines before the program (open defecation). Actual regular usage ranges from 95% for adults to 85% for children. During a 2012 study, WaterSHED found that 29% of purchased toilets had not yet been installed at the time of survey (mostly as households wait to build a shelter). 50% of those had purchased the core material over a year earlier, but 76% did not have the all materials they wanted to build the complete toilet, including the shelter.
- Customer satisfaction: According to WaterSHED latest consumer adoption study, 97% of customers are satisfied with their latrine and 74% recommended it. Improvement areas include: slow delivery (31%), product breakage during transport (23%), lack of installation service (16%), lack of credit facilities (10%).
- Evidence of impact on health: NA
- Promotion of related behaviors: In Cambodia, WaterSHED also started marketing commercially water filters and is planning to introduce a handwashing device (which is already introduced in Vietnam). However, it does not promote related WASH behaviors during its sanitation promotion events.
- Waste collection and disposal strategy: N/A

Economic sustainability

End consumers

- Affordability for end users: The price of the latrine is set by the supplier (on a "cost plus" basis). The average price observed is $45-50, to which $10-20 is added to dig the latrine and possibly help install it. The biggest expense though comes with building the shelter (>$200), as 80% of families prefer a concrete one. In the areas where WaterSHED operates, the latrine price corresponds to 0.5-2 months cash income for a family. However, the perceived price (i.e. how much customers believe the latrine would cost) is much higher (most customers quote over $100). Consumer household surveys confirmed that latrine adoption is directly linked with level of income (50% of purchasers are within the top 4th quartile, while 11% belong to the poorest quartile). When no credit solution is offered, >50% of clients have the cash at hand, and 27% saved the money. Interestingly, rural sanitation in Cambodia seems to be an 'all or nothing game'. Households hover between open defecation and improved sanitation (with a hard-built shelter). Very few households go for an intermediary step of 'unimproved sanitation'. About 80% of non-adopters prefer pour-flush, good looking latrines.
- End consumer financing: WaterSHED is partnering with two MFIs to offer payment plans to its end-consumers. Cumulative sales done through MFIs amount to 1952 latrines from January to November 2013 (the scheme being rolled out in 3 provinces, with 49 manufacturers). The MFIs provide 18-months loans for the latrine itself, with a 2.8% monthly interest rate, provided incremental operational costs would be paid for by the manufacturer (set at 1$/sale). MFIs require a $4.5 non-refundable down-payment from customers.

Upstream organization

- Main organization: WaterSHED does not generate any revenues for its organization. However, it deploys its grants cost-effectively (average program cost per latrine installed of $18). It is currently exploring ways to evolve into a social business.
- Non-staff agents:
  - *Latrine manufacturers:* WaterSHED provides them with training and business support. Manufacturers earn ~$10 per latrine (20% margin). Given that most sold 2-3 latrines/month prior to the program, this represents an important source of income for many of them ($100/month, or an estimated 20-30% of their net profit). Less active manufacturers (i.e. producing less than 12 latrines/month) are gradually phased out of the

program (60 of them in 2013, or 26% of all).

  - » *Sales promoters:* Consisting mostly of local officials, they are incentivized through a small commission. Depending on whether they induce or close a sale, the promoters earn a commission ranging from $1.25 to 2 (directly negotiated with the producer). Given that commune-level promoters sell in average 5-8 latrines/month, for ~1 day worked, this represents an interesting additional source of income (a commune-level official earns $20-30).

- Staff costs: The field force mostly consists of 52 district-level 'Facilitation Specialists', who coach 3-4 manufacturers and 10-12 promoters each, help liaise with local authorities, and gather data. Recruited among university graduates, they earn $100/month plus 10-30% bonus depending on sales performance (100 latrines installed/month), which is the basic salary NGOs pay at local level. To limit the disruptions linked to rather high turnover, WaterSHED introduced a 3-month probation period.

Innovations

- Sales agents and manufacturers in the lead: "off-hand approach" for enhanced sustainability
- Home-delivered, full sanitation solution, with transparent pricing and maximum convenience
- Commercial marketing tools (provocative, real-life examples). These materials are open source, and helped bring about more consistent and powerful sanitation campaigns (the material was adopted by 17 organizations in 6 countries).

Remaining hurdles and bottlenecks

- Most households prefer a concrete shelter for their toilet, but these are way more expensive than the latrine itself (over $200). As a result, households often wait to be able to afford the shelter before installing the latrine, to avoid constructing a temporary shelter they'd have to destroy. WaterSHED is planning to work on a low-cost, hard-built shelter
- While pits take longer to fill up in Cambodia, it is expected there will be a wave of overfilled latrines in a couple of years from now. The installation of an overflow pit seems to be the most practical and economical solution to avoiding emptying it manually. WaterSHED is looking into the possibility of promoting it in the coming future
- WaterSHED adopts a hands-off approach to the development of local supply chains. It is still exploring however, when is the 'tipping point' beyond which the market does not need to be facilitated anymore and latrines would become 'mainstream' products.

Contact information

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Appendix

Sources: www.sanitationupdates.files.wordpress.com/2009/10/watershed-latrines.pdf; www.sanitationmarketing.com/_blog/Sanitation_Marketing_Blog/post/WaterSHED_in_Cambodia_-_a_hands-off_approach_to_SanMark/; www.watershedasia.org

Exchange rate: 1 USD = 4000 KHR

APPENDIX 2:
URBAN CASE STUDIES

3S - A DIVISION OF SARAPLAST PVT. LTD.

Project	3S - A Saraplast enterprise
Organization	3S - A Saraplast enterprise
Geography	India (6 cities)
Areas	Urban
Solution	Collective
Date started	1999
Stage	Scale up
Scale	3.5k rented toilets rotating between various projects; 1k toilets sold; 150k daily users

3S Truck. Source: Hystra

Project description

History of organization

Shramik Sanitation Systems (3S) is a social enterprise launched in 1999. In 2006, Saraplast was founded separately as a manufacturing entity, and in 2008, 3S and Saraplast merged into Saraplast Private limited (but kept the 3S name for service operations as the name was already popular). The company started with the clear social purpose of providing clean toilets to people who did not have access to them yet. It provides portable toilet cabins, hand washing stations, urinals, shower cabins, and associated services (septic tank cleaning and waste disposal). They first focused on project developers who offer shelter and food to their migrant workers while they work on site – and rarely have sanitation solutions built in; as well as event organizers. Today 3S has 3,450 available units for rent with at least 80% utilization rate at any point in time. 3S has offices in Pune (where headquarters are located), Mumbai, Delhi, Hyderabad, Bangalore and Chennai. It managed to raise its second round of investment from ResponsAbility in April 2013, allowing for rapid expansion. It has also set up a Trust which received funding from Michael & Susan Dell Foundation (MSDF) that sponsors – on a purely philanthropic basis - innovative approaches to bring sanitation to the poorest, such as support to existing public and community toilet entrepreneurs to turn them into successful businesses (as of 2013 pilots were conducted in Delhi, Pune and Mumbai).

Value proposition and profile of customers

3S installs and services toilet cabins with built-in tanks in poor settlements with migrant workers (paid for by the project developer, at $75-100 a month for a squat toilet). The use of toilet is free for the workers, and sometimes the site allows the neighboring slum to use the toilets after the site is shut and workers have gone home, or simply if there is capacity for more people to use them. One toilet should serve around 50 workers a day, and 3S services each toilet once a day or at least once every second day. This represents 81% of 3S revenues.

3S also installs toilets for specific events where a model of sitting toilet is also proposed for $25-33 per day, including a toilet attendant and all the consumables for the toilet (soap, etc.). This represents 11% of revenues.

Only the toilet interior changes between sitting and squat toilet cabins, so toilets are modular between these two formats.

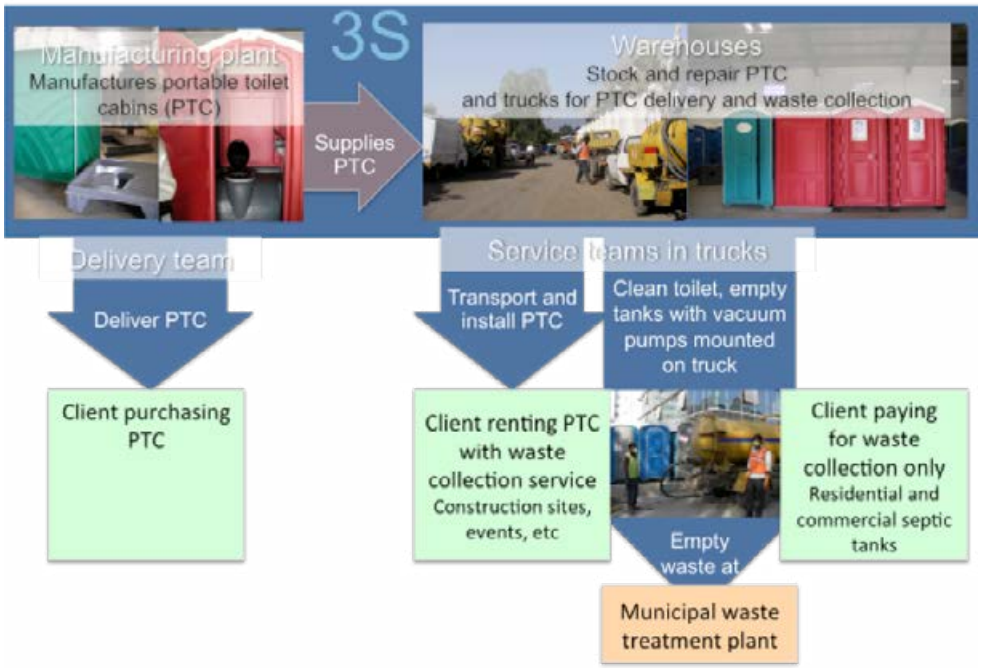
Alternatively, organizations can purchase the cabins for $750 (squat toilet) to $1,083 (sitting toilet) – but then service is not included. This represents 5% of 3S revenues, but growing rapidly.

3S also provides commercial and residential septic tank emptying and disposal (only 3% of 3S revenues).

Finally, 3S is also experimenting with supporting collective toilet entrepreneurs in poor urban areas to improve their service to clients, e.g., with water points in the toilet, wall

painting, basic marketing support, sales of additional related product (e.g. sanitary napkins). Entrepreneurs charge users ~$0.80 per month per family to use community toilets (i.e. in poor residential areas, open 24 hours a day), similar or more than what they charged before 3S intervention (as they provide better service), or $0.03 per use in public toilets (i.e. in areas with a lot of transit, open 11am-9:30pm), which is the maximum price allowed by law for one toilet use. 3S considers these as pilots to explore opportunities of working directly in the slums, and is not charging end-consumers (costs of these pilots are covered by grants, representing less than 1% of 3S total revenues).

Value chain



Manufacturing

Toilet interiors (in plastic) are manufactured in a plant 40km outside of Pune, then assembled with the rest which is imported (side panel and roof come from the US, head pumps and foot pumps from Ireland, the rest from various cities in India). The plant can manufacture and assemble 800 toilets per month (but is currently working at only 25-30% of its full capacity, producing 200-250/month on average). Manufacturing the entire product in-house would take off 26-30% of toilet costs (some from customs and freight) and the investment in the manufacturing facility would make sense economically for 5,000 toilets per year.

Marketing & sales strategy and organization

The sales organization is deployed through city branches (6 cities in total), with at least four sales person in each. On average, one sale person sells rental contracts for over 100 toilets throughout a year. Sales persons are overseen by the Centre heads (in charge of operations and sales activities), located in each of the 6 main cities of operations. There has not been any issue of sales saturation so far as the market is huge and 3S is the first entrant, with their number of toilets installed doubling every year.

Installation

Toilets go through a full check before they are dispatched to new sites. They are installed (and then maintained) by a team of 2 technicians, 1 driver and 1 supervisor, who transport the toilets in a truck and install them on site. Installing a cabin takes 5 minutes. No link with water tank or sewage is required as toilets have their own tanks, one for water that can be replenished with clean water by 3S, and one for waste that can get emptied by 3S as well, if water and sewage connections are not available on site. In case of link to a sewage system, plumbing done at the site can be done onsite.

Cash/payment collection

Construction site clients are billed once a month.

Community toilets are either pay per use or subscription system, but payment was not always enforced. In community toilets (in residential areas) supported by 3S, families are now requested to pay the monthly family amount at the beginning of each month, directly to the toilet entrepreneur (all revenues go to the toilet entrepreneurs). Before the intervention of 3S, about half of the users were not paying anything. In public toilet (in areas with a lot of traffic), the system is pay-per-use, and clients must pay INR 2 to the operator before use.

Usage and hygiene

Indian squat toilets are all provided with hand wash facilities outside the toilets, while Western toilets have hand wash inside the toilet. 3S also offers showers in a separate cabin (not very popular yet though).

Maintenance and cleaning

The toilets are sturdy and need repairs only 2-3 times in total over their 10 years lifetime. Maintenance is done in the warehouse by the installation/collection team where each toilet is dismantled, cleaned piece by piece and verified. If a problem happens on site, site supervisors can conduct basic maintenance themselves. These small repairs cost on average $8 per year a toilet. Toilet cleaning is done by the collection team after the pit is emptied (see below in "waste storage and collection"). Technicians then add a deodorant and disinfectant solution dissolved in 5L of water, and clean the inside and outside of the structure as well. The deodorizers can be bio deodorizers or bio tab or dissolvable biosachets, all ecofriendly and made in the USA (EPA approved).

Waste storage and collection

The collection team is the same as the installation team. Hiring requirements are minimal – anyone who applies can get the job, and keep it if they respect basic discipline (e.g. being on time and present every day, respecting the safety conditions). Turnover has been lowered over the years thanks to a comprehensive HR policy (e.g. in addition to competitive salary, breakfast offered at the warehouses every day, group activities etc) and is now between 10 and 30% depending on the cities. The collection team collects the waste from each toilet daily (up to 190L waste per toilet), or every 2 days for the most remote sites, following a set route in a truck with a 1000-3000L storage tank on top. They cover 50-85 toilets per day.

Waste treatment, disposal and recovery

The collection tanks on trucks are brought and emptied at municipal treatment facilities (multiple trips a day, given the volume of waste). As of 2013, the total cost of using these waste facilities is around $1,000/month for 3S. In Pune (city with the largest operations for 3S), the municipal waste treatment plant is currently close to full capacity and is likely to ask players like 3S to find other ways to dispose of their waste. 3S has started thinking about setting up its own treatment facility there.

Technology

Description of toilet-related technology

Key features:

- Cost: $550 on average; Price: $700.
- Design: Pour-flush, collective portable toilet: cabin with base, side panels, one piece door and roof, held with slide on corner moldings and a rivet system. Some models come with hover handle, coat hook, mirror and shelves. Dimensions are: 2.3m x 1.1m x 1.2m, for 68 to 80 kg. The interiors are made of LLDPE (Linear Low Density Polyethylene) and the exteriors are made of HDPE (High Density Polyethylene).
- Durability: The toilet structure (interior and exterior) can last 10 years, with some small parts needing repairs (lock, rivets for the door, etc.).
- Water and energy efficiency: The flush uses 0.3L of water per stroke, contained in a 150L water tank in the cabin replenished from a local water source (paid for by the construction site or event organizers) or by 3S clean water tank each day, as part of the service contract. Today S3 pays the various municipalities less than $2000/year in total for water. The toilets do not require any energy (the flush works via foot pump or gravity).
- Malodors and safety: The malodor is limited thanks to the chemical disinfectant solution which is added every day. This solution helps control malodor for several days. The toilet is completely safe to use and faeces are stored in the tank below the toilet.
- Waste storage: On-site tank below the toilet (up to 200L capacity) – or when available, connection to public sewage system (which can be done even for temporary toilets).
- Waste collection: Daily collection by 3S trucks with vacuum pumps – high pressure jetting mechanism to evacuate quickly the waste and avoid that anyone touches it – or when available connection to public sewage system. Pumps are powered either via a small motor of by the truck engine.

- Potential and limitations:
  - » The industrialized collection process set up by 3S is economically viable with one truck for at least 50 toilets visited daily, which is feasible in dense areas but can become more challenging in more dispersed environments.
  - » The routes could be further optimized with IT; trucks with larger capacity would limit the number of trips to the waste treatment facility. 3S is working on both.

