

CASE

Fecal sludge to nutrient-rich compost from public toilets (Rwanda Environment Care, Rwanda)

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Supporting case for Business Model 14

Location:	Kigali, Rwanda
Waste input type:	Source-separated urine and feces from urine diversion dehydrating toilets (UDDT)
Value offer:	Provision of sanitation services and sanitized urine and feces as a safe organic fertilizer for agricultural production
Organization type:	Private
Status of organization:	Operational since 2009 (NGO since 2006); assessed in 2012-2014
Scale of businesses:	Production: 200 tons of fecal-based organic fertilizer per year
Major partners:	Kigali City Council (KCC), United Nations Development Programme (UNDP) and European Union (EU)

Executive summary

Rwanda Environment Care (REC) is a privately owned company engaged in the business of providing public toilet services and producing organic fertilizer from fecal sludge for sale to agricultural producers. With a mismatch between an ever-increasing urban population and the sanitation services provided by the municipalities, a significant number of inhabitants in Kigali have limited to no access to sanitation products such as toilets and when they do, there are virtually no collection systems in place. REC tapped into this gap in the sanitation value chain and has set up several public toilets at different locations in Kigali, Rwanda, using the ecological sanitation (eco-san) technology. The main goal of REC is to implement a sustainable sanitation services delivery system – which ensures that customers not only have access to services (i.e. toilets) but also mechanisms to ensure consistent and efficient waste collection and treatment systems are put in place. Its activities extend to the agricultural sector via the conversion of the collected fecal sludge from their public toilets into a valuable resource – urea-rich organic fertilizer (urine-enriched compost). REC implements a multiple revenue stream strategy comprised of: toilet fees amounting to USD 324 per day, kiosk and shop rentals (USD 334 per month), compost sales (USD 6,483/year) and consultancy service fees from the provision of technical assistance in the design and construction of eco-san latrines. The adopted technology – eco-san toilets – is simple and cost-effective and also ensures easy access to segregated waste inputs. REC's activities provide

inhabitants, especially, the migrating population in Kigali with access to toilets which has significantly reduced the incidence of open defecation and ‘flying toilets’. Additionally, reduced open-dumping of human excreta in the environment will reduce the risk of soil and groundwater contamination. Increased availability of environmentally safe fertilizer alternatives will contribute to reducing water and soil pollution from reduced nitrate release attributed to chemical fertilizer use. While the current scale of REC may not have a notable employment impact, with plans to out-scale their activities, it is expected that a significant number of jobs will be created along the sanitation value chain.

KEY PERFORMANCE INDICATORS (AS OF 2013/14)

Land use:	1.6 ha					
Capital investment:	USD 29,173 excluding land costs					
Labor:	2 unskilled full-time laborers					
O&M cost:	USD 188.39 per toilet block of 8 units and 2 kiosks					
Output:	200 tons of organic fertilizer per year					
Potential social and/or environmental impact:	Reduced risk of ground- and surface water pollution, reduced health cost associated with poor sanitation, reduced human exposure to untreated waste and chemical pollutants, enhanced soil fertility and productivity, increased food security					
Financial viability indicators:	Payback period:	2 years	Post-tax IRR:	N.A.	Gross margin:	N.A.

Context and background

Rwanda Environment Care (REC) was established in 2005. It received an award of USD 50,000 from a United Nations Development Programme (UNDP) Partnership Small Grant Programme in 2006 to establish fee-paying ecological sanitation services to residents in Kigali alongside rainwater harvesting. In 2007, an additional UNDP grant was awarded which allowed further development of public eco-san latrines in Kigali including the construction of public eco-san toilets in the main districts of Kigali. Rwanda Environment Care (REC) was first established as a pilot project but is now a profit-generating business. In 2009, they introduced a ‘sanitation as a business’ model which included an improved eco-san design along with additional adjoining units that were rented as kiosks, small shops and/or communication centres. REC’s initiatives have been particularly important for Kigali as it has filled an important gap in the sanitation sector as the coverage of sanitation in urban areas is limited, particularly in the low-income areas (slum areas). It is equally important that revenue through fee-charging is generated from such facilities to cover routine repairs and staff salaries ensuring a level of sustainability. In addition to the high demand for public latrines in urban areas, there is an equally high demand for soil conditioners and fertilizer in farming systems throughout the country. Maintaining soil fertility through sustainable land management practices remains a major challenge which is compounded by poor agricultural practices and a lack of access to affordable fertilizers (Donovan et al., 2002).