Social impact

- Scale: Over 3,000 toilets rented at any point in time, 3,450 in total available for rental, 300 sold in 2013, 700-900 sold since inception. Assuming 50 users per toilet in average, this means that over 150k users use 3S toilets every day.
- Penetration: It is assumed that most workers use the toilet, as this is the only free sanitation facility available. In some instances, if allowed by the site manager, other people from the neighborhood might be using them as well. There is no clear monitoring of usage.
- Acceptance and usage: N/A.
- Customer satisfaction: 90% of construction companies sign up for a new contract after their first one. S3 has just set up a 3-person hotline to answer any client concern or user question. At end user level, anecdotal evidence of S3 construction workers being first time users of toilets and deciding to build a toilet at home.
- Evidence of impact on health: NA.
- Promotion of related behaviors: In addition, on construction sites where 3S installs toilets for the long term, 3S staff conducts at least one awareness campaign on sites – about open defecation, good hygiene practices such as how to wash hands, how to use a toilet, the benefit of bathing and keeping the residence area clean, etc., using a UNICEF movie, pictures and other media. According to Saraplast, around 40% of users attend the training, and that most of them claim that they were applying what was taught. As of 2012, over 6000 participated. In addition, 3S has installed free toilets in various schools (grant-based project), and uses the schools as a platform to raise awareness on the importance of clean sanitation. Finally, the company launched a "City 100% Sanitation Campaign" to generate awareness on these topics among Pune's citizens and stakeholders.
- Waste collection and disposal strategy: The toilets are rented for a fee, which includes daily collection done entirely by 3S. There is no ensured compliance for the toilets that are sold, or for the public toilets that 3S helps run.

Economic sustainability

End consumers

- Affordability for end users: Free for end-user in the case of rented contracts, pay per use at $0.03 or pay per month at $0.83 per household in case of collective toilets (0.3% of household income with 3 persons working).
- End consumer financing: N/A

Upstream organization

- 3S: 3S charges its institutional clients $75-100 for the set up and servicing of a toilet per month (for long-term contracts) or $25-33 per day (for short term events – this higher cost includes an attendant). One route needs 50 toilets per truck to breakeven in 15-18 months (on the costs of the toilets, plus the truck, plus the local team operating the truck, plus cost of waste disposal – which is as of now minimal in municipal waste treatment plant). 3S also generates revenues from advertising on toilets. 3S is currently profitable.
- Public toilet operators: Revenues from user fees. Initial pilots show that if well run, public toilets can be a small business for local entrepreneurs (earning over $60/month, in areas where average salary is around $80/person).

Downstream organization

So far, 3S has to pay for disposal of waste at the municipal treatment plant ($1,000/mth for all 6 locations, covered by the margins of the upstream organization). However as the Pune plant is reaching full capacity, the municipality will likely ask 3S to treat their waste themselves. It is also likely that the price of water will increase as water is becoming scarcer. Hence S3 is thinking of building its own waste treatment plant that should allow to convert 80% of the waste into a water clean enough to clean toilets (for S3 own use), or to be mixed to make cement (if sold to construction sites). The pay-back of such a plant (based on savings on municipal waste treatment plant fees and reselling the clean water) would be around 2 years.

Innovations

- 3S has found a truly profitable business model by targeting clients who are not the users themselves, but people who are ready and able to pay for toilets: construction site managers willing to provide a better work environment for their workers. The fact that workers can avail this facility free of cost allows spreading the experience of regular and clean toilet use.
- 3S markets its cabins with free trials: when construction site managers hesitate to take on the service, 3S provides its toilets and service for free for a month. 50% of managers then decide to take on the paying service.

Remaining hurdles and bottlenecks

- Finding a sustainable model to educate and serve end-users directly in the slums: 3S is only catering to a limited market segment. It still needs to find a way to better cater directly to end-users in slums:
  - » Upgrading community toilets can be challenging as these are often government buildings and local governments are reluctant to let a company interfere with their work
  - » Organizing waste collection for small home toilets (i.e. waste in a bag) is forbidden in India (a law forbids to carry waste by hand, to make sure the scavenger's job disappears)
  - » Households still prefer septic tanks, when they can afford; which 3S could service and is in the process of acquiring equipment and new technology to cater this vast market.

Contact information

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Ulka Sadalkar, co-founder and Director: ulka@3sindia.com

Appendix

Sources: Field visit of Pune operations, December 10-11, 2013. Interview with Ulka Sadalkar, Director, Ranjit Kher, Director, Colonel A.A. Gune, Lead for operations in Pune and for India, Tapan Apte, Chief Financial Controller, Amey Mahure, Business Development CLTS (Community Led Total Sanitation) ; www.3sindia.com; www.businessinnovationfacility.org/page/saraplast-3s-shramik-portable-sanitation-and-waste-management-in-; www.planetedentrepreneurs.com/wp-content/uploads/entrepreneurs/Inde/Shramik/Pdf_Shramik.pdf

Exchange rate: 1 USD = 60 INR

BANZA LTD.

Project	Banza Sanitation Project
Organization	Banza Ltd.
Geography	Kenya, Nairobi
Areas	Urban
Solution	Individual
Date started	April 2013 (in-field pilot)
Stage	Pilot
Scale	38 toilets, ~190 users

Banza Prototype Toilets. Photo by Patrick Kiruki

Project description

History of organization

Banza Ltd is a Kenyan company founded by Patrick Kiruki, an industrial designer, who developed the Banza Toilet. Banza started field-testing the product prototype in April 2013 in the Mathare slums of Nairobi, and installing units in August 2013, in partnership with Community Cleaning Services (CCS), a Kenyan NGO which trains and manages mobile cleaning teams from local underprivileged youth, who in turn collect the waste from the installed toilets. Banza was grant-funded by Grand Challenges Canada and is now fundraising to expand its production facilities significantly.

A modified design is in preparation in response to requests from relief agencies for units that may be used in refugee and emergency situations. These modified units will be used as community facilities in conjunction with a Banza shelter.

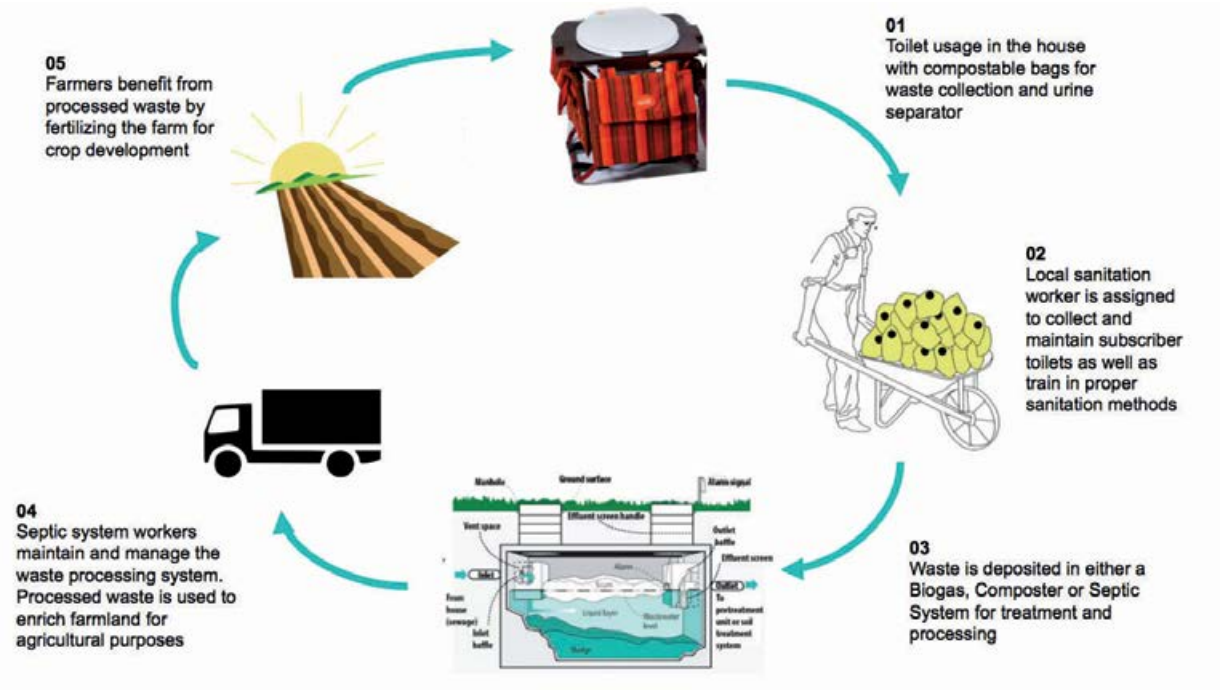
Value proposition and profile of customers

Banza manufactures Banza toilets, which are compact, waterless, portable units to be used in homes by families not connected to the sewage. While the toilets remain the property of Banza, they are promoted and serviced daily (against a fee) by a team of waste collectors who pick up and dispose of the waste which is contained in biodegradable bags under the toilet seat. For now, the team disposes of the bags in the main sewage line (with the authorization from the municipal authorities), but Banza is currently developing partnerships with organizations which can treat and process the waste (e.g. Sanergy).

Users are families living in the slum neighborhoods of Mathare, a district selected because it already has been the focus of education efforts to improve hygiene and sanitation. Early adopters included people who were actively involved in these sanitation education efforts, families with bedridden people, families where women value the convenience and safety of having home toilets at night in particular. 90% of slum residents are renters (1000-2500 KSH monthly rent), who live in ~9m2 rooms (mixed type of habitations, ranging from metal to solid walls constructions), and earn monthly 7000-10,000 KSH/household (out of which 2000 KSH goes to the rent if it is a metal shack), working as hawkers, factory workers, cleaners, tailors, etc.; 60% of those do not have a sanitation solution at night, when the public toilet is closed and it may be dangerous to defecate in the open. A number of Banza toilets were also installed in public institutions (school, church, health center).

Once they agree to rent a toilet, they sign a simple contract agreement, which lays out the conditions and the price at which they hire the toilet. They pay an upfront one-month deposit, which covers the initial servicing costs, and then regularly at the end of each month. Pricing was initially set at 450 KSH, but was brought down to 200 KSH (which is roughly the double of what a family would pay at the 'basic' public toilet, and about the same as their electricity bill, five times more than weekly garbage collection, and over three times more than the price of public tap water – assuming 20L/day/household).

Value chain



Manufacturing

Banza sources and assembles the different components of the toilet (plastic, metal and fabric) from China, Taiwan and Kenya. The compostable BioBags used for waste collection are imported from Belgium. Current cost of the prototypes is ~$85/unit. For 3000 units, production costs (without overhead) could be brought down to $35 USD, as the plastic unit manufacturer would invest into molds (estimated cost of $15k). Production cost could be brought down to as little as $30 each, for 10k pieces.

Marketing & sales strategy and organization

The Toilets are promoted by a team of 6 mobile cleaners. These are youth with limited or no education, who set up a micro-enterprise around mobile cleaning services (they clean institutions, homes, do garbage collection, operate public toilets), with the help of CCS in 2007, and who operate it under CCS name and license[17]. It was easy for them to 'expand' into home toilets cleaning, as they say this as an extra addition to their line of work, and there were until now limited expansion opportunities in Mathare (otherwise, it would have been challenging to find 'fresh' entrepreneurs). They receive no commission for identifying new clients, as this is their business. CCS however believes that such promotion would not have been possible, were it not for all the community sensitization work that happened previously in these areas. Previous to the Banza Project Pilot Study, the communities would not only have welcomed the idea of home toilets, but would have also questioned the utility of having the toilets cleaned.[18] The fact that CCS and this team of youth are present and known in Mathare also significantly facilitated the adoption of the service.

The cleaning team does most of the promotion (demonstrations, door-to-door every two weeks), but it seems that a lot of the sales latest pick-up comes from word-of-mouth.

17 CCS also sells them toilet cleaning products and cleaning equipment, which CCS buys in bulk. Over the past 4-5 years, CCS trained over 200 youth, organized in about 10 teams. It developed a rather 'water-proof' methodology to identify which youth could turn out successful cleaning entrepreneurs, mostly gauging whether the youth is well known and respected in the community, and whether he owns a trusted enough network of neighbors to be able to rent at least 3 toilets. Finally, CCS plays a central role in communicating and coordinating with the local authorities, for them to authorize and support the project.

18 Previous 'CLTS-like' work in the Mathare slums surfaced well engrained open defecation practices (i.e. all families would go to a given place, early morning before going to work, to defecate and meet). Hence, few households understood the importance of improved sanitation, and many would question the usefulness of changing if everyone else was still open defecating, without seeing much inconvenience to it.

Installation

Transport of units is provided by CCS. No installation is needed. Home delivery is organized by the team of mobile cleaners, who explain the functioning of the toilet and have the servicing agreement signed on.

Cash/payment collection

Cash payment is done on a monthly (60%) or bi-monthly basis (40%), and collected by the cleaning team. In one third of the cases, there is delayed payment.

Usage and hygiene

The cleaning team provides initial advice to customers on how to use the toilet (e.g. do not throw sanitary napkins into it).

Maintenance and cleaning

Cleaning is done by the household users of the Banza Toilet (the cleaning team only provides cleaning services to institutional users). No maintenance is required. Banza is in discussions with Kim-Fay East Africa to explore the opportunity of selling and providing personal care, tissue and hygiene products to households.

Waste storage and collection

The cleaning team collects used bags daily from each household and replaces them with new bags (which are provided/delivered by CCS, after being purchased in bulk by Banza). They also empty the urine tanks into a barrel for disposal. Urine and bags are carried away to be deposited into the main sewage line (with the authorization from health authorities). In practice, one team member is in charge of the collection for each day of the week, which he does in 1.5-2 hours, early morning, leaving plenty time for other small jobs. They do it altogether on Sundays to finish earlier. Hence, CCS believes that 1 cleaner could do as many as 50 visits a day. Two CSS supervisors monitor the work of the cleaning team, follow progress, random check satisfaction of customers, and help liaise with the local authorities. These two supervisors could oversee many more teams, if working at scale.

Waste treatment, disposal and recovery

The team leaves the waste in the main sewage line, which terminates with the Ruai municipal treatment plant. In future, it is planned that waste reuse will be contracted out to available providers in each area served. For example, Banza is establishing working relationships with Sanergy, which is working at setting up a waste disposal and recovery operation.

Technology

Description of toilet-related technology

Key features:

- Design: Portable toilet unit designed for in-home use, easily stored when not in use. The toilet has five components: Tubular steel structure capable of holding up to 130 kg; the seat of the unit is in high impact plastics (current prototypes use wood); the urine diversion part (in plastic); the bag holder (in metal); and the urine diversion tube (in plastic). The urine diversion limits odors, and enables composting of the solid human waste. Urine is collected in a separate tank.
- Durability: Estimated lifetime is 5 years for the plastic version of the toilet.
- Water and energy efficiency: Waterless toilet.
- Malodors and safety: Malodor is a major issue currently (as faeces lay directly in the bag under the toilet). The team is currently redesigning the toilet to explore how to seal the waste compartment when not in use, and possibly add suitable chemicals to address the issue of smell by creating a better user experience.
- Waste storage: Solid human waste is stored in biodegradable, compostable, hygienic, easy to use bags, where waste is contained up to 24 hours. These bags contain no plastic and, while durable, fully dissolve in water or when composted and also can be burned without harmful residues. The cleaning team advises against throwing newspaper, sanitary and feminine hygiene products into the bag, to ensure they can then be easily processed into compost. The bag (currently purchased in very small retail quantities) costs 10 $ cents/ bag. This could possibly brought down to 3 cents, with bulk purchasing.
- Waste collection: The route is worked out by the cleaning team; waste (liquid and solid) is collected in 2 hand-carried containers.
- Other: The Banza Toilet is in the process of being endorsed by the Kenya Bureau of Standards, which may allow the team to import its components at lower tariffs further reducing the cost of the Banza toilets.

Social impact

- Penetration: 100 toilets were produced for this pilot. 50 of them were made available in the Mathare slums (out of which 38 were installed over the past 6 months, serving about 200 individual users). In the small area covered by the project (2 square km), it is believed that 1800 households could potentially benefit from Banza toilets services as they have no night sanitation solution[19] (~9% current penetration). The other 50 prototype units will be used to test the concept with organizations considering large-scale adoption and institutions such as the Red Cross, World Vision, Water for People, and other organizations with a greater reach to people in need of sanitation services. The demand for the toilets has been doubling every month, after the first few months when toilets were introduced.
- Acceptance and usage: No customers have returned the toilet to date. However, most customers only use the toilet at night (given the smell, and the lack of privacy), significantly limiting the benefits they could draw from having toilets at home.
- Customer satisfaction: Customer satisfaction is randomly done by the two CCS supervisors. Main topic of complaint is related to smell and lack of privacy. A key plus in the eyes of customers is the servicing dimension (i.e. someone comes and takes care of their toilet at home).
- Evidence of impact on health: Too early to tell.
- Promotion of related behaviors: None. CCS feels it may be unproductive to have the toilet cleaners, which it wants to position as a business, also do what is perceived as 'NGO talk' on hygiene and hand-washing.
- Waste collection and disposal strategy: The toilets remain the property of Banza. Hence customers only rent them, and the fee contributes to paying for toilet servicing

Economic sustainability

End consumers

- Affordability for end users (% of total household income): The monthly servicing fee is 200 KSH for families and 400 KSH for institutions. The initial price for home toilets was set at 450 KSH, which was not accepted by most potential users since they had not seen the Banza unit to put a value to the toilet in relation to the service.
- End consumer financing: N/A

Upstream organization

- Main organization: Banza and CCS currently operate on a subsidized basis because the project is currently a pilot study.
  - » *Banza hopes to significantly increase production and sales* (notably by focusing on big institutions buyers, such as NGOs, sanitation projects, government tenders, private players in tourism, extraction/construction industry), so as to bring production costs down and generate a margin for themselves.
  - » *CSS plans to sell the bags to the cleaning entrepreneurs* to cover part of its operations, but would be unable to pay for the initial community education work out of this revenue stream. It could also sell its facilitation and coordination services, in the case of a bigger contract with a development organization or the government. However, it feels it would struggle if it would specialize into such kind of projects. For them, it does and would make sense as a 'complementary' line of work, given their focus on setting up youth-based enterprises in the field of cleaning services – for which their work is totally subsidized at present as the financial model is tested during the pilot phase.
- Staff: CCS supervisors working on the Banza pilot are currently financed out of the grant managed by Banza (KSH 27,000 salary).