Market environment

In Kigali, 80% of the population has access to latrines but only 8% of these latrines meet hygienic standards, hence improved access to hygienic and convenient public latrines is an important environmental sanitation and public health measure. Additionally, the significant migration population that characterizes this city makes this an even more important necessity. Furthermore, a continuously available supply of human effluent coupled with farmers’ quest for an alternative to chemical fertilizer have been some of the driving forces for the establishment of this business. The maintenance of soil fertility through sustainable land management practices is a major challenge in the agricultural sector of Rwanda, and particularly for peri-urban agriculture in Kigali. REC thus processes fecal matter collected from its eco-san toilet to nutrient-rich organic fertilizer for sustainable agriculture.

Macro-economic environment

Given the relatively high global fertilizer prices, most farmers in Rwanda cannot afford to purchase fertilizers at the beginning of the season. Increasing oil prices and fuel costs have also greatly influenced fertilizer prices in landlocked Rwanda. Hence to make fertilizers more affordable for smallholder farmers, the government introduced the fertilizer subsidy programme for certain food crops. This measure will potentially have an undesirable impact on new businesses like REC who are entering the fertilizer market. They will be facing fierce competition if chemical fertilizer remains comparatively low in price and more cost-effective than organic fertilizers. Comparable incentives will have to be implemented for organic fertilizers to mitigate the effects of competition and facilitate entry of new waste reuse businesses in the fertilizer market.