  A cleaning team member earns in average KSH 1400/ month (as they split the revenues over the 6 of them, and do not pay anything for the bags yet). Given the little time worked (1.5 hours, 4-5 times a month), this is a lucrative supplement income source (about KSH 200/ hour, which compares with KSH 84/hour for the formal minimum wage). There is very little turnover in the cleaning team working in Mathare (80% of them remain the same over the past 5 years).

19 Or 60% of the total population living in the area.

Innovations

- The simplicity and cost of the technology allows for a whole new segment of users to access home toilets.

Remaining hurdles and bottlenecks

- The main hurdles to the wider and faster adoption of this toilet are: the smell, which in turn leads to lower utilization and lesser benefits, including economic ones; and the education on sanitation and hygiene, not only at the individual level, but at the community level is also seen as essential to create some level of demand.

Contact information

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Appendix

Sources: www.alrudesign.com/Banza_home_page.html; www.banzasanitation.wordpress.com; www.facebook.com/photo.php?v=10151698800546301&set=vb.238360899612863&type=3&theater; www.youtube.com/watch?v=9gBXvtCEMmg&feature=youtu.be

Interview with Patrick Kiruki and David Dunn (Banza) on 29 November 2013; Interview with Joy Kiruki (Banza) and Joseph Njenga (CCS) on 2 December 2013; Field visit of Mathare slums operations on 3 December 2013

Exchange rate: 1 USD = 85 KSH

CIUDAD SALUDABLE

Project	Pro Reciclador
Organization	Ciudad Saludable
Geography	Peru and Latin America
Areas	Urban and semi-urban
Solution	Household garbage collection
Date started	2002
Stage	Replication
Scale	38 toilets, ~190 users

A professional recycler in Lima

Project description

History of organization

Founded in 2002 by Albina Ruiz, Ciudad Saludable is a Peruvian non-profit organization that aims to improve waste management (sorting, collection and recycling) in developing countries. It operates in Bolivia, Brazil, Colombia, Mexico, Peru, Venezuela, Ecuador, Chile and India, and plans to expand to Guatemala and Costa Rica. Ciudad Saludable is part of the "Ciudad Saludable Group", along with Perú Waste Innovation SAC (the for-profit consulting arm founded in 2009, specialized in solid waste management) and Healthy Cities International Foundation (a non-profit entity created in 2010, in charge of replicating the model and strengthening partnerships, especially with the US).

Ciudad Saludable has built a community-based approach involving all of the value chain actors through various programs:

- Pro Reciclador, that promotes the professionalization and socio-economic inclusion of informal waste pickers by building a productive value chain creating better employment opportunities in waste management
- Basura Cero, that helps local governments and civil society to implement efficient tools, programs and a legal framework allowing proper management and reuse of solid waste
- Ciudadanía Ambiental, that promotes environmental best practices in schools, firms, communities and organizations through trainings, awareness workshops, social marketing, and communication.

In this case study, we will focus on the Pro Reciclador program, which has increased the quantity of recyclable waste collected and has been turning waste collection into a profitable source of income for waste pickers, who in turn became more professional and empowered.

Value proposition and profile of customers

In Peru - as in most developing countries, urban solid waste is improperly and inefficiently managed by municipalities. According to the World Bank,[20] 30-60% of urban waste in developing countries remains uncollected and less than 50% of the population is served. In some cases, as much as 80 percent of the collection and transport equipment is out of service, in need of repair or maintenance. In most developing countries, open dumping with open burning is the norm. Informal waste pickers illegally sell waste collected on the streets and this impacts the neighborhoods in terms of safety and hygiene. Furthermore, waste-pickers only obtain limited revenue from this informal activity, as the buying companies impose below-market purchase prices on them.

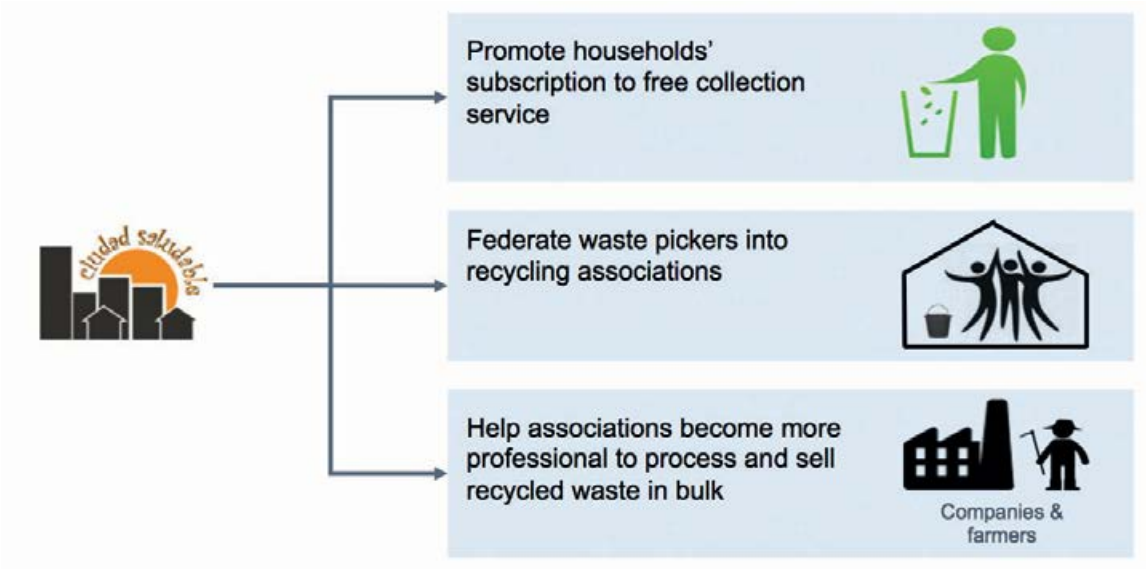
Ciudad Saludable created an innovative recyclable waste management system that is attractive for municipalities and their citizens, as well as the existing informal waste pickers. The Pro Reciclador program supports existing waste pickers by enabling them to become micro-entrepreneurs and set-up or join local recycling associations. Through this organization, they can provide a free door-to-door recyclable waste collection service to households, and centralize the waste in a local collection center owned collectively.

20 www.go.worldbank.org/A5TFX56L50

The recycling agents ("recicladores") who work for the associations usually work full-time, with collection activities in the morning and sorting activities in the afternoon. The association as a whole can then sell the recyclable waste in bulk to manufacturing companies or buyers specialized in different streams. The associations are initially not-for-profit, but are encouraged to progressively turn into for-profit micro-enterprises to further scale-up and invest in processing equipment. By 2011, nearly 30% of the 102 associations created had switched to a for-profit micro-enterprise set-up.

The families who benefit from the waste collection service are composed of 4 to 5 members in average and live most often in formal settlements. When they decide to participate to the program, they commit to sort their recyclable waste, store it in a large plastic bag (provided to them) and deliver it to the reciclador during his weekly visit. Participating households put a sticker on their front door to help the recicladores identify them. Families can place the bags full of recyclable waste in front of their front door on the day of collection, and do not necessarily need to be present at the moment of collection.

Value chain



Marketing & sales strategy and organization

- Convincing municipalities: Ciudad Saludable engages directly with municipalities to promote health education and the importance of waste management, in order to convince them to collaborate with recycling micro-enterprises (by passing laws and regulations that guarantee the rights and inclusion of waste pickers in municipal waste plans). In addition, Ciudad Saludable works closely with local municipality officials and technicians to ensure that the collection work is linked to the removal services of other municipalities and government agencies.
- Raising awareness among households: Ciudad Saludable convinces households to subscribe to the free service, mostly through mass media campaigns combined with door-to-door visits. When starting to work in a new area, Ciudad Saludable starts with a 4 day promotion campaign, involving about 8 Ciudad Saludable staff and 8 volunteers, visiting all households once in order to get them to "participate". Promotion efforts are critical to raise the awareness among family households and lead them to participate in the program. To further incentivize the families, Ciudad Saludable rewards the "good contributors" by planting trees close to their houses and developed a system of penalties for non-participation in some cities where the participation rate is high.

Waste collection

- Support of recycling associations: Ciudad Saludable helps existing informal waste pickers create and manage local recycling associations that will centralize and collectively sell the recyclable waste. Once organized in associations, the recicladores are able to collect larger amounts of recyclable waste in a centralized collection center, and sell each category of waste (cardboard, plastic, PET, metal, etc.) to companies at better selling prices. The waste is sold on-site, which also ensures that the quantities sold are accurate, thanks to a weighing scale owned by the associations themselves.

Each association is composed of an executive committee with a president, secretary and treasurer (who deals with the remuneration of recyclers and the revenues generated by the recyclable waste sales to buyer companies) chosen among the recicladores; general meetings are organized on a regular basis.

Based on information obtained during a field visit in Lima, one collection center can be shared by about 50 recicladores grouped in 4 recycling associations, whereby each reciclador covers 250 households.

- Support of recicladores within the associations: Ciudad Saludable helps recicladores in allocating households amongst themselves, and provides them with training (e.g. safety equipment, garbage separation, processing preparation and machinery usage) and logistic support (e.g. collection route optimization). It ensures that the association provides them with the appropriate equipment, such as a helmet, gloves and working pants allowing them to collect waste in safe and hygienic conditions, as well as greater dignity.

  Ciudad Saludable also supports recicladores by enabling them to access attractive micro-financing options to buy a small collection vehicle (typically motorized tricycles which cost about $300) in partnership with local banks. For instance, it created a specific fund at Scotia Bank – guaranteed by Ciudad Saludable with a deposit of $30k – that offers credit at a 12% annual interest rate.

Waste disposal and recycling

The recycling associations enable recicladores to centralize and sell specific categories of recyclable waste in bulk to companies, without any intermediary.

The recycling associations that turned into micro-enterprises have future plans to enhance their downstream business of recyclable waste, such as by:

- » investing in waste recycling machines (e.g. presses to compact plastic or cardboard, and shredders for plastic) to improve the commercial offer to buyers by going a step further in the recycling process
- » in the longer run, exporting certain categories of waste that are not used nationally, thereby further expanding their commercial activity at an international scale.

To ensure demand for the recyclers, Ciudad Saludable works with local actors to promote the recycling of new/ different types of waste. For instance, Ciudad Saludable established organic farms to train farmers in using compost and other materials from recycled organic waste.

Social impact

- Reach and penetration
  - » The proportion of Peruvian households that initially agree to participate appears to vary significantly across neighborhoods, with on average 13% and up to 95% in Miraflores (a wealthy neighborhood which benefitted from strong promotion efforts driven by the local mayor). Possibly only 60% of these families respect their commitment and are actively participating. Hence, continued promotional efforts are critical.
  - » Over 200 municipalities are working with Ciudad Saludable; usually large municipalities of over 100k inhabitants in Peru.
  - » 11.5k organized waste-pickers including 6.5k formalized recyclers in Peru
  - » 67 recycling associations in Peru created through Ciudad Saludable's technical assistance
  - » 35 environmental waste management micro-enterprises (that originate from recycling associations before turning into for-profit)
  - » 300k tons of recyclable material collected by recicladores per year in Peru
  - » $18.5M of sales value of recyclables per year in Peru
  - » 9 million users who benefit directly or indirectly from Ciudad Saludable's programs in Peru (through the coordination of recycling services and general waste collection by municipalities).
- Evidence of impact on health

  Ciudad Saludable contributed to reducing the prevalence of waste-related diseases (e.g. diarrhea, hepatitis) for both citizens and ill-equipped waste collectors.
- Environmental impact

  It is estimated that Ciudad Saludable enables to save about 2 million trees per year through the collection of paper and cardboard in Peru.
  - » *Systemic change:* Ciudad Saludable has been very active in lobbying all stakeholders involved in waste-related issues.
  - » *Recicladores:* Previously informal waste pickers benefit from a more stable and better paid job (the remuneration is up to 2 times the minimum wage, and 3 to 5 times what they earned from their previous informal work, which used to be about $2 per day). Additional benefits also include improved health working conditions (e.g. the plastic bag that they now provide to the families), and the credit to buy a tricycle. A virtuous cycle is created by giving these micro-entrepreneurs the potential to further develop

their businesses by reaching more households. Their grouping in recycling associations opens new opportunities to further develop market-based activities (future investments in recycling machines and exporting). Furthermore, Ciudad Saludable provides a path for the best recicladores to go after business accounts (e.g. collecting paper from banks) and increase their income to $300/ month or more.

» *Local authorities/ municipality:* The city's waste collection costs are significantly reduced by the waste sorting upfront; city streets are cleaner; municipalities can obtain financial support from the government based on their performance in waste management and environmental sustainability.

» *In the political space:* Ciudad Saludable played an active role in the creation of various legislations regulating solid waste management and the activities of recyclers, including the first General Law on solid waste in Peru in 2000. It also launched roundtables and networks of municipalities.

» *In the academic space:* Albina Ruiz created at "La Universidad Católica del Peru" a post-graduate program in integrated waste management and a Master's degree in environmental management, training more than 5k master students.

Economic sustainability

- End consumers: The solution is free for end-consumers.
- Main organization: As of 2011, Ciudad Saludable team was composed of 23 staff, 10 consultants, over 100 sub-contracted specialists and student volunteers, supporting the recycling micro-enterprises. The yearly operating budget was of $1.2 million. The organization is grant funded by Peruvian ministries, municipalities and universities, international organizations and foundations. Moreover, the Ciudad Saludable programs benefit from the profits of its for-profit arm Peru Waste Innovation.
- Recycling associations: Each of the recycling associations supported by Ciudad Saludable is managed independently and brings together 10-20 recicladores on average.
- Revenues: come from sales of recyclable waste to companies and amount to $50k yearly per association (16 tons of waste per month, sold at $300 per ton). The associations also collect $350 of yearly membership fees from recicladores ($15-30 per reciclador to join a recycling micro-enterprise supported by Ciudad Saludable).
- Costs: Recicladores are paid $180-260 per month; Collection vehicles are financed individually by the recicladores. The collection center is rented or owned by the association. Other equipment costs comprise of weighing scales.
- Profits: In this configuration, associations can more than cover their costs and outstanding profits at the end of the year are distributed across the recicladores.
- Municipalities: 20% of municipal waste management budgets are saved thanks to the Ciudad Saludable program. Moreover, the government allocates subsidies to the municipalities that implement the Ciudad Saludable program (at the condition that at least 11% of the households participate in the municipality). The household participation rate in municipalities is measured and monitored by government agents, based on the evaluation of the volume of recyclable waste collected.

Innovations

- Community-based approach that benefits to all stakeholders: it provides a free service to end-consumers, cost reductions to municipalities, formal jobs to waste pickers and more supply to waste purchasing companies
- Integrated approach that links and incentivizes all stakeholders in the supply chain.

Remaining hurdles and bottlenecks

- It is challenging to increase penetration rates in targeted areas from the current 13% as it requires continued promotional efforts. To achieve this, the following could be helpful:
  - » a stronger field force to go door-to-door and who support community leaders in convincing families of the need to participate. Promotion agents could be hired from the community or from outside.
  - » a stronger push or more regulation from the municipalities to enforce or encourage participation to the program
  - » continued support from local municipality officials over time to continue promotion efforts in their municipalities, beyond the initial push given by Ciudad Saludable.
- Ciudad Saludable recognizes that the initial model of (not-for-profit) association of self-employed entrepreneurs can only be seen as an intermediary step towards the creation of micro-enterprises, with the ability to make investments in processing equipment. Only for-profit micro-enterprises would be able to go after business accounts, add value through processing and possibly directly export recycled material.