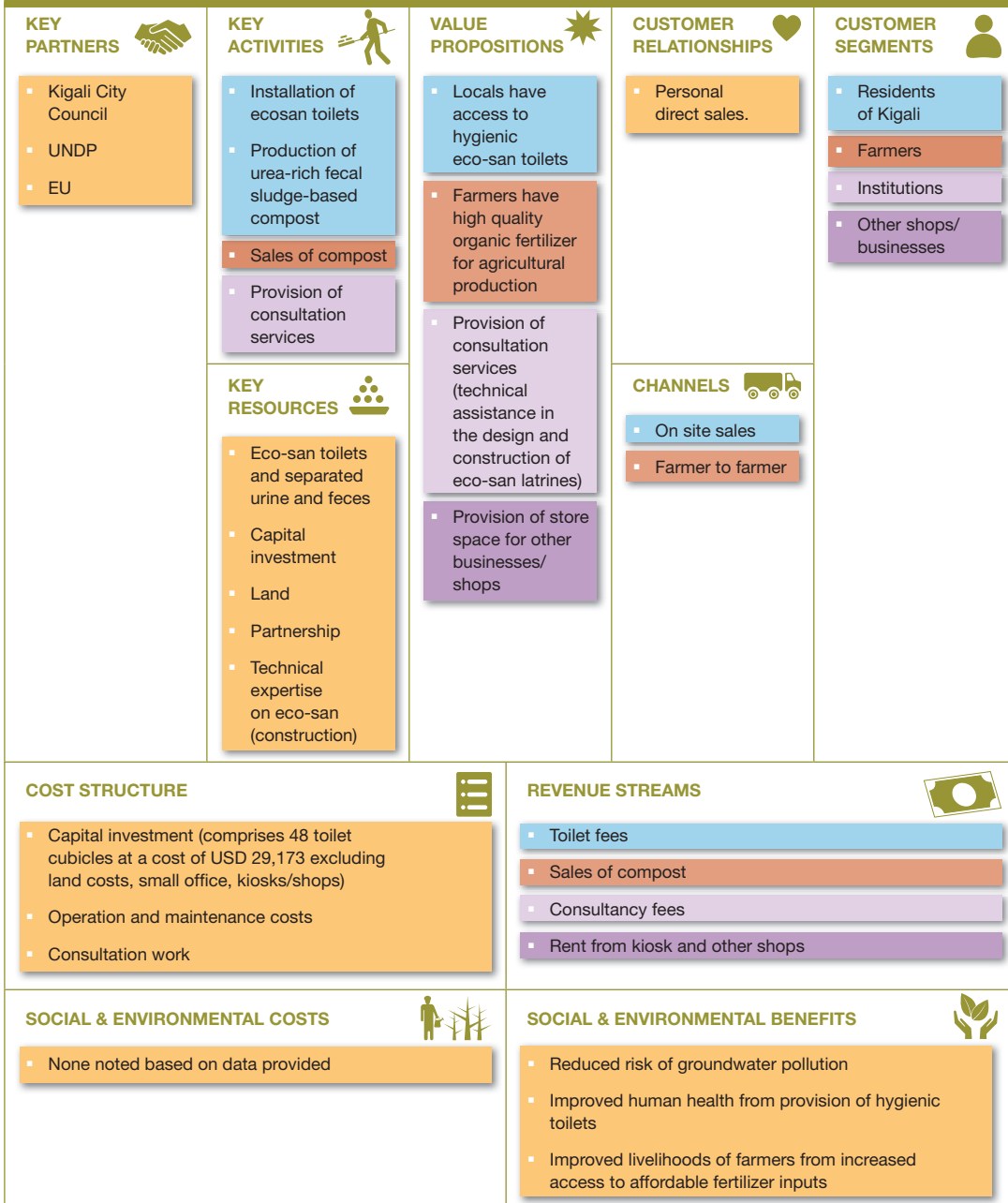
Business model

Figure 183 below presents an overview of REC's business model. REC's business model is based on two main value propositions: a) provision of hygienic eco-san public toilets on a fee-for-use basis; and b) offer of affordable urea-rich, fecal sludge-based organic fertilizer (urine-enriched compost) which is sold directly to farmers. The high demand for public toilets in Kigali ensures a daily revenue through toilet fees. On average, the 4,000 daily users generate a total of 200,000 Rwandan Francs (RWF) (USD 324 per day). An essential part of this enterprise is the inclusion of other shops in the toilet complex, from which rent is derived, increasing the revenue stream available to the enterprise. In addition to the provision of public latrines, REC plans to provide an eco-san consultancy service through the provision of technical assistance in the design and construction of eco-san latrines which will include follow-up visits in the first six months of operation. An example of this consultancy work has included constructing eco-san toilets in over 18 schools over the last five years which were funded through the American NGO Water for People. The multiple revenue stream strategy ensures and secures funds for the composting component of the business and safeguards it from shocks such as delayed payments. REC received financial support from UNDP and the EU and land free of charge from the Kigali City Council. These grants were crucial at the start-up phase of the business given how traditionally difficult it is to access funds from formal financial institutions. REC's activities have resulted in several socio-economic and environmental benefits. Increased access to toilets especially in low-income areas have significantly reduced the incidence of open-defecation and 'flying toilets' and consequently environmental pollution. Increased access to environmentally safe and affordable fertilizer alternatives represent monetary gains for small-holder and large-scale farmers.