Contact information

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Appendix

Sources: "Case for Support" document by Ciudad Saludable (2011)

www.fairstreet.org/?tag=recyclage&lang=en; www.ciudadsaludable.org; www.proyectoproreciclador.wordpress.com; www.skollworldforum.org/2009/10/22/ciudad-saludable-solutions-in-the-waste

Field visit on the week January 6th, 2014

Exchange rate: 1 USD = 2.5 PEN

CLEAN TEAM

Project	
Organization	Clean Team
Geography	Ghana (Kumasi city)
Areas	Urban
Solution	Individual
Date started	2012
Stage	Pilot
Scale	503 toilets (Dec2013), >2500

Clean Installation team with toilet on pushcart
Source: www.ideo.org

Project description

History of organization

Clean Team is a for-profit social business incorporated in urban Ghana since 2012, owned by Water and Sanitation for the Urban Poor (WSUP), a UK-based not-for-profit business. It started actual production and installation of toilets in early 2013, Clean Team has been developed in partnership with WSUP, Unilever and IDEO. Unilever provided technical assistance and seed funding while IDEO designed the business model and the brand strategy. In addition, Clean Team has received funding from the Stone Family Foundation, and DFID.

Value proposition and profile of customers

Clean Team charges a monthly subscription fee for a portable toilet with a waste collection service 2-4 times per week. There is no up-front toilet cost for the households, as the toilets remain the property of Clean Team[21]. Depending on the service level – waste collection can be done 2x a week (for households with less than 5 people, currently 43% of all customers), 3x a week (households of 5-10 people, currently 52% of customers), or 4x a week (more than 10 people, currently 4% of customers). The waste is then disposed of at the city's local sludge treatment plant, while the waste containers are cleaned for the following morning's collection round.

Depending on the frequency of service, customers pay $8.5, $11.9 or $15.3 per month respectively. This compares to $3 per month for a very cheap and poorly maintained public toilet, $5 for a better maintained toilet and $8 for a nice one (assuming 2 adults per 4-5 person household would pay for use of a public toilet every day). Otherwise, the most widespread solution in this area until some years back was a system of night soil collection, which has been banned by the government. Anecdotally, about 50% of Clean Team customers state they now spend less money, and 50% say they spend more but that the added convenience is worth it. Besides of the economic argument, most consumers value the convenience (i.e. being able to use the toilet anytime, safely) and cleanliness of this solution (for instance many client households have elderly people at home with limited mobility), as well as the fact of being serviced by a professional team which brings status

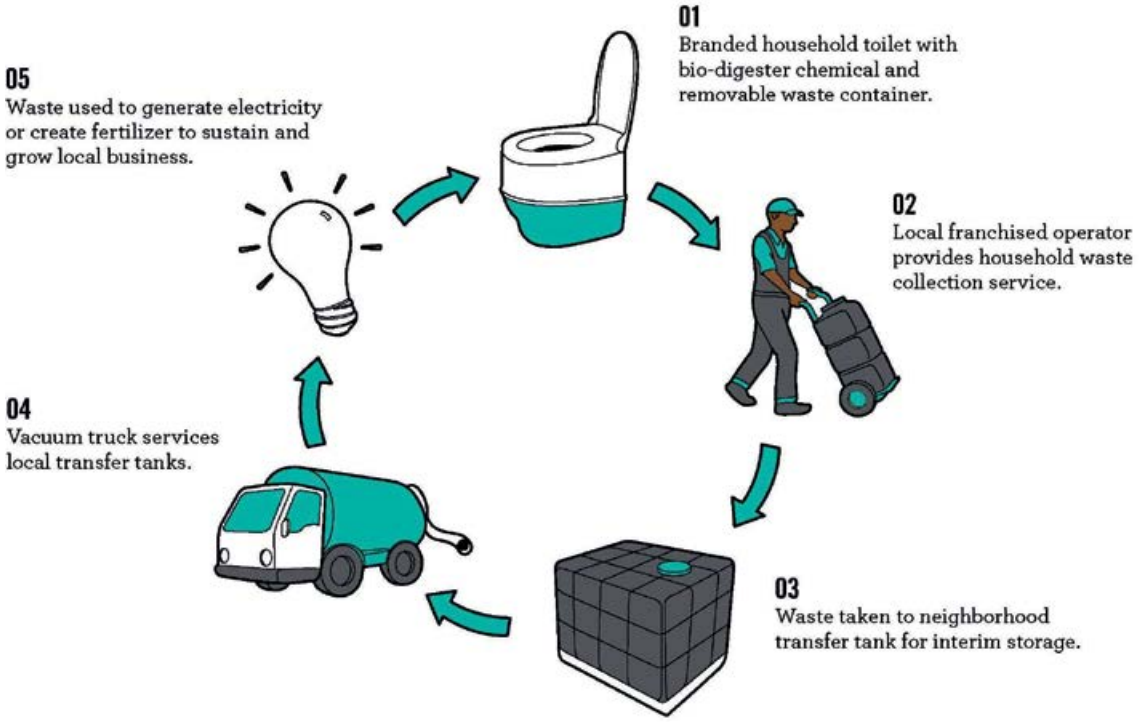
Interested customers sign a contractual agreement with Clean Team describing the service, outlining respective expectations and terms of the agreement. They also receive a booklet where payments are recorded. Payment terms are flexible and can be paid in a lump sum at the end of the month or collected in small amounts throughout the month.

Clean Team is present in a poor area of Kumasi, a city in South Ghana, which was chosen as it has a waste treatment plant, a very collaborative local government and both WSUP and Unilever had an established presence there. Most residents have irregular, informal jobs (e.g. hairdresser, food stall owner, market traders, tailors), and rent their dwelling (given that landlords manage to charge 5 years upfront rent, there is little incentive on both sides to actually improve the

21 While ownership of the toilets is essential to the Clean Team model (revenue from services and assurance that waste is collected and disposed of properly), no current customer is asking to actually own the toilet.

infrastructure inside or outside the house). There is running water in the courtyard for a small proportion of customers, and houses are built in hard, with a room for bathing. An estimated 20-30% of customers live in a one-room shack, while 70-80% live in compounds with 2 rooms and a small space for a storage or bathroom. Household income likely ranges from $85 to 250. There is limited information available on what previous sanitation solutions Clean Team users were using until then.

Value chain



Manufacturing operations

The toilets are manufactured in China and imported. The cost of the toilet and shipping is of $82 (import duties have varied a lot, but average a 15% on top of that). Unilever owns the molds. It hopes to bring down the costs of production to $50 by manufacturing at scale and investigating local manufacture to reduce import costs.

Marketing & sales strategy and organization

Clean Team currently operates in North East Kumasi, and the sales territory is divided into five areas. Each area is serviced by one Sales Associate, one Waste Collector and counts about 100 client households.

Clean Team promotes its toilets via two main strategies:

» It has a team of 5 uniformed door-to-door promoters, who are young men and women well connected in their neighborhood (no other specific requirement), who go and sell the toilet based on a photo book (they show the pictures and help customers do the math in terms of public toilet savings) and leaflets. They act as referrals, and if a customer is interested, they register their details and the recruiter compiles a list which is then passed on to the Customer Registration Officer. They currently receive very little formal training.

» Once a week, there are team promotions in the street (Clean Team regular team in uniform disseminate brochures, stickers and T-shirts to interested potential customers).

Both strategies seem equally effective in terms when balancing out time spent and number of people mobilized. Clean Team does not do any ATL campaign yet.

Once an initial client base is established in an area, word-of-mouth seems to play an important role, as penetration roughly doubled from August until December 2013. The main driver for word-of-mouth is the installations of actual toilets, which creates a buzz in the local neighborhood and is also an opportunity to connect with potential customers.

The **Customer Recruitment Officer** then goes through the list and checks/ confirms the interest of potential customers, arranges for the payment to the promoter, and coordinates for the toilet installation. This person is also in charge of market research. A short customer satisfaction survey is conducted monthly through the Service Associates to provide feedback on the service. Quarterly, the team hires external enumerators to complete a more detailed customer satisfaction survey to remove any bias from staff reporting. The Customer Recruitment Officer compiles a report of issues and recommendations for action to address these.

One of the 5 **Service Associates** (literate, numerate Clean Team staff) is present during the installation of the toilet. They explain the contract and agree on a payment schedule, even though payment is very much flexible, as customers often contribute towards to total amount each time the Service Associate – who is also in charge of money collection - visits them (and records payments in the customer pass book). Each Service Associate is in charge of roughly 100 customers (and they see in average 30-35 customers a day). They also get a commission if they bring a new client.

Installation

One plumber (Clean Team staff) does the installation of the toilet, which simply requires to assemble the few parts together and arrange for the urine diversion pipe (either into a container, whose content is then poured away, or diverted into the gutter). The toilets are actually delivered by a rickshaw driver and then pushed by hand cart to the home by the plumber.

Usage and hygiene

Toilet usage is explained during the installation and specified in the contract. Posters are provided to remind customers of how to use the toilet (this does not include hand-washing and standard hygiene practices). The Waste Collectors (see below) clean the toilet surface when they collect the cartridges. Otherwise, the household should be taking care of the toilet cleanliness. In a survey on hand washing practice completed by Cranfield University, 90% of respondents reported using soap for hand washing after using the Clean Team toilet.

Waste storage and collection

Waste is stored in cartridges under the toilet, which are sealed and removed from homes by one of the uniformed Waste Collectors (Clean Team staff), in the early morning, and then transport them to a local holding tank, where the cartridges are cleaned using water and bleach and fresh toilet additive is added. Each Waste Collector is in charge of roughly 100 customers (they see in average 30-35 customers a day).

Waste treatment, disposal and recovery

Clean Team hires a local vacuum truck to transport the waste to the municipal plant, where it is treated at the facility (reportedly the best of Ghana). The vacuum truck pays for the transport and the gate fee at the plant.

In addition, Clean Team is exploring new ways to use the waste as a fertilizer or an energy source, by testing the efficiency of 3 different anaerobic mid-size systems (2500 households' waste capacity).

Technology

Description of toilet-related technology

Key features:

- Design: Molded ABS & HDPE plastic (7 components) portable toilet. The toilet has a urine diversion compartment (linked to a urine diversion tube).
- Durability: Manufacturer estimates at 3 years lifetime. No need for specific maintenance.
- Installation needed: No installation needed but for the placing of the tube for urine diversion.
- Water and energy efficiency: This is not a flush toilet. Water can however be thrown in for personal hygiene. No electricity needed.
- Malodors and safety: There is no barrier between the faeces and the user. The toilet additive helps limit odors and bacteria growth. Malodor may however occur, in heavy use and high temperatures.
- Waste storage: Urine is diverted through a flexible tube for gutter/container collection. The faeces fall into a removable container under the toilet, which is filled with 4L of a toilet additive product which hides the faeces, limits odors and bacteria growth.
- Waste collection: The toilet has a removable sealable waste tank. Top half of toilet unlocks and hinges up, allowing tank to be hygienically sealed with a lid and removed by service person. Tanks stack up for transport and storage. Emptying and cleaning is done manually at a dedicated facility although this is planned to be automated.

  Potential and limitations: Requires imported toilet additives, which were not designed for hot climates, although there is a product development activity underway to address this; toilet lacks a barrier between user and waste; urine is not currently collected but simply disposed of in the gutter by the user.

Social impact

- Penetration: So far 503 toilet contracts have been sold thus benefiting to around >3000 users. Planned scale-up once unit-level breakeven has been reached.
- Acceptance and usage: Over the past 10 months, Clean Team registered about 5% drop outs (temporary – if the family travels for a longer period of time, or permanent). The policy is to wait up to 2 weeks of non-payment before removing the toilet. The main reasons for permanent drop-outs are: the family moves outside of the current operational area or travels; changing financial circumstances/affordability.
- Customer satisfaction: Monthly surveys are conducted by the Service Associates. Independent surveys are conducted quarterly to follow quality of service. Main reason of complaint is related to malodor. In November 10% of the customers interviewed said pickup frequency did not fit their needs and so action was taken to ensure all waste collectors left early and had finished collections by 9am. 98% of customers say they were getting value for money.
- Evidence of impact on health: It is expected that health indicators will be measured in a study in 2014.
- Promotion of related behaviors: For now, related behaviors are not actively promoted. Sale of soap products through the Clean Team Sales Associates is being envisaged, and may act as an educational channel.
- Waste collection and disposal strategy: The toilets remain the property of Clean Team and are removed in case of non-payment or improper use.

Economic sustainability

End consumers

- Affordability for end users: Most user families pay between $~8 and $12, which represents roughly 2-4% of the estimated average household monthly income in the area. This is however roughly double the price of what the family adults would pay if they would go daily to a more expensive public toilet. The price was set lower during the trial and there was extremely high demand. Once all costs of the business were known, decision was taken to increase to current levels. Demand fell slightly, indicating right level.
- End consumer financing: No financing is required for the toilet. The frequency for the payments can be negotiated from twice a week to monthly (about 60% of family prefer to pay twice a week and 40% at the end of the month). It is estimated that about 30% households pay somewhat late, but no contract was discontinued so far due to non-payment.

Upstream organization

Clean Team aims to reach breakeven at 1500 toilets installed at each central processing facility. As of today, important variable cost elements are the additives employed within the toilets (the team is looking at ways to bring those significantly down), and labor. Relatively large amounts of capital are immobilized, with regards to the stock of toilets and additives. Clean Team installed about 400 toilets in 2013 (i.e. about 30 new toilets/month), but experienced peaks of 80-120 toilets/month, during those months where it experienced less operational challenges. The steady growth is encouraging, given that Clean Team keeps working in the same areas, pointing at the fact they have still not reached a first level of saturation.

Promotion agents act as referrals for their neighborhoods mostly, and earn a commission: $0.67-0.89 per toilet depending on how many they sign-up each week. Given they sell in average 8-10 toilets a month (up to 20 toilets in good months), this results in an income of $6-10, for a job that requires little of their time, for the period they are actively engaged in finding customers among the families living in their neighborhood.

The remuneration of the Clean Team field staff ranges from $220-250 for the lower positions, to $400-450 for the supervisor position. There is limited turnover among the waste collection team, as this represents a stable, full-time job for illiterate men, with little other opportunities. The turnover is slightly higher for the Service Agents, who essentially see this job as a springboard to continue studies or find better opportunities.

Innovations

- Convenient product adapted to households in dense, urban areas not connected to sewer, for whom the main alternative was expensive and often poorly maintained public toilets
- Service-based model ensuring regular revenues and avoiding end-consumer financing
- Aspirational brand, turning the functional into the desirable

Remaining hurdles and bottlenecks

- In order to evolve towards being a globally relevant business, Clean Team is exploring how it could ensure waste treatment in cities with no waste treatment facility, either by integrating technologies that would allow it to produce biogas and fertilizer
- Working capital management (given large amounts of cash immobilized in equipment and inventory); this and overall profitability could be dramatically improved if the total costs of the toilets could be brought down to the target $50
- Clean Team is currently working on an alternative formulation and production of an effective and affordable toilet additive, with a view to reduce this significant variable cost item; Inconvenience of seasonal malodor.

Contact information

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Appendix

Sources: www.cleanteamtoilets.com; www.nextbillion.net; London School of Hygiene and Tropical Medicine in collaboration with Domestos, Mapping Sanitation Solutions; Interview with Lisa Hawkes, COO Clean Team on 21.11.2013

Exchange rate: 1 USD = 2.94 GHS

PEEPOOPLE

Project	Initial Launch Project
Organization	Peepoople Kenya (NGO)
Geography	Kenya, Nairobi (Kibera slum)
Areas	Urban
Solution	Individual
Date started	2010
Stage	Pilot
Scale	995k bags distributed (out of which 512k sold and 483k distributed in schools)

Peepoo bag. Source: www.greenupgrader.com

Project description

History of organization

Started in 2005, Peepoople AB is a Swedish for-profit social business which aims to provide "universal access to hygienic and dignified sanitation". Peepoople produces Peepoo, a single-use, biodegradable, self-sanitizing bag for urine and feces, easy to use when fixed to a suitable small bucket or container. Peepoople created an NGO, Peepoople Kenya, to sell this sanitation solution in the Kenyan slum of Kibera. The objective is to build a sustainable sanitation operation that could be replicated in other urban slums. The product was field tested in 2009 and 2010, and was rolled out late 2010. The following two years were spent on exploring different sales and distribution schemes, until mid-2013, when the current approach was stabilized. The project run by Peepoople Kenya is currently funded by Simavi (Dutch NGO) and the Swedish government agency Vinnova. Since 2013, Peepoople also provide Peepoos to aid organizations (e.g. ACF, Swedish Red Cross) for emergency situations. In late 2012, Peepoople Kenya also started working with approximately 60 informal schools (10,000 children) on a philanthropic level, whereby it provides cabins, an attendant and free bags for use by the children.