Value chain and position

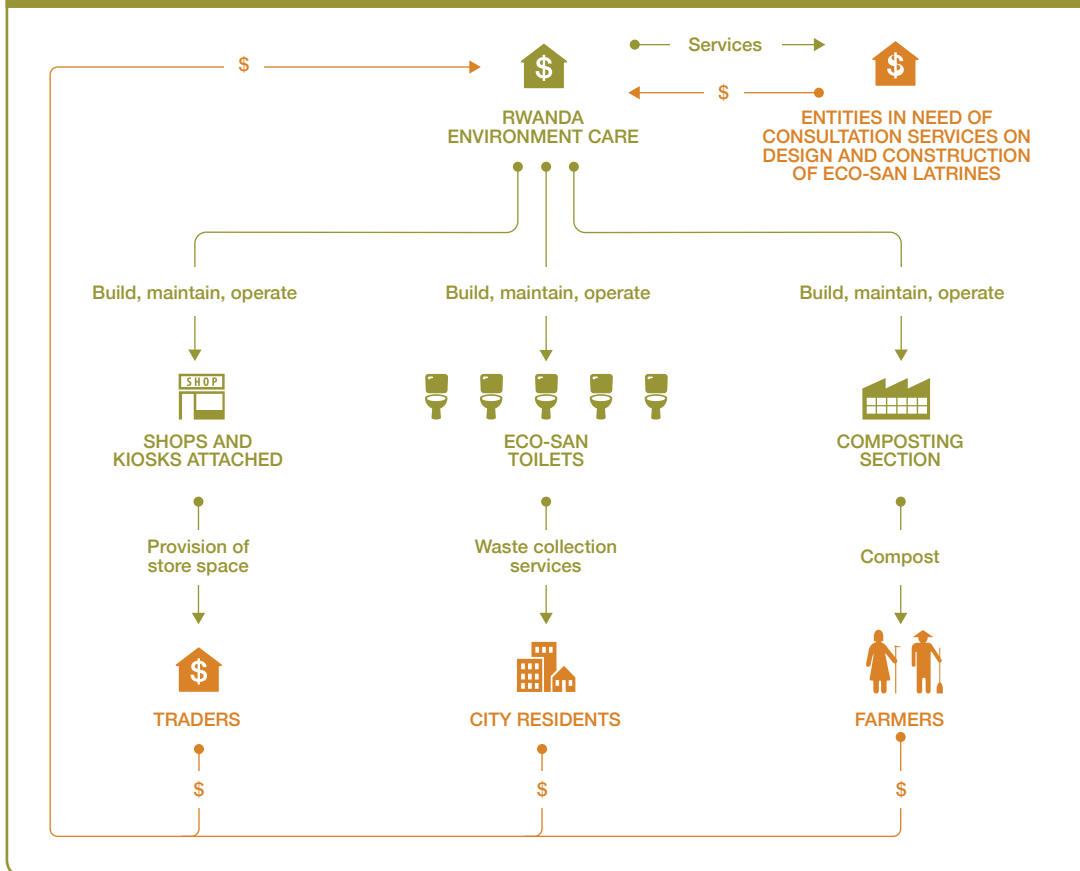
Figure 184 provides an overview of REC's value chain. REC's business is composed of four main parts: a) provision of toilet facilities on a fee-per-use basis; b) provision of shops and kiosks to traders; c) sale of fecal sludge-based organic fertilizer to farmers; and d) provision of consultation services on technical assistance in the design and construction of eco-san latrines. From its early years, REC has constructed and managed five eco-san units in Kigali at the following locations: Kigali City Council (12-door toilet facility); Nyabugogo (12-door toilet facility); Kacyilry (four-door toilet facility); Kimironko (12-door toilet facility); and Kicukiro (eight-door toilet facility). The resulting 48 toilets in the city which on average receive 4,000 users on a daily basis are producing an estimated average of 0.6 tons of fecal matter per day. The high demand for public toilet use ensures a consistent waste supply stream. Quality factors such as moisture (i.e. eater use) can be regulated and monitored, ensuring high quality of the waste input. Currently there is no competition in this supply stream as new eco-san toilets are located where public toilets facilities are limited. The enterprise uses human effluents obtained from its toilet business and processes it into fertilizer, hence faces no competition for the waste input. The urine (urea)-enriched organic fertilizer is sold directly to large-scale farmers in the Northern Province who come to the site for purchase. Prior to collection the compost is stored at a central site in Kigali

FIGURE 183. REC'S BUSINESS MODEL CANVAS



where it undergoes final decomposition before being bagged and stored ready for collection. During the assessment period, REC produced annually over 200 metric tons of compost generating over RWF 4 million, which in 2012/13 corresponded with about USD 6,483. The compost is bagged and stored at a centralized yard in Kigali ready for collection. Demand was from the start higher than production and this has remained constant. REC does recognize that the government subsidized chemical fertilizer

FIGURE 184. RWANDA ENVIRONMENT CARE'S VALUE CHAIN



programme could represent competition for their compost product and thus the need to implement a long-term marketing strategy to increase its share of the market. Additional revenue streams such as renting out shops and kiosks incorporated in the toilet building design has been important for REC in mitigating fluctuations in compost demand, thus invariably improving the sustainability of the business.