Value proposition and profile of customers

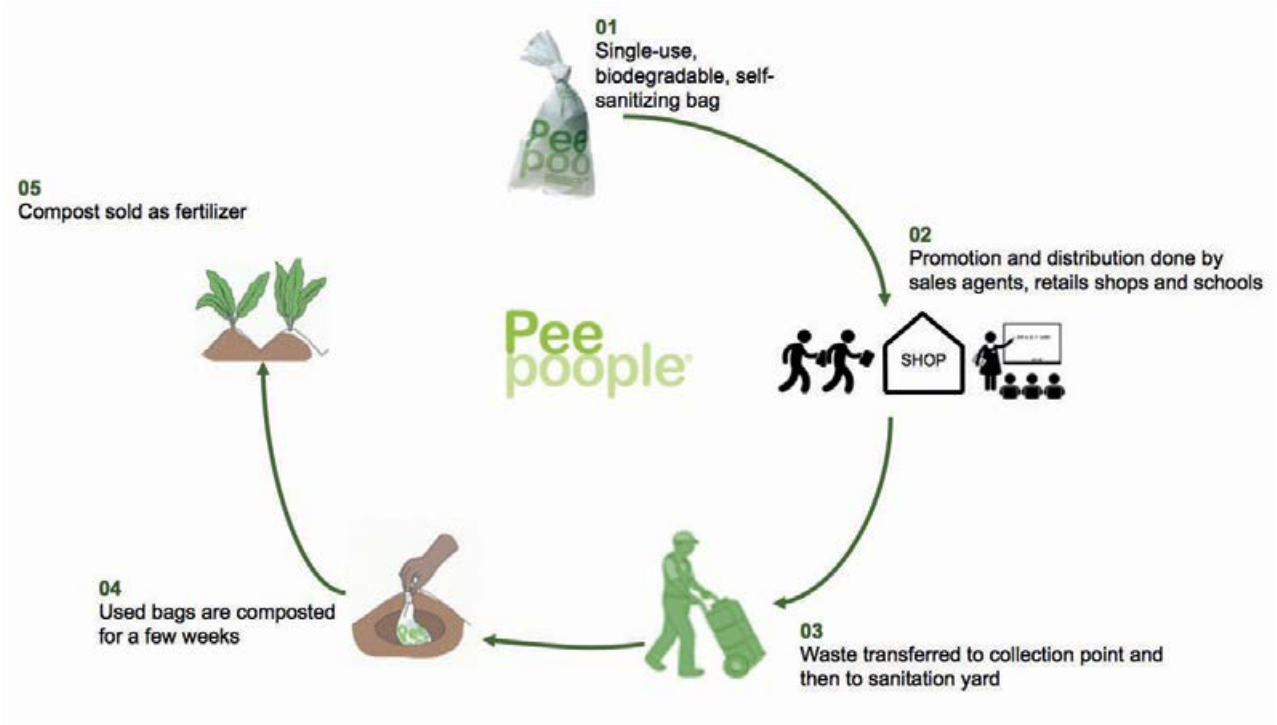
Peepoo is an improved sanitation solution for slum dwellers, who have to choose between open defecation, unhygienic public toilets or "flying toilets', as they have no space in their homes for a toilet. It consists of a self-decomposing and self-sanitizing bag, which is fitted on the Peepoo Kiti (customized seat) or any suitable small bucket or container, which are brought back to Peepoople drop points in exchange for a refund. The bag can be easily sealed for hygiene and safety, it does not smell for 12 to 24 hours, and is single use. It costs SHK 3, out of which SHK 1 is refunded. Users can also buy packs of 28 bags for SHK 50 (SHK 1.8/bag), or if users buy 2 packs they will be given a Peepoo seat (Peepoo Kiti) for free (2013 introduction campaign). As the bags are hygienic to handle, single-use and odorless, they are a clean and hygienic improvement on open defecation and flying toilets practices. Households use them in particular at night (when it is unsafe to get out), with kids (to replace night pots) and when they are located far from public toilets. Many regular public toilet users also prefer Peepoo, as it is a more economic option than paying a public toilet fee (which costs SHK 5 for adults and SHK 3 for children). Finally, unlike flying toilets, which polluted streets and gutters, Peepoos also get collected.

Peepoople sales operations are active in 4 of the 13 'villages' of Kibera, covering a population of approximately 9000 households (45,000 people). The population living there are 90% renters (SHK 500 to 3000 rent/month) and it is estimated that open defecation is practiced by 50% to 70% of the slum population. Slum dwellers are hawkers, construction or factory workers, they also undertake cleaning jobs or run small informal businesses.

Within and beyond these areas, Peepoople also run the Peepoo School Program where Peepoo toilets (cabins and regular supply of bags) are distributed for free to approximately 60 informal schools on a philanthropic basis.

For emergency operations, Peepoople also sells its products in bulk (packs, Kiti seats and tents).

Value chain



Manufacturing

Peepoople buys the biodegradable plastic resin from BASF and has it transformed into plastic films. Peepoo production was manual and low-scale until 2013, when it purchased a specialized fully automated machine (3.5m Euros) which can produce 500,000 bags a day. Peepoos are manufactured now in Europe. Once the manufacturing operations have been fine-tuned the maximum production capacity is about 500,000 bags per 24 hours.

Marketing & sales strategy and organization

The project carried out a number of radio campaigns to drive awareness of the product. However, promotion is mostly done by sales agents, during small information sessions at community events. At these events the agents explain the basics of hygiene, hand-washing and safe sanitation, as well as promoting Peepoo bags as a safe and hygienic sanitation solution. Peepoople now employs 21 sales agents each covering 400 to 450 households on average, and selling 1 to 10 packs/day (one pack containing 28 bags), with about 25% of sales agents selling 10 or more packs a day. The sales agents organize on average between 3 and 6 community meetings every month (where 5 to 10 participants end up buying the product and are given free soap as a bonus). These meetings are particularly effective in 'breaking the taboo', as all matters related to sanitation are 'shameful' in Kenya and most do not want to admit practices of flying toilet or open defecation. The neighbors can discuss the product and possibly agree on how to organize themselves within their neighborhood. This makes it easier for any individual family to adopt the practice. Otherwise, sales agents work door-to-door to restock existing customers and possibly find new customers (typically 1 to 2 new customer/day). Word-of-mouth is already one of the main sources of business, as existing users share and recommend the product.

The agents purchase the rolls at SHK30 (making a margin of SHK20 on the sale) and are given an incentive payment of SHK 300 each time they successfully run an event (i.e. with a minimum of 10 packs sold). The sales agents are either ladies that are well connected and respected in the community, or community health workers (that are volunteers, who relay the government policies at the grassroots to help roll out health programs). They are trained for 1 to 3 weeks on the job, depending on their background. While the sales ladies turnover was relatively high at the beginning of the project (as sales struggled to pick up), it is minimal today. After working a couple of hours a day a sales lady can currently earn between SHK 3600 to SHK 6600 per month, which compares rather favorably with the average household income in slums, which hovers around SHK 7,000.

Other sales channels include 23 retail kiosks, who sell 6 to 7 packs/week (they also reported the sale of 10 single

units/day). Most customers are not regular and come to the shop for convenience and privacy reasons. Finally, school attendants are also encouraged to sell the products, even though this has proved to be more challenging as they work from 9am to 4pm, and most of the schools are actually located outside of the current operational areas of Peepoople.

Sales agents, Peepoo collectors and small retail shops are supervised by 6 'zone markers' (Peepoople staff) who also manage stocks and payments.

The team uses a system of zone mapping and marking to count households and assess penetration, as well as make sure each area is linked with a single sales person and collector. Individual homes are also marked with an "S" (if sold to them) and/or a "C" (if they wish home collection).

In schools, the project distributes in average 2000 to 3000 bags a day for 10k school children, and pays the 40 school attendants in the bigger schools a lumpsum of 5000 SHK/ month. Collection is organized differently depending on the location of the school, but there is no refund system. Each school undergoes a 2 to 3 months trial period, at the end of which the project tries to enroll parents by telling them about the program and the need for improved sanitation. There is currently little evidence that this program drives sales in these areas (partly due to the fact that a number of schools are located outside of the operational areas of the project). However, there is anecdotal evidence that the school program helped drive acceptance of the Peepoo solution in the community, and parents are even starting to see participation in the Peepoo School Program as a selection criteria for schools.

Installation: N/A

Usage and hygiene

Sales agents educate local communities on hygiene and hand washing during promotion events, where they also explain how to use Peepoo.

Maintenance and cleaning: N/A

Waste storage and collection

Bags are single use, and need to be sealed after use to ensure hygienic handling. They remain odorless for 12 to 24 hours afterwards. The Peepoople team first assumed that most users would bring them back for the refund, but this did not take place. Instead, 9 collectors (mostly women) saw this as an opportunity to earn some additional income and started spontaneously covering their neighborhood to collect the waste. In other areas, the sales ladies and community health workers helped identify potential candidates for this role. 1 collector is now attached to approximately every 2 sales ladies to ensure clear zone demarcation between them. Collectors make an income by cashing in the refund, and typically work early morning (8am to 10am). A good collector gathers approximately 200 to 300 units a day (earning as much in SHK). In new or slow areas, the collectors are given a flat fee until the number of users picks up. Users either leave used bags in the street, in bins, or ask for them to be collected at home (about 20% to 30% of them). In addition, some slum dwellers also offer to do the collection for their lane or compound, the proceeds are either kept or redistributed back to their neighbors.

Four drop points are situated in strategic areas of the project. They are run by full-time Peepoople staff, drop point attendants who count and pay for the units returned. The drop points are open from 6.30 am until 4 pm. The name, date and number of bags are recorded there.

Cash/payment collection

The drop points attendants hand out the refunds on a weekly basis (all of this is done through m-pesa).

Waste treatment, disposal and recovery

Used bags are collected daily from the drop points in large numerated containers and brought to an intermediate collection point, the 'aggregation center'. On a weekly basis, they are then brought to a sanitation yard, where they stand for 3 to 4 weeks, so that all pathogens are killed. The by-product is compost, which is then distributed to farmers and various other projects. The project, after experimenting with the compost, is now planning to sell the decomposed bags to farms. Three farmers are already growing coffee, maize and napier grass using Peepoo as fertilizer. Peepoople Kenya is also exploring the opportunity to collaborate with agroforestry representatives to help acceleration reaforestation efforts in the country.

Technology

Description of toilet-related technology

Key features:

- Cost: 5.1 SHK/bag (raw material costs only). This cost may come down along with the price of biodegradable materials. As utilization of the high-capacity production line increases, the fully loaded cost (including full production cost, overhead and depreciation) will stand between 10 to 15 SHK/bag (according to the production volume projections of period 2015-2016). By 2020, the project hopes to bring down the fully loaded cost of the bag to approximately 5 SHK.

- Design: Peepoo is made of degradable bio-plastic "Ecovio", whose ammonia-based composition allows for almost complete malodor control and self-sanitization. The bag is opaque and equipped with a foldout funnel that facilitates usage and the outer bag is long and slim for safe and easy sealing with a knot. In addition, the bag contains 6 gram of urea, a sanitation agent that drives the effective self-sanitization process.
- Personal, single-use, easy to store and transport, safe-to-use product, that does not require fixed infrastructure or investment from the households
- Water and energy efficiency: N/A
- Malodors and safety: Once sealed, the bag does not carry any odor for 12-24 hours
- Waste storage: Once sealed, waste is safely stored in the bag.
- Waste collection: Bags are brought to larger collection containers at drop points in buckets or plastic bags
- Potentialities and limitations: The biodegradable plastic currently used is an emerging, hence still expensive technology. The polymer is a mixture of aliphatic/ aromatic co-polyesters and poly-lactic acid, with small additives of wax and lime. The biomaterial is developed in cooperation with the German company BASF.

Description of by-products-related technology

Key features:

There is no specific technology involved in the composting process. Thanks to the urea stocked in the bags, the waste is made completely safe after 3 to 4 weeks (urea turns into ammonia that inactivates pathogens). The process is well controlled thanks to the storage in larger sealed containers.

Economics:

Currently, Peepoople Kenya collects 10 tons of waste per week. Peepoople has been testing the properties of its compost and its applications. Early results are very encouraging, composted bags can be directly laid under new tree seedlings after the 3 to 4 weeks storage period in the sanitation yard, resulting in accelerated growth of the plant (2 to 3 fold increases). It has now managed to sell its first 3800 single unit bags (250g to 300g each) to coffee farms for 4SHK/ composted bag (about 25 units are needed per plant).

If let decompose underground for another 2 months, the compost turns more concentrated while keeping high levels of hydrogen and can replace very advantageously synthetic fertilizer. 5 tons of 'further processed' compost per ha spread at planting resulted in 50% to 60% more yields than yields obtained with the recommended levels of synthetic fertilizers. In addition, this organic fertilizer contains carbon which contributes to structuring and nurturing the soil (while synthetic fertilizers typically dry and deplete it). In terms of price however, Peepoo still remains much more expensive ($4700 per ha for 5 tons of Peepoo, vs. $230 for 250k of chemical fertilizers containing the same recommended level of nitrogen and phosphorous). To obtain 5 tons of 'further processed' compost, Peepoo needs to collect 15 tons of fresh human waste (100k bags, or 60% of the current monthly collection volume). Hence, while the results of this improved compost are impressive, Peepoo would need to dramatically expand its operations to become the supplier of choice of a number of mid-sized farms.

Social impact

- Penetration: During the latest months, Peepoople Kenya sells on average approximately 2000 to 3000 bags a day (80k a month) and distributes approximately 60 to 80k bags a month in schools (when open). In Kenya slums, estimated penetration is 35% to 55% (after about 7 months of stable operation) if counting all 1 time only buyers. Sales agents estimate however that 1200 to 1500 households (17% of all households in the area) use Peepoo once or twice a week (for night or emergency use, or at weekends when they do not go to their workplace toilet), and 300 to 500 households (or 5% to 6% of households living in the area) use it regularly. The project would need to sell up to 1.5 million units/month (or 60k units/day, which would be roughly 3% regular users among the estimated population of 2 million slum dwellers in Kibera) to reach breakeven (assuming significant cost reductions on the production side and systematic sales of fertilizer). Peepoople AB also sold about 2m bags this year (2013) to emergency clients in Pakistan, Philippines, Syria and China.
- Acceptance and usage: Consumers are likely to purchase the product given the convenience, comfort, safety and hygiene it offers (including in the surroundings where flying toilets diminish), but still few consumers use it as their sanitation solution of choice. In fact, the product is somehow linked to the 'taboo' practice of flying toilets, which customers are often ashamed to admit. And so, many times they would not articulate the need to replace or improve this practice, but for their children.
- Customer satisfaction: Surveys (including customer satisfaction assesment) have been conducted in 2012 and 2013.
- Evidence of impact on health: Too early to tell for slum users. In schools, it is reported that the introduction of Peepoo toilets has dramatically improved enrollment (as parents see this infrastructure as a plus) and reduced absenteeism by 40%. In addition, children are sensitized

to the importance of hand-washing and safe sanitation.

- Promotion of related behaviors: Sales agents do basic WASH education during the community promotion sessions, where they broadly cover the topics of germ transmission, the need for handwashing five times a day, and the need for safe sanitation.
- Waste collection and disposal strategy: The Peepoo team had initially envisaged that the refund fee of 1SHK per unit would be enough to drive individuals to drop theirs at the drop points. However, given irregular usage, the fact that 1 SHK is very little and the fact that 'handling shit' is a taboo, no individual ever does. However, local slum dwellers saw this as an opportunity, and they cover whole neighborhoods. While the project tries to allocate those to zones, there are still issues of competition and 'border-crossing' between them.

Economic sustainability

End consumers

- Affordability for consumers: Peepoo bags can be purchased by the unit (3 SHK) or in 28 units packs (1.8 SHK/unit) out of which users can get a refund for 1 SHK, bringing the price down to 0.8 SHK/unit if the users actually bring it back themselves to the drop point. This compares to SHK 5 for public toilets use (3 SHK for children). Very few families manage to negotiate a family package deal of SHK 150/family/month at the public toilet, making Peepoo a more private, pleasant and safe alternative, as well as cheaper alternative to daily public toilet use. Peepoo costs SHK 270 assuming 1 daily use per family member and no refund vs 570 SHK assuming 1 public toilet use for each family member, or SHK 300 if only the adults use it. If used bags are returned, regular use costs as little as SHK 120/family/month. For comparison, these families spend on average 300 SHK/month on electricity and at least 1200 SHK/month on cooking fuel. The average household income is SHK 10 to 15k SHK/month, out of which approximately 25% typically goes for rent. One hypothesis is that the most avid Peepoo users were previously using public toilets regularly.

  For schools, the Peepoo solution is a clear plus, as many were equipped with pit latrines that required frequent emptying (every 2 to 3 months, for a price of SHK 15k to 20k)

Upstream and downstream organization

- Main organization: Peepoople Kenya estimated that it would need actual sales of 22m bags a year (60k a day) to reach break-even, assuming they could bring down their 'imported price' to 5 SHK/ new bag and sell for 5 SHK/ composted bag. At this scale, Peepoople Kenya would cover both its operating and overhead costs.

Innovations

- Limited infrastructure and no maintenance cost. At scale, distribution and collection operations could be streamlined to a minimum.
- Self-sanitizing technology (ammonia-based sanitation technology, combined with being personal and single-use solution, enclosing the feces directly at the source caters for good hygiene and disease control.
- Very small and lightweight, portable and mobile, enabling in-home usage, while being a clear improvement on 'flying toilets'.