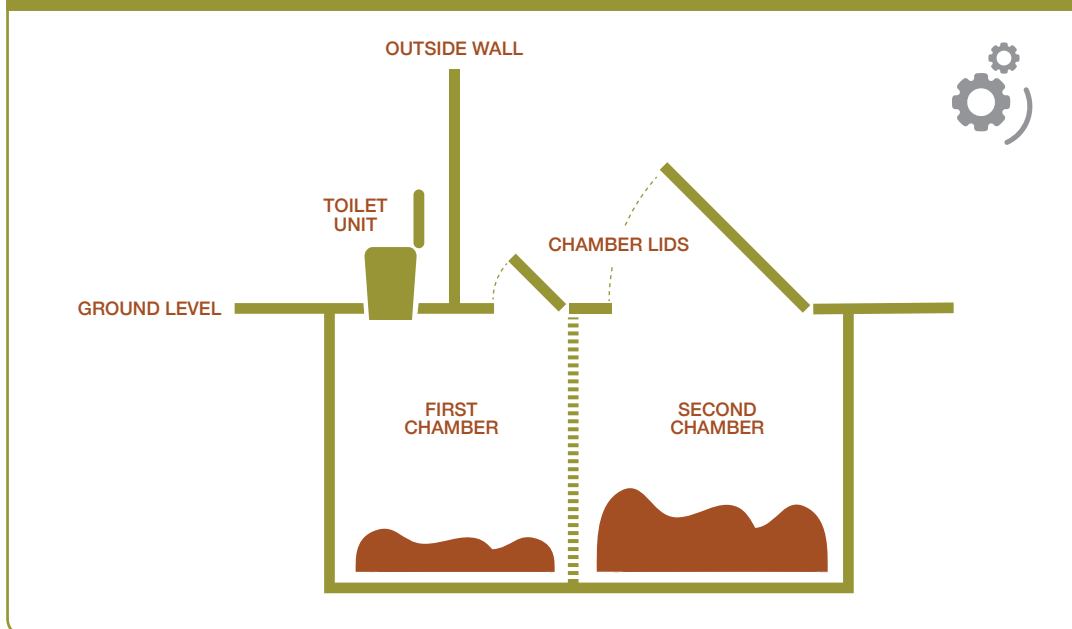
Institutional environment

Eco-san toilets were a relevant new introduction in Rwanda and while there are laws and regulations on the use of human waste issued by the Rwanda Utility Regulation Agency these did not have specific quality standards or guidelines for ecological sanitation. Consequently, REC has been working with the government agency to draft appropriate eco-san quality standards and guidelines. The Rwandan government is supportive of eco-san interventions as illustrated in the fact that urban land is provided by local authorities for projects such as eco-san toilets as they recognize this as an important contribution to service provision in urban environmental sanitation.

Technology and processes

Eco-san toilets are based on a very pragmatic principle of on-site treatment while separating the liquid and solid elements of human waste (Figure 185). In doing so, it brings several advantages such as

FIGURE 185. ECO-SAN CHAMBER DESIGN AS USED BY REC



Note: Urine diversion not shown and chambers not drawn to scale

removing the necessity for having flushing water in a toilet system, thus eliminating any wastewater that would normally flow into a septic tank or sewer. Also diverting urine from fecal matter and then keeping the fecal matter relatively dry eliminates the strong odors associated with the combination of urine and fecal sludge. Once urine is isolated and stored in a container the odor is reduced, moreover with usually no bacterial contamination the urine can be added to the latter stages of composting for compost enrichment or be diluted with water and instantly applied as a crop fertilizer. The fecal matter takes considerably more time to decompose into a state ready for crop application, consequently in the design of all eco-san toilets the separation of liquid and solid waste is a central feature. For the liquid element, urine is normally channelled into a receptor thus providing a safe method of harvesting and storing the urine, but in regards to managing the solid matter there is a degree of variation in how the solid element of human waste is collected, stored and treated, for example variations in chamber size, the use of chambers in series or in standard parallel arrangement and addition of solar heated chambers. The eco-san toilet systems have been designed in such a way that the physical structure fits the surrounding environment. One or two chamber systems can be used. In the latter, the smaller chamber is directly under the toilet unit while the adjoining larger chamber allows entry for a worker to shovel the dry waste from the first chamber to the second, and to empty the compost once it has matured. To increase heat in the large chamber and provide optimum decomposition conditions, the metal lid of the chamber is painted black to absorb solar radiation. Due to high number of users, the pits get full within a short time. Ideally, once the pits get full, the toilets are decommissioned for a period of at least three months during which the feces are left to compost. However, as the toilets are needed, the fecal matter is transferred to an external dry place to complete the composting which allows the vaults to be used again.

Funding and financial outlook

The project was funded by the UNDP and EU at an initial cost of USD 29,173 for the construction of an eight-door toilet complex with two kiosks. This amount is exclusive of land costs which was provided

for free by the urban council. It is estimated that initial construction investment can be recovered in a two-year period. Operation and maintenance costs for a block unit is projected at USD 84 per day. REC has currently three revenue streams: toilet fees, kiosk/shop rentals and compost sales. On average 4,000 daily users of eco-san toilet generate USD 324 per day and the sale of 2,000 bags of compost generates USD 6,343 annually. Toilet fees anchor the compost business as noted from the significant difference in the revenues generated.

Socio-economic, health and environmental impact

REC's initiatives provide eco-san toilets of hygienic standards to the Kigali community and has reduced the intense pressure which hitherto existed on the available public toilets. It employed at the time of the study two people who work on a full time basis and are responsible for the collection of toilet fees as well as daily cleaning and maintenance of the facility. REC ensures to mitigate occupational health risks by providing protective gear (i.e. masks and gloves), which the staff are obliged to wear while working on site and particularly during chamber emptying operations. REC also ensures that it produces a safe compost product which is achieved from the long storage period of the decomposed substrate in the eco-san systems before collection. This ensures that most pathogens are eliminated before the product is used for any agricultural production. In the early phase of the project, microbial levels were tested and found to meet an acceptable level but it was noted that such testing has not become a routine measure and the results of the initial testing were not available. This however does not discount the significant quantities of nutrients recovered from the human effluent which is used for farming activities, thus improving the nutrient level of soils and increasing productivity.

Scalability and replicability considerations

The key drivers for the success of this business are:

- Significant migrating population that are in need of convenient public latrines.
- Strategic partnerships to mitigate capital investment risk at start-up phase; technology and product development/innovation.
- Assured supply of key production input (human excreta) at no cost.
- Increasing farmers' quest for a more affordable alternative to chemical fertilizer.
- Multiple revenue streams – which mitigates risk associated with fluctuations in demand of any of their products and services.

REC's model is replicable and can be scaled out and up especially in communities with no access to the flush toilet system. However, the replication and scaling up and out of this model is highly capital intensive. In Rwanda, eco-san toilets have proven to be successful and socially acceptable, however the main constraint in replicating such services is access to investment funds although the work of REC is now being recognized and the sector is attracting the interest of local development banks.

Summary assessment – SWOT analysis

Figure 186 presents an overview of the SWOT analysis for REC. By implementing a multiple revenue stream strategy, REC is able to safeguard the business from shocks such as delayed payment for compost or seasonal demand, or decreased demand in the provision of any of its products and services. This business has been particularly successful in leveraging its business partnerships to mitigate capital investment risk. Also importantly, it uses a technology that has a key advantage, i.e. there is no wastewater or sludge produced as in a flush-based toilet systems or pit latrines. The technology can be raised off the ground and is thus compatible with flood prone areas or in locations with high water tables as the risk of groundwater contamination is avoided. Currently, the use of urine-based fertilizers remains an underexploited resource in farming systems around Kigali, so demand

FIGURE 186. SWOT ANALYSIS FOR RWANDA ENVIRONMENT CARE

	HELPFUL TO ACHIEVING THE OBJECTIVES	HARMFUL TO ACHIEVING THE OBJECTIVES
INTERNAL ORIGIN ATTRIBUTES OF THE ENTERPRISE	STRENGTHS <ul style="list-style-type: none"> ▪ Diversified revenue streams ▪ Easy accessibility and availability of waste input ▪ No wastewater or sludge is produced from process ▪ Suitable in flood prone areas ▪ Compost is rich in urea ▪ Strong partnership with the municipality ▪ Latrines meet hygienic standards 	WEAKNESSES <ul style="list-style-type: none"> ▪ Inadequate market strategy ▪ Capital intensive at start-up phase ▪ Site location may increase distribution cost ▪ Technology requires expertise ▪ Limited storage capacity ▪ Under high usage, composting periods within the pit gets shorter
EXTERNAL ORIGIN ATTRIBUTES OF THE ENVIRONMENT	OPPORTUNITIES <ul style="list-style-type: none"> ▪ Increase in toilet users ▪ Increase in compost users ▪ Sale of urine-based organic fertilizers 	THREATS <ul style="list-style-type: none"> ▪ Competition from continued subsidization of chemical fertilizers ▪ Some cultural values prevent usage of public toilets ▪ Regular monitoring necessary to ensure correct usage and effectiveness of composting

remains low mainly due to a lack of awareness in its benefits as a liquid fertilizer. As REC does not have the capacity to store and transport urine for on farm applications they have found an alternative use for the resource, which consists of using the urine to enrich the compost by adding quantities of urine to the compost heap during the later stages of decomposition. This is a common practice found in small-scale gardening as the urea feeds the bacterial action in the composting process. There is a great opportunity for REC to add value to the collected urine and with a sound marketing strategy increase its share of the fertilizer market. The compost from human excreta is sold directly to farmers and plans are underway to develop a market for the enriched urine. Although operating so far on a small-scale, the scaling-up and out of REC's initiatives supported by its partners, like SNV, has a high potential to generate significant impact.

Contributors

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References and further readings

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- Dusingizumuremyi, E., Ruzibiza P. and Nkurunziza, T. 2011. Effectiveness of eco-toilets management in public places, case of Kigali City. www.ircwash.org/sites/default/files/Dusingizumuremyi-2011-Effectiveness.pdf (accessed November 8, 2017).

Case descriptions are based on primary and secondary data provided by case operators, insiders or other stakeholders, and reflect our best knowledge at the time of the assessments 2012/14. As business operations are dynamic data can be subject to change.