Remaining hurdles and bottlenecks

- Sales of fertilizer have only just started. While the product seems to be good, there is still much demonstration and market building needed to have most of the waste actually sold to small-size farmers and agroforestry
- So far, the project does not manage to charge enough for its products itself to allow for faster and better cost recovery

Contact information

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Appendix

Sources: London School of Hygiene and Tropical Medicine in collaboration with Domestos, Mapping Sanitation Solutions; www.peepoople.com; www.germany.ashoka.org/sites/germany.ashoka.org/files/CIDG%20Fellow%20-%20Anders%20Wilhelmson.pdf

Exchange rate: 1 USD = 85.5 SHK

SUSTAINABLE ORGANIC INTEGRATED LIVELIHOODS (SOIL)

Project	Scaling-up sanitation solutions
Organization	SOIL
Geography	Haiti (Cap Haitien)
Areas	Urban/ peri-urban
Solution	Individual (household pilot)
Date started	2006 (2012 for the household pilot)
Stage	Pilot
Scale	251 household (home toilets), around 110 households (31 shared toilets)

SOIL urine-diversion toilet. Source: Hystra

Project description

History of organization

Sustainable Organic Integrated Livelihoods (SOIL) is a US non-profit organization. Its work focuses on two urban areas in Haiti, Port-au-Prince and Cap-Haitien. SOIL's mission is to protect soil resources, empower communities and to transform waste into valuable resources. SOIL mostly receives grants from foundations and individual contributors.

The work of SOIL in Haiti spans 3 main phases, firstly in 2006-2009 it focused on constructing 54 public urine-diversion toilets. Secondly in 2010-2012, following the earthquake, SOIL focused on constructing 200 emergency ecological toilets in 32 camps around the city and a composting waste treatment facility in Port-au-Prince to treat the waste collected from these toilets. Thirdly since 2012, SOIL has focused on a household-level toilet pilot. For this pilot SOIL was supported by re.source Sanitation (experts from Stanford University), who helped with the ecosan toilet design and household surveys. Today, 251 households (approximately 1'980 people in total) are using SOIL home toilets and another 110 families share the same toilets between 3 to 4 families (orabout 870 people in total).

Value proposition and profile of customers

SOIL provides portable, waterless, urine-diversion toilets (branded as Twalet EkoSOIL) to be used in homes or outside (in shared compounds) by families not connected to the sewage. The toilets remain the property of SOIL, which promotes and services the toilets twice a week (against a monthly fee of $5/toilet) by a team of waste collectors who pick up the waste, which is contained in a drum under the toilet seat. All the waste is brought to, treated and processed at the SOIL compost plant, before being sold to the Ministry of Agriculture and various businesses.

Users are families living in a slum of Cap Haitien (Shada neighborhood). This neighborhood was chosen, because SOIL was known there for its previous work. Nearly all slum residents are renters, who live in rooms of under 10 square metres in size (very basic type of habitations, ranging from metal to solid walls constructions) and earn $50 per household monthly. A family accounts for about 7.9 people and a family shares two of these small rooms. Most early adopters are families in the phase of upgrading their living facilities, who are often familiar with SOIL's public toilets installed after the earthquake.

Once they agree to a contract with SOIL for a toilet, the users sign a service agreement, which lays out the terms of the collection service.

SOIL also promotes the same solution for groups of households, who share the use and the costs (the price of the service is also $5). These are typically families who have less income earners.

Value chain

Manufacturing

SOIL toilets consist of a plastic toilet seat, urine diversion inlet and cover, along with a wooden shelter (if shared and/or outside toilet), as well as 20 or 60 liters drums (depending on the number of families using the toilet). It sources the plastic part from local shops, and subcontracts the manufacturing of the wooden elements to local carpenters. When SOIL was manufacturing the toilets itself, manufacturing costs were about $75 (without shelter). Currently, the production cost is $50 without shelter (home solution) and $175 to $400 with a shelter (shared toilet) depending on the materials used, notably for the superstructure. Today, SOIL can get 140 toilets a month from its suppliers.

Marketing & sales strategy and organization

SOIL's marketing strategy focuses on community events. The events are held by a team of four, non-dedicated SOIL staff, who organizes 5 to 6 events a month in different communities. They receive no commission for this work, but are paid a salary by SOIL. Currently however, as word-of-mouth picks up, demand outstrips supply in those communities where SOIL is working.

Installation

A team of four SOIL staff undertakes the transport, assembly and installation on-site. These are regular SOIL employees. It takes only few minutes to set-up a new toilet. This team also explains the functioning of the toilet and terms of the servicing agreement. Making the service agreement takes the most effort, it involves identifying the contract partner and the person paying for the service fee and documenting the agreements.

Cash/payment collection

Cash payment is done on a monthly basis and collected by the waste collection team. There is limited information available on payment delays. So far, a few toilets have been taken back due to default of payment.

Usage and hygiene

The installation team gives initial advice to customers on how to use the toilet (e.g. do not throw sanitary napkins into it). Households are given a hand-washing bucket with the toilet at installation. The households are also provided with sugarcane bagasse or peanut shells, this material is to be thrown into the toilet after use, to reduce flies and it assists in the composting of the excreta.

Maintenance and cleaning

Families clean the facilities themselves. In the case where multiple families share the toilet, they typically select one caretaker. Maintenance is usually not required.

Waste storage and collection

Feces are contained in a bucket under the toilet which is collected twice a week from households by the SOIL collection team (the buckets are closed, replaced by a new, clean one, and brought to a collection point, where they are transported by truck to the composting plant on a weekly basis). At the plant, the content of the buckets is dumped into the compost bins and covered with sugarcane bagasse. The buckets are then cleaned and returned to the collection point. The collection and transportation of drums is undertaken by a team of 5 SOIL employees (2 collectors,

1 truck driver and 2 assistants). On average, each collection team member services 100 households during an 8 hour day. Urine is diverted by a pipe, either into a separate bucket that is emptied by the user in the vicinity of the household (canal, sea, ground, etc), or directly to a soak pit if possible.

Waste treatment, disposal and recovery

SOIL uses a large composting site for the waste collected from toilets in Cap-Haitien. After processing, each batch of compost is tested for germs before being packed into 20 litre bags for sale. There is only one dedicated person working at the compost site, they are assisted by the collection teams in the waste processing work.

Compost marketing

SOIL markets its compost under the brand name "Konpòs Lakay" to businesses such as Heineken (as part of a CSR initiative) and the Ministry of Agriculture, which purchase it in bulk for subsidized distribution to small farmers. To market the product, SOIL runs demo agricultural trials and directly markets the product to potential customers through a team of four people. From the beginning, SOIL has had to devote more time and energy into marketing compost than the toilet services. This is primarily due to the fact that there is no existing market for compost in Haiti. Today, SOIL manages to sell 50% of its compost on average.

Technology

Description of toilet-related technology

Key features:

- Design: Compact, portable toilet unit designed for home use. The toilet has 5 main components.
- Durability: Estimated lifetime of 5 years.
- Water and energy efficiency: No electricity or water is needed.
- Malodors and safety: Sugarcane bagasse or peanut shells are thrown in to eliminate smell, reduce flies and to assist in the composting of the excreta.
- Waste storage: The opening in the back section of the seat allows the feces to drop into the drums that are located below the toilet structure. The front section of the seat diverts the urine.
- Waste collection: Is done manually until collection points.

Description of by-products-related technology

Requirements and functioning:

The solid human waste is transformed into agricultural-grade compost at the composting site in Cap Haitian. SOIL applies a thermophilic composting process to treat the human waste, i.e. the waste is stored in wooden boxes, it is watered regularly and covered with carbon matter (this ensures that flies cannot access the fresh feces, reduces smells and insulates the pile to maintain the internal high temperatures). Once the bin is filled, the compost stays in the bin for at least one month and is closely monitored. Every 2 to 3 days, SOIL measures the temperature of the compost to monitor temperatures throughout the pile. When the temperatures start to go down (usually after 3 months) the compost is moved into windrows to finish decomposing (which takes another 0.5 months). SOIL's composting process is effective at eliminating all human pathogens within the first 3.5 months of treatment at the compost facility. SOIL tests all finished compost for E. coli, a key indicator pathogen, before sale or use. The compost that can be sold for various purposes (soccer fields, tree planting, nurseries, fish food, household gardens in urban areas, community gardens, and tree planting).

Economics:

SOIL's waste treatment sites treats and transforms over 76,000 litres of human waste per month. These 76,000 litres yield to about 36k litres of compost per month. This corresponds to 12.1 litres of compost per person per month, at an average price of $0.15 per litre (or $1.8 per person/ per month). The processing costs less than $3 per person per month. Processing costs includes the labor, equipment, as well as the infrastructure costs. Since 2011 SOIL has sold 235'000 litres of compost to individuals, companies, and organizations around Haiti.

Social impact

- Penetration: Since 2010, SOIL has installed and is servicing 251 home toilets and 31 shared toilets, used by 375 families (or 2'960 people). This corresponds to about 6% of families in the Shada neighborhood.
- Acceptance and usage: No customer has returned the toilet to date, and most households use the toilet regularly (night and day).
- Customer satisfaction: Customer satisfaction is not surveyed systematically. Main topic of complaint is related to the service fee.
- Evidence of impact on health: No survey conducted yet.
- Promotion of related behaviors: No promotion of such behaviors. However, toilets come with a hand-washing bucket.
- Waste collection and disposal strategy: The toilets remain the property of SOIL.

Economic sustainability

End consumers

- Affordability for end users: The monthly servicing fee is $5 for single families (or an estimated 5% of total household income) vs $1.5 to $2 if the adults regularly use the public toilet. The price was set based on initial surveys on willingness to pay. As a point of comparison, re.source found that people usually pay $2.3 to $4.6 /month) for their cell phone bills.
- End consumer financing: N/A

Upstream organization

SOIL operates a number of projects thanks to grants. With regards to the home toilets project, current servicing revenues cover for the salaries of the waste collectors, and the fuel of the collection truck. It does not cover for overhead costs and toilet manufacturing costs. Scaling up the project to 500 toilets should help cover additional costs, such as manufacturing costs.

Field team members earn ion average $100/month. Due to very limited job opportunities, there is a very little turnover among the team.

Downstream organization

SOIL currently manages to sell 50% of the compost it produces. It is estimated that compost sale revenue and waste treatment fees can recover about 70% of overall costs for waste treatment in the long term.

Its main client so far washas been BRANA (Brasserie Nationale d'Haiti S.A), a member of HEINEKEN, which agreed to purchase 190'000 litresers of compost to test the compost's ability to increase local sorghum yields. Overall, SOIL has about 75 customers purchasing one to two bags of compost (about 200 KG) per month. The Clinton Foundation has also made a grant to SOIL of $25,000 for additional agricultural research on compost.

Innovations

- SOIL has been effective over the years in establishing itself as a reputable provider of sanitation solutions in the communities they work in. Hence, customers now havenow a high awareness and acceptance of SOIL's sanitation solutions.

Remaining hurdles and bottlenecks

- To set-up business processes that would better support the scale-up of its operations, SOIL is considering setting-up a separate private company for the household toilet and compost business.

Contact information

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Appendix

Sources: Berendes, D. et al. (2013). Evaluation Of SOIL Latrine Waste Composting In Port-Au-Prince, Haiti. Atlanta: Georgia: U.S. Centers for Disease Control and Prevention. Retrieved from www.oursoil.org/cdc-releases-report-on-soil-composting-process. Interviews and discussions between Sasha Kramer, Leah Page, Gregorie Virard and Heiko Gebauer (eawag).

Exchange rate: 1 USD = 43.5 Haitian Gourdes

X-RUNNER

This case study was prepared in collaboration with X-Runner and Eawag.

Project	X-Runner and sanitation in Peru
Organization	X-Runner Venture
Geography	Lima, Peru
Areas	Urban
Solution	Individual
Date started	2012
Stage	Pilot
Scale	76 households (380 people)

X-Runners users. Source: www.grandchallenges.ca

Project description

History of organization

X-Runner Venture is a social enterprise launched in 2011, which introduced mobile, easy-to-install, water-free toilets to private households in urban slums of Lima (Peru) in 2012. The initial approach has been refined and X-Runner since November 2013 has been piloting an improved toilet design, branding and pricing strategy, as well as servicing operations. X-Runner has received a grant from Borealis and two Swiss Foundations, among others. Currently, X-Runner sells and installs about 6 toilets per week.

Value proposition and profile of customers

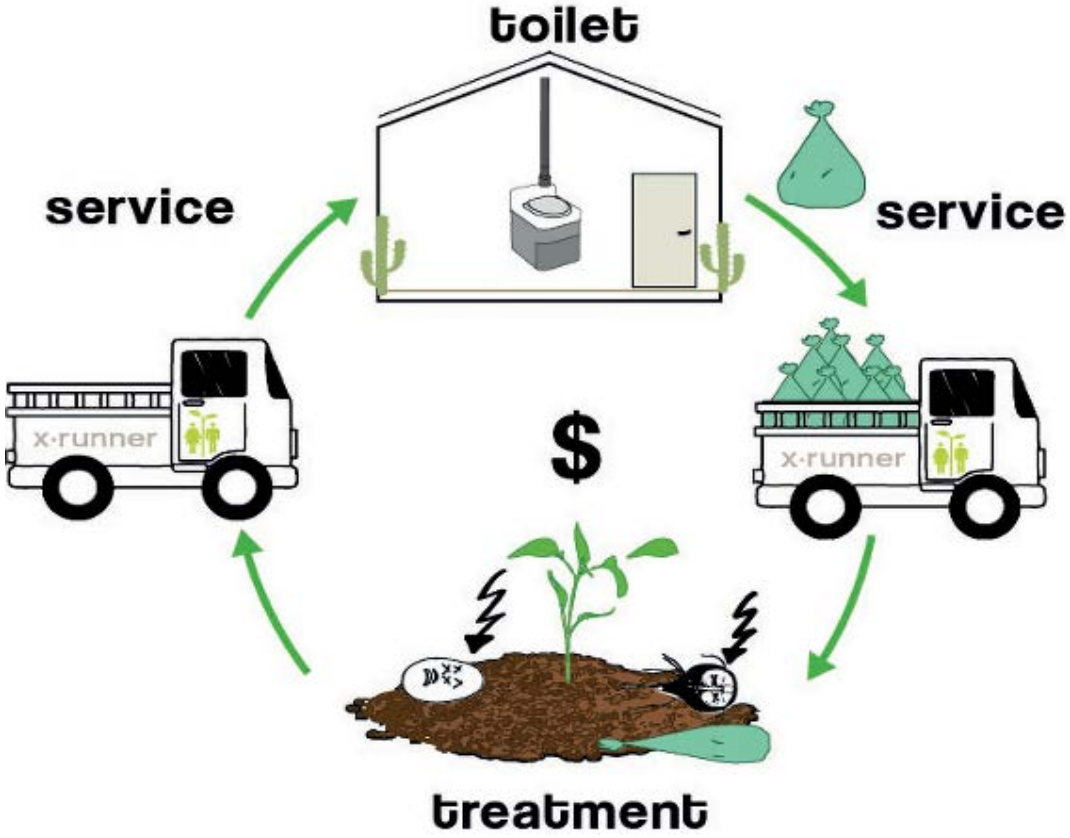
X-Runner rents home mobile toilets to urban slum families and provides them with weekly waste collection services. The waste container is collected once a week in front of the family's home by a pick-up service and replaced by a clean one. X-Runner charges families a service fee of $14 per month for the collection of containers and the provision of sawdust, a smell neutralizer. The toilet remains the property of X-Runner. There is a small up-front toilet investment for households of about $18 (payable either in 1 or 4 installments). This helps to ensure that only serious and trustworthy households with a more or less stable income will enter the service agreement. The expansion phase is being carried out in the community of San Juan de Miraflores, where X-runner is now using biodegradable bags inside the containers that families carry to a local collection point.

The waste collected is stored and treated in a compost site. This compost could potentially be sold to third parties, including municipalities. There has been interest in buying the compost and potential demand seems to be emerging. To meet this demand, the quality of compost processing is currently being improved and studied together with the National Agrarian University of Lima.

The target customers are typically households without access to a sewage system and whose pit latrines cannot be used anymore (either because they are full or have broken down) and who are eager to switch to a new system. Early adopters are people with stable and predictable incomes who usually have small children, they are tired of their latrines and they usually have a large number of people in their homes. Their houses have multiple rooms and sufficient space to locate the toilet. The average income of a client family is about $500 per month.

Compared to pit latrines, the X-Runner solution can be more expensive (depending on the type of construction and assuming no financing solution). However, it presents many advantages to its adopters, it is an excellent toilet, has little upfront costs, convenience, cleanliness, and hassle-free servicing.

Value chain



* X-Runner is currently experimenting collecting waste in biodegradable bags to avoid cleaning and handling of containers.

Manufacturing operations

The toilets by X-Runner are manufactured (automated production) locally in Lima. The manufacturing cost of the toilet is approximately $200 for a manufacturing batch of 500 toilets.

The estimated production capacity is up to 2,000 toilets (based on the 3 molds that X-Runner currently has). With the current toilet manufacturer, the production costs will remain at the current level of about $200. Lower manufacturing costs can only be achieved through a higher-volume production.

The new biodegradable bags used for the new collection system are produced in Chile. X-Runner currently buys the bags at $ 0.37 piece. Sawdust costs about $1 per month per family.

Marketing & sales strategy and organization

X-Runner promotes its branded toilets via the following strategies. Firstly, 'guerrilla' marketing (which creates attention through stickers, graffiti art, and posters displayed in the community). Secondly, community events (where sales staff undertake product demonstrations and explain the service to their potential clients) and finally through promotions in the street (by distributing brochures, stickers and T-shirts to potential customers).

During these events, potential customers register on a waiting list and are then contacted by sales staff who visit them at their homes and explains the toilet, service agreement and payment arrangements. If the customers are convinced about the X-Runner solution, they sign a contractual agreement with X-Runner that describes the service, outlines respective expectations on payments and the terms of the agreement. The customers also receive payment instructions and a payment record book.

X-Runner is also considering giving incentives to customers for referrals, as it seeks to encourage word-of-mouth.

At this early stage, the sales staff are paid a fixed income and the work is done in teams. X-Runner is exploring motivation schemes to reward sales staff individually.

Installation

The toilet comes assembled by the production company, so customers do not have to do any additional work. A team of X-Runner installers undertake the installation of the toilet at the family's home, which requires a urine pipe to be connected to a soak pit and a ventilation pipe to be connected to the roof. The average installation time is less than 30 minutes. Installation teams consist of young men with basic technical skills.

Cash/ payment collection

The small upfront investment and the monthly fees are either collected by X-Runner sales staff or customers can pay at bank agents of the largest Peruvian Bank, BCP. Payments are due monthly and customers receive an invoice every month to remind them of the amount payable.

Usage and hygiene

Consumers clean the toilet and the container (when using waste bags). There is no specific maintenance necessary and customers can call X-Runner when difficulties occur.

Waste storage and collection

With the new collection scheme being trialed in San Juan de Miraflores, households are asked to carry the buckets containing their solid waste (which is enclosed in the biodegradable bags) to a local collection point once a week where a truck comes by to collect their buckets. Walking to the collection point takes about 1 to 5 minutes. The X-Runner collection staff retrieves the bags and returns a clean empty bucket with new bags. The truck then transports all the collected bags to the local composting plant for processing, where they are emptied into a large compost pool. The collection team is comprised of 2 to 4 young men.

Waste treatment, disposal and recovery

Together with the National Agrarian University of Lima, xX-Runner is testing ways to produce safely treated compost by heating it over a period of three months. X-Runner has not yet marketed its compost.

Technology

Description of the toilet-related technology

Key features

- Design: Portable dry toilet, made out of fibreglass. It has 5 main components: a urine-diversion and draining system, a container for solid waste collection (containing a biodegradable bag for the new collection system), a manual dry flushing system with saw-dust, and a ventilation pipe.
- Durability: Lifetime estimated at 5 to 10 years.
- Installation needed: No installation needed but for the urine diversion and ventilation pipe.
- Water and energy efficiency: No electricity needed. Saw-dust is flushed manually with a handle.
- Malodors and safety: With the sawdust, evacuation pipe and closed compartment, bad smells and insects are avoided for at least a week.
- Waste storage: Urine and feces are handled separately. A closed compartment under the toilet seat keeps gases out and directs the urine away from the solid waste container. Urine can either be drained onto the ground or collected in a plastic jug to be reused. The container is closed.
- Waste collection: The toilet has a removable sealable waste tank, which can easily be removed and handled by the customers. Containers stack up for transport and storage.
- Potential, limitations: The dry toilets allow for composting if used well, but do not work if water is added; a cool climate in peri-urban area enables the limitation of smells, but this can be challenging in countries with a warmer climate. On the other hand, the design of the toilet does not allow for any interface between the customer and the waste, this makes it safer and easier to handle.

Description of by-products-related technology

Key features:

Off-site composting site, which has the capacity to store waste of up to 1000 households. The manure is kept and aerated manually for 3 months, until it is converted into safely treated compost.

Requirements, limitations and improvements:

The processing requires that the compost stays a temperature of 60-70°C, but this is a challenging requirement and it is difficult to reach fermentation level. Continuous improvement strategies at the composting site have been initiated in 2013. These include building a roof over compost piles, improving the grounds under the compost and testing innovative ways to increase the temperature.

Economics:

Currently, compost is worth $1 per kilo. The goal is for the compost revenues to cover the cost of processing.

Social impact

- Penetration: So far 76 customer families (i.e. almost 400 users) are using X-Runner toilets (or a penetration of 3% in the target area where they operate). X-runner aims to reach 500 families by the end of 2014.
- Acceptance and usage: Over the last year, X-Runner registered only one drop out, where a family has started to build their own pit latrine. In case of delayed payments, the policy is to charge penalties and after two weeks of non-payment the toilet is removed.
- Customer satisfaction: Workshops and discussions with existing users suggest a high level of customer satisfaction.
- Evidence of impact on health: No impact study held so far.
- Promotion of related behaviors: None for now. X-Runner is considering introducing the sale of hygiene products (e.g. soap).
- Waste collection and disposal strategy: The toilets remain the property of X-Runner and are removed in case of non-payment or improper use.

Economic sustainability

End-consumers

- Affordability for end user: Customers have to pay an upfront investment of $18 and the monthly service fee is $14. The service charge corresponds to about 3% of the household average income of the targeted population. Compared to pit latrines, which cost on average $465 to install (estimated life time of between 6 months and 3 years), and about $65 to $70 to maintain and empty per year, the X-Runner solution is more expensive. The prices have been estimated through qualitative assessment of the willingness to pay for sanitation services.
- End-consumer financing: No financing required. The percentage of on-time payments has increased from 40% to nearly 90% between April and July 2013.

Main organization

It is estimated that X-Runner needs at least 500 households to cover its direct costs (excluding SG&A). The production of 1500 toilets would enable X-Runner to cover all its costs (direct costs and SG&A).

Innovations

- A convenient and well-branded product that looks like a "real" toilet, it uses sawdust and is well-adapted to households in dense urban areas that are not connected to a sewer system (for whom the only alternative of pit latrines is expensive, poorly maintained and not sustainable in the long term).
- A quality service-based model (rather than selling a product) which ensures regular revenues and avoids high up-front investments for the end-consumer.

Remaining hurdles and bottlenecks

- The production of compost fertilizer is challenging given the small size of the company, which restricts the purchase of efficient production technologies.
- The personalized door-to-door service has been adapted to collection points since it allows for higher efficiency. The main challenge in the new collection method is how to ensure that both staff and customers deliver on time.
- In order to reach a higher scale of customers, marketing and commercial strategies would need to be further developed (e.g. incentives, rewards, customer feedback).

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Appendix

Sources: www.xrunner-venture.com, www.xrunners.wordpress.com, forum.susana.org; interview with X-Runner team and visit to site operations in January 2014

Exchange rate: 1 Peruvian Sol = 0.35 USD

APPENDIX 3A: WASTE MANAGEMENT TECHNOLOGIES THAT PROCESS WASTE INTO BY-PRODUCTS

WASTE INTO ANIMAL FEED AND BIODIESEL (CENTRALIZED BLACK SOLDIER FLY PROCESSING)[22]

BSF larvae (source: www.sanitationventures.com)

History and status

The London School of Hygiene and Tropical Medicine has explored the use of BSF larvae in human waste treatment in a project funded by the BMGF. A few projects have emerged from this research, including a promising 2012 joint-venture between Bear Valley Ventures (an incubator that focuses on the development of market-led innovation in hygiene and sanitation for the BoP) and AgriProtein, a company that specializes in "nutrient recycling". This joint venture called the BioCycle is currently running a pilot in an informal settlement near Cape Town, South Africa.

Key features

BSF larvae are fed with human waste and transformed into animal feed and biodiesel. For fecal waste, the transformation process is likely to be more cost-effective if centralized and could probably operate at a number of scales, from community up to municipality. First, the waste is loaded onto feeding trays upon which BSF larvae are fed during a 2 to 3 week period. Then, there are two main options to process them:

Low-grade feed: BSF larvae are rinsed and sterilized in an oven at >100°C during a few minutes, dried at high temperature during two days and sold as low-grade animal feed. One kilogram of wet waste feeds approximately 250g of larvae, which is turned into 50g to 100g of low-grade feed.

High-grade feed and biodiesel: BSF fat (~30%) is separated from the protein with an oil separator. The fat is turned into biodiesel (in a mini-refinery, with the addition of methanol and potassium hydroxide) and the protein into high-grade feed. One kilogram of waste feeds approximately 250g of larvae (i.e. approximately 75g of fat and approximately 175g of protein, which is turned into approximately 75g of biodiesel and 35g to 70g of high-grade feed).

Economics

Investments: Turning flies into animal feed requires investment into equipment such as modules for breeding and feeding, an oven or other means to remove any residual pathogens, an oil separator and mini-refinery equipment. The investment for a small plant would start at around $20,000.

Operating costs: The highest operating costs of processing BSF are the labor costs. A plant requires a large colony of flies (a few million) that need to be looked after (i.e. collecting the eggs, growing the larvae, feeding, etc). A small plant would require at least one skilled staff member (ideally an entomologist) to look after insects and three low-skilled people to move the larvae between the modules. The operating costs, including staff and utilities, could start at approximately $50k per year.

22 Interviews with Walter Gibson, founder and director of Bear Valley Ventures (December 2013), and Steve Sugden, Senior Program Manager for Sanitation, Water for People (November 2013); www.youtube.com/watch?v=HM0d2EsVehQ; www.sanitationventures.com; Nitin Agrawal, Marissa Chacko, Meena Ramachandran, Min Thian, Assessing the Commercial Viability of BSF as Biodiesel & Animal Feed, University of California Berkeley Haas School of Business, London School of Hygiene and Tropical Medicine, 2011.

Revenue: Animal feed prices could vary between about $0.8 per kg for low-grade feed and about $1 per kg for high-grade feed. The nutritional value of the product has been recognized and is accepted to feed poultry, pigs, fish, etc. Biodiesel is a more uncertain market, depending on government regulations. Prices usually vary around $1 per litre. A 5 person household produces between 500kg and 600kg of fecal waste per year, which could be turned into about 20kg of high grade feed and approximately 40L of biodiesel and hence generate approximately $60 revenue per year.

Proof of concept: The pilot project of Bear Valley Ventures and AgriProtein has shown that the technology works in terms of waste conversion into BSF larvae and is transferable and scalable. They are currently working with a community of about 700 households; the next stage is to expand the pilot to a city environment.

Outstanding hurdles

Current pilots are working with freshly collected waste separated from urine. However, waste cannot be mixed with chemical products and this is a hurdle for home mobile toilet waste.

The key questions to the sustainability of BSF processing at scale concerns the sourcing of fresh waste (e.g. need for specific waste properties or conditioning), the processing (e.g. difficulties in breeding fly colonies at scale) and the commercialization of the by-products.

While the value generated from waste processing is substantial as compared to other technologies, it is still too little (approximately $10 margin per household per year) to cover the costs of door-to-door collection in a home mobile toilets project. The optimal level of centralization as regards to transportation costs (currently one plant for 500 to 1,000 households) needs to be evaluated.

WASTE INTO GAS AND FERTILIZER (BIODIGESTER)

Biodigesters. Source: Takamoto Biogas

History and status

Biodigesters are tanks using anaerobic digestion (degradation of organic matter by bacteria in the absence of oxygen). They have been a widespread solution for centuries. In the previous decades, millions of small domestic biodigesters were built in Asia alongside larger treatment plants for collective waste. Domestic models are spreading to other developing countries in Africa and South America. Developed countries are building an increasing number of treatment plants using anaerobic digestion to produce renewable energy, mostly from agricultural waste. Although digesters have predominantly used animal waste for the production of biogas and digestate, they can also offer efficient and economically attractive solutions for the treatment of human waste.

Key features

Digesters can come in all shapes and capacities (from 0.5m to thousands of m3) and be made out of different materials (stones, bricks, concrete, metal, plastic...). The two by-products of digestions are:

- Biogas that can be used as a source of energy: The nature of feedstock is the key determinant to the quantity of biogas produced. The existing literature shows that yield varies between species (i.e. human feces yield approximately 40L of biogas per kilogram, cow dung about 45L, pig dung about 55L, and chicken droppings approximately 70L). Biogas can be burnt in stoves or lamps or fed into a generator to provide electricity. The energy value of one cubic meter of biogas corresponds to 0.5L of diesel fuel.
- Digestate that can be used as fertilizer: The amount of digestate produced by a reactor roughly equals the amount of water and waste (approximately one volume of water for one volume of waste) the digester is fed. Fresh digestate can be sprayed directly onto the fields or mixed with agricultural residues.

Economics

Value of biogas: In the absence of a market for biogas, its financial value is derived from the cost of the fuel it replaces. The annual waste of a 5 person household allows to produce approximately 20m3 of biogas corresponding to 10L of biodiesel, worth about $10 if we consider that the fuel it replaces is biodiesel worth $1 per litre.

Value of digestate: Similarly, the value of digestate depends on the fertilizer it replaces. According to a SNV study in Laos , based on local prices of fertilizer, one ton of fresh cattle digestate would be theoretically worth $8 to $10 (i.e. approximately $10 per year per household). However, the potential of human manure to be marketed can be questioned.

Outstanding hurdles

The daily biogas production of one individual is not even sufficient to cook for two minutes. The quantity of waste needed for the operation of a digester thus requires the presence of either cattle or a large number of people. The collection of feces from individual sanitation solutions such as home mobile toilets could provide the necessary mass for treatment in a digester. However, centrally produced biogas and digestate may hardly find their way on the market and, even if they do, their low market value could only generate low profits that would not make a difference in the sustainability of home mobile toilet projects.

WASTE INTO FERTILIZER[23] (COMPOSTING)

X-Runner's composting facilities. Source: X-runner field visit.

History and status

Contrary to biodigester treatment, composting consists of the digestion of waste by aerobic microorganisms, mainly bacteria and fungi. It has been practiced on a small-scale for centuries, particularly in Asian countries. However, large-scale and industrial composting has only been developed since the 1950s.

Key features

Composting can be operated for most organic solid matters (e.g. organic wastes such as plant residues, kitchen wastes, excreta, etc.). It requires appropriate moisture content, aeration, temperature, pH, and carbon/nitrogen ratio. The waste is first sorted to remove contaminants, mixed if necessary with additives and then placed in boxes or trenches. To ensure aerobic conditions the pile should be turned regularly and the temperature controlled. After 21 to 60 days (active phase), the composting process enters the curing phase when the pile should be left without turning for some weeks and up to a year depending on local conditions. The end product is an inoffensive and safe-to-handle material that can be used as soil amendment/ fertilizer to enhance organic matter and nutrient content. Composting 1kg of human waste would result in approximately 50g of fertilizer.

Economics

Composting requires a large space for sorting, composting, screening and packaging operations, as well as for the storage of the compost. Waste collection and sorting costs are the most significant costs as glass particles and heavy metals should be totally removed to prevent compost contamination. The value of compost depends on the fertilizer it replaces. The solid waste of a 5 persons household over one year (i.e. approximately 500kg to 600kg, is equivalent in nutrient value to approximately 30kg of fertilizer worth about $6 in a developing country, assuming that the fertilizer it replaces is the NPK (20:10:10) worth $0.2/kg.

Outstanding hurdles

Firstly composting does not come at zero costs. It requires large footprints of land and considerable handling time, especially in the first phase when the waste needs to be turned regularly. Secondly the by-product fertilizer may hardly find its way on to the market (because of perception and regulatory barriers) and, even if it does, its value per household would remain low.

23 www.sswm.info/category/implementation-tools/wastewater-treatment/hardware/sludge-treatment/co-composting-large-sca

WASTE INTO FUEL PELLETS[24] (CENTRALIZED DRYING)

Fecal sludge in transition to granular fuel inside solar greenhouse.
Source: www.waste-enterprisers.com

History and status

The centralized processing of waste into fuel pellets, serving as clean renewable fuel for industrials, is an innovative waste processing technology being developed by Waste Enterprisers, a company launched in Ghana in 2010. After a pilot in Accra, Waste Enterprisers operating as Pivot Limited is opening a plant to scale up its activities in Mombasa, Kenya.

Key features

Fecal sludge coming from septic tanks/pit latrines is dewatered, dried in specially designed greenhouse facilities and as a final step sterilized in a thermal dryer. This process produces a fuel in granular form that can then be sold to industrial clients for combustion in kilns or certain biomass boilers. One ton of wet fecal sludge contains a total suspended solids (TSS) fraction that can produce approximately 20kg to 80kg of fuel. The variation in TSS is driven by location or method of collection. The calorific value of this fuel is higher than wood pellets(i.e. 17 MJ per kg vs 25 to 35 MJ per kg for coal). The process of dewatering and drying human waste is already applied to sewage sludge (by-product of a traditional wastewater treatment facilities), however as sewage sludge represents a post-treatment input the energy density is lower and less attractive.

Economics

- Investments: Drying operations require a large footprint that could be reduced by using modular solutions. A plant producing 10 tons of output daily would cost $2 to $3 million.
- Operating costs: In order to run cost-efficient transformation operations, one key challenge is to manage an efficient dewatering process. The plant also needs workers, a plant producing 10 tons of output daily would require between 10 and 15 workers on a daily basis.
- Revenues: An industrial client in Europe would pay over $10 per GJ of fuel, which drops to $3 to $4 in Africa. Assuming one person produces approximately 1.5 kg of sludge per day (feces and urine), a 5 person household produces about 2.5 tons of sludge annually (i.e. 125 kg of pellets which would be worth approximately $8).

Outstanding hurdles

Granular fuel has multiple advantages, it is carbon neutral, has good calorific value and is available all year. However, firstly the financial viability of such a model still needs to be proven. Secondly, it is a capex intensive business that requires large volumes of waste to be sustainable and thirdly the support of a facilitating policy environment (especially regulations concerning waste treatment and unsafe dumping) is required for such a business to scale up.

24 Interview with Tim Wade, COO, Waste Enterprisers (December 2013)www.waste-enterprisers.com

URINE INTO FERTILIZER[25] (STRUVITE PRODUCTION)

Small struvite reactor (source: Eawag)

History and status

Urine is rich in nutrients, of all the components found in human waste it contains about 80% of the nitrogen, 50% of the phosphorus, and 60% of the potassium. It also contains very few pathogens. Urine could thus be used as a valuable fertilizer, either in its original form (storage is necessary to eliminate remaining pathogens) or after being processed into a nutrient-rich powder called struvite.

Urine storage

- Key features: Urine could be used directly on soil when it comes from a reliable source (e.g. a urine diverting household toilet), provided that one month passes between fertilization and harvest. When urine is sourced on a large scale (e.g. from community toilets), risks of contamination are higher and treatment is necessary. Simple storage in tanks during 1 to 6 months kills pathogens while recovering nutrients. Pasteurization methods can be used to accelerate the treatment process.
- Economics: The urine of a 5 person household over one year (i.e. about 2,500L) is equivalent in nutrient value to a 50kg bag of NPK (15:10:10) fertilizer worth $8 to $12 in a developing country.
- Outstanding hurdles: While very little investment or labor is needed (mostly appropriate storage space and containers), transportation can represent a significant cost (as compared to the very low value of by-product) and limit the viability of the process.

Struvite production

Key features: Urine is difficult to transport/store and it is also smelly. After a basic precipitation reaction, the majority of phosphorus can be crystallized into a powder called struvite. Struvite has many of the fertilizer properties of urine and several additional advantages, it can be stored and transported easily, it is odor-free, and its granulated form is convenient for fertilizer-use. Struvite processing requires a reactor.[26] The reaction is forced by adding magnesium. It is quick (approximately 10 minutes) and needs to be followed by sun drying. 90% of phosphorus is recovered in the process. The powder can be then transformed into granules using a granulation drum.

Economics: With a 500L reactor, it is possible to treat ~5kL of urine per day, and to produce ~10kg of struvite. Such an installation costs approximately $450, as well as a full-time operator. The highest costs incurred are for urine collection, struvite production would make only sense when urine can be collected in large amounts and only when very small distances are travelled to transport the urine. In a pilot in Nepal, struvite could be sold for up to $0.50 per kilo. One kilo of struvite is obtained with 500L of urine, which is roughly the quantity of urine discharged by one person each year. Hence, a 5 person household would generate $2 to $3 in struvite revenue per year.

Outstanding hurdles: The low prices of struvite compared to the quantity of urine required to obtain it, dramatically limits the potential for sustainable processing.

26 Struvite can also be produced from wastewater instead of urine (including domestic wastewater or liquid animal manure) but the process is more difficult and requires additional chemicals for pH control.

25 www.sswm.info/; Joensson, Richert, Vinneraas, Salomon (2004): Guidelines on the Use of Urine and Faeces in Crop Production Stockholm: EcoSanRes; Johansson (2000): Urine Separation - Closing the Nutrient Cycle. Final Report of the R&D Project: Source-Separated Human Urine - A Future Source of Fertilizer for Agriculture in the Stockholm Region. Stockholm: Stockholm Vatten, Stockholmshem & HSB National Federation; Muench, Winker, GTZ (Editor) (2009): Urine diversion components. Overview of Urine Diversion Components such as Waterless Urinals, Urine Diversion Toilets, Urine Storage and Reuse Systems. Eschborn: German Agency for Technical Cooperation (GTZ) GmbH; Tettey-Lowor: Closing the Loop between Sanitation and Agriculture in Accra, Ghana. Wageningen: Wageningen University; Tilley, Udert, Etter, Khadka, *Low-cost struvite production using source-separated urine in Nepal*, Eawag: Swiss Federal Institute of Aquatic Science and Technology, 2009

APPENDIX 3B: WASTE MANAGEMENT BIO-TOILET PROJECTS

BANKA BIOLOO[27]

History and status

Banka BioLoo began as Banka Enterprises, a company engaged in developing and promoting innovative, environmentally friendly products and services for human waste management. They use the DRDO technology to offer bio-toilets for families and community toilets and bio-tanks for railways, other corporate clients and institutions.

Key features

- Railway tanks: 450L stainless steel tanks for train coaches, costing $1,400 a piece. Banka BioLoo has sold 500 of these tanks to Indian Railways.
- Household tanks: 500L to 1,000L fiber-reinforced plastic tanks for individual or collective use, in homes or mobile toilets. They are sold for $150 to $350 and for up to $500 with full toilet infrastructure. Banka BioLoo has sold 100 of these tanks and toilets, mainly to businesses and NGOs.
- Bacteria liquid: Banka BioLoo sells bacteria liquid at $0.40 per litre for its tanks (each tank needs to be filled up with 20% bacteria liquid), they also sell to NGOs or construction companies that may need it for their own bio-toilets. Banka BioLoo has sold 120k litres of bacteria so far. When Banka BioLoo sells a full system, bacteria liquid typically represents 10% to 15% of the value of the contract.

Economics

Banka BioLoo generated approximately $1m annual revenue and a positive EBITDA in 2013.

Banka BioLoo breeds its bacteria in a 5k square feet digester (approximately $70k investment out of a total startup investment of approximately $200k), processing 1,500L of water and 1,500L of cow dung to produce 3,000L of bacteria liquid per day.

Banka BioLoo is paying a royalty according to DRDO commercialization requirements (i.e. 2% on government contracts, 4% on domestic sales and 6% on international sales).

27 Interview with Namita Banka, founder of Banka Enterprises (November 2013), namitabanka@gmail.com; www.bankabio.com; 1 USD = 60 INR

BIOFILCOM[28]

History and status

Biofilcom was started in 2007 as a business selling innovative sanitation solutions in Ghana.

After a conclusive pilot phase, Biofilcom is planning to scale up its B2C business. It will need to prove that the technology is completely safe (through external assessment), it will also need to design a scalable production process, reduce production costs, and develop financing solutions in order to make the solution affordable to the masses.

Key features

Biofil Microflush Toilet (source: www.biofilcom.org)

The Biofil toilet is equipped with a highly efficient organic digester. The batch bio-digester is filled with different microorganisms (tiger worms, black soldier flies, dung beetles, and cockroaches) to process the waste. Worms are located in the front compartments, and cockroaches at the end. These microorganisms need sufficient and continuous feeding to survive, hence they are injected only 3 weeks after tank installation. The tank enables over 90% waste reduction within a few weeks. It prevents odors thanks to a water seal and the fact that it uses aerobic digestion. Biofilcom will need to prove the safety of the soil effluent through an independent evaluation.

The tank is compact (one-metre by one-metre by two-metre), it is currently made of concrete. Biofilcom is testing cheaper options.

The system can last for many years without specific maintenance, except in case of over-use (in excess of 10 users per day) or in the event that hazardous materials are thrown down the tank. Regular household bleach can be used without damaging the system.

Biofilcom has designed a micro-flush system for poor areas with water shortages. The micro-flush system is combined with a hand-washing station and it reuses hand-washing grey water for flushing.

Economics

The tank costs $390 and is adapted for up to 10 users. The total toilet cost (with shelter, wash basin, and installation) is approximately $1k.

The company has sold 4k systems to date, including 2.5k direct household sales. Biofilcom sells mostly through referrals. The typical client is a middle-class household whose house is located in areas with high water tables and those households that have had a bad experience with a septic tank. Biofilcom will need to adapt its pricing, offer financing options, and design a specific marketing strategy to reach out to poorer customers.

28 Interview with Mumtaz Arthur, Project Director of Biofilcom, beebs.arthur@gmail.com; www.biofilcom.org; 1USD = 2.7 GHC

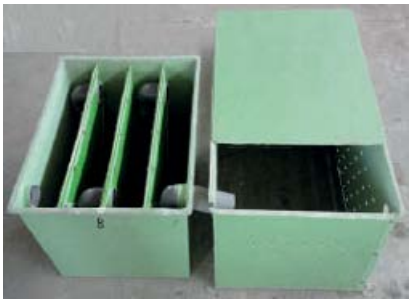
Mohan Rail Components Pvt . Ltd.

MOHAN RAIL COMPONENTS[29]

History and status

Mohan Rail has produced railway coach components since 1987. In 2008, Mohan Rail developed a bio-toilet based on the DRDO technology for Indian railways but also for communities and households.

Key features



Fiber reinforced plastic bio-digester system for households (source: www.biotoilet.in)

Railway bio-digester systems: Mohan Rail provides equipment for 4k train coaches per year. Each new coach is equipped with four bio-digester systems (up to 75 people can sit in one coach). These are 400L stainless steel systems.

Household bio-digester systems: Mohan Rail also sells 725L fiber reinforced plastic systems that can be installed above or under-ground. The price is around $500 ($650 when transportation and installation are included). 50 such systems were sold since May 2013. Mohan Rail has a contract to provide 12k units to households on the Lakshadweep islands. These are funded by the Planning Commission and not by the households. 1.5k have been installed so far. Mohan Rail also sells bio-digester toilets (i.e. packages comprising a bio-digester system, a toilet, and a cabin). Three versions are available, with prices ranging from $1100 to $2400, 50 units were sold in 2013.

Economics

The group generated approximately $30m revenue in 2012-2013. While bio-toilets are only a small activity, Mohan Rail is one of the leaders in the sector.

Mohan Rail makes a 15% gross margin on the sales of bio-toilets.

29 Interview with Vivek Kumar Manaktala, Head of Sales and Marketing (December 2013), vivek@mrcpl.com; www.biotoilet.in; 1 USD = 60 INR

STONE BIOTECH[30]

History and status

Stone India Ltd is an 80 year old engineering company that has historically served Indian railways. In 2010, the latter asked them to develop a solution for sanitation. Stone India initially tried to work with anaerobic technology but eventually decided to develop a different technology.

Key features

Stone India technology relies on multi-strain aerobic (not anaerobic) bacteria converting waste into innocuous water. No sludge needs to be removed.

This new bacteria offers various advantages, reduced greenhouse gas emissions, complete digestion within 24 hours (faster than anaerobic technology) and no malodors thanks to an anti-odor strain in the bacteria.

However, contrary to anaerobic technology, the tank needs to be refilled with bacteria regularly (20mL every 1 to 6 months depending on usage). The refill process is very simple (mix with 1 litre of water with the bacteria and pour into the toilet).

The tank can be made in either fiber reinforced plastic (lifetime of 10 to 15 years) or stainless steel (lifetime of 25 years).

Economics

In 2013, Stone India had installed more than 1,000 toilets (approximately 50% for individual households) with grant support from various governments, multilateral organizations, and foundations.

The minimum price for a complete bio-toilet is $500, including 5 year bacteria loads.

30 Interview with Sudip Sen, Sr Vice President, Stone India Ltd, sensudip@stoneindia.co.in; www.stonebiotech.co.in; 1 USD = 60 INR

TIGER TOILETS[31]

History and status

The Tiger Toilet technology was initially developed with a grant for the London School of Hygiene & Tropical Medicine from the BMGF. It is being piloted in three pilot projects since 2013, with a USAID grant to Bear Valley Ventures Ltd. Tiger toilets have been installed in Myanmar, Uganda and India, in a humanitarian camp, in peri-urban as well as in rural areas. The results of these pilots will be available in September 2014. Additional trials are being undertaken with NGOs (OXFAM in Liberia and ACTED in Pakistan).

Key features

Tiger worms (source: Bear Valley Ventures Ltd)

Tiger Toilet being installed (source: Bear Valley Ventures Ltd)

The Tiger Toilet is a tank containing three elements, a bedding layer (e.g. coir, compost), composting worms and the drainage layer. The waste is flushed into the tank, the solids are captured on the bedding layer and the liquid passes through this layer and into the drainage layer. The worms continuously process the solid part of the waste (and convert this waste into vermin-compost). One kilogram of fresh waste is coveted to 100g to 200g of vermicompost. The liquid is further treated in the drainage layer, resulting in an effluent that can be discharged into the soil.

The design tested in pilots is a squat toilet with pour-flush and water seal (different designs exist for worms' bedding layer, drainage or construction). The tank itself can be in plastic, concrete bricks, etc. The system is one-metre diameter and one-metre high. Tiger toilets that are currently piloted use a low volume pour-flush system (1L to 2L per flush).

Approximately 200 grams of worms are required per person. Inside the tank, the worms become a self-sustaining population. The worms are very robust and can survive long periods without food. No smell or flies exist, as the system is aerobic and given the water seal of the toilet.

According to early experiments, the tank would need to be emptied every 4 years. R&D teams are developing another technology with a double-compartment system and tanks, which allow for safe and easy self-emptying. Households could open up the lid and empty the safe compartment, thus avoiding contact with fresh waste.

The technology is highly effective in mass reduction (with a conversion rate of 80% to 90% of solids per day). The small tank is suitable for high-density urban areas. The technology can work in almost any climatic conditions (20°C to 30°C leads to maximum productivity).

Economics

The current cost of a Tiger Toilet (including superstructure) is $350, but R&D teams expect to reduce this significantly and have a target price of $150 to $200.

The supply of worms could become an issue at scale. Presently worms are purchased from worm farms, but there is wide variations in the prices charged.

Servicing requirements (i.e. tank emptying and business models) should be explored for the commercialization the toilet.

31 Interview with Walter Gibson, founder of Bear Valley Ventures, waltergibson@bearvalleyventures.com, and review by Claire Furlong. www.sanitationventures.com; Furlong C., Templeton M.R., Gibson W.T. (2014) Processing of human faeces by wet vermifiltration for improved on-site sanitation. The Journal of Water, Sanitation and Hygiene for Development

LIST OF ACRONYMS

AFD: Agence Française de Développement

AWASH: Association for Water, Sanitation and Hygiene

BCP: Banco de Crédito del Perú

BMFG: Bill & Melinda Gates Foundation

bn: billion

BoP: Base of the Pyramide

BRAC: Bangladesh Rural Advancement Committee

BRANA: Brasserie Nationale d'Haiti S.A

BSF: Black-Soldier Fly

CBO: Community-Based Organizations

CCS: Community Cleaning Services

CEO: Chief Executive Officer

CHW: Community Health Workers

CLTS: Community-Led Total Sanitaton

CRM: Customer Relationship Management

DFID: Department for International Development

DIY: Do-It-Yourself

DRDO: Defence Research & Development Organisation

EBITDA: Earnings Before Interest, Taxes, Depreciation and Amortizations

EPA: Environmental Protection Agency

FINO: Financial Inclusion Network & Operations Ltd.

FMCG: Fast-Moving Consumer Goods

HDPE: High-Density Polyethylene

IT: Information Technology

ICT: Information and Communication Technologies

IFC: International Finance Corporation

IVDP: Integrated Village Development Project

KPI: Key Performance Indicators

LLDPE: Linear Low Density Polyethylene

m: million

MFI: Microfinance Institution

NABARD: National Bank for Agriculture and Rural Development

NCT: Nageshwara Charitable Trust

NGO: Non-Governmental Organization

NPC: New Philanthropy Capital

P&L: Profit & Loss

PLA: Polylactic Acid

R&D: Research & Development

SOIL: Sustainable Organic Integrated Livelihoods

SG&A: Selling, General and Administrative Expenses

SHG: Self-Help Group

WSP: Water & Sanitation Program

WSUP: Water & Sanitation for the Urban Poor

WHO: World Health Organization

WTO: World Trade Organization

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