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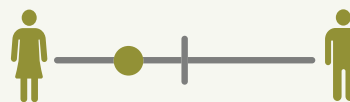
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BUSINESS MODEL 14**Compost production for sustainable sanitation service delivery**

Miriam Otoo and Munir A. Hanjra

A. Key characteristics

| | |
|-------------------------------------|--|
| Model name | Compost production for sustainable sanitation service delivery |
| Waste stream | Source-separated urine, feces from urine diversion dry toilets (UDDT) and pit/septic tanks |
| Value-added waste product | Urine-based fertilizer and fecal sludge-based soil conditioner |
| Geography | Suitable for slum areas/communities with limited provision of waste management service and/or no access to the flush toilet system. UDDT technology particularly suitable for flood prone areas or in locations with high water tables |
| Scale of production | Small to medium: 150–200 tons of fecal-based organic fertilizer |
| Supporting case in this book | Kigali, Rwanda |
| Objective of entity | Cost-recovery []; For profit [X]; Social enterprise [] |
| Investment cost range | USD 25,000–32,000 |
| Organization type | Private or business foundation |
| Socio-economic impact | Improved access to sanitation facilities, reduced health cost associated with poor sanitation, reduced human exposure to open waste dumping, enhanced soil fertility and agricultural productivity, jobs for unemployed |
| Gender equity | Toilet provision. Reduced practice of open defecation away from home, especially in the dark, reduces personal risk for women and girls |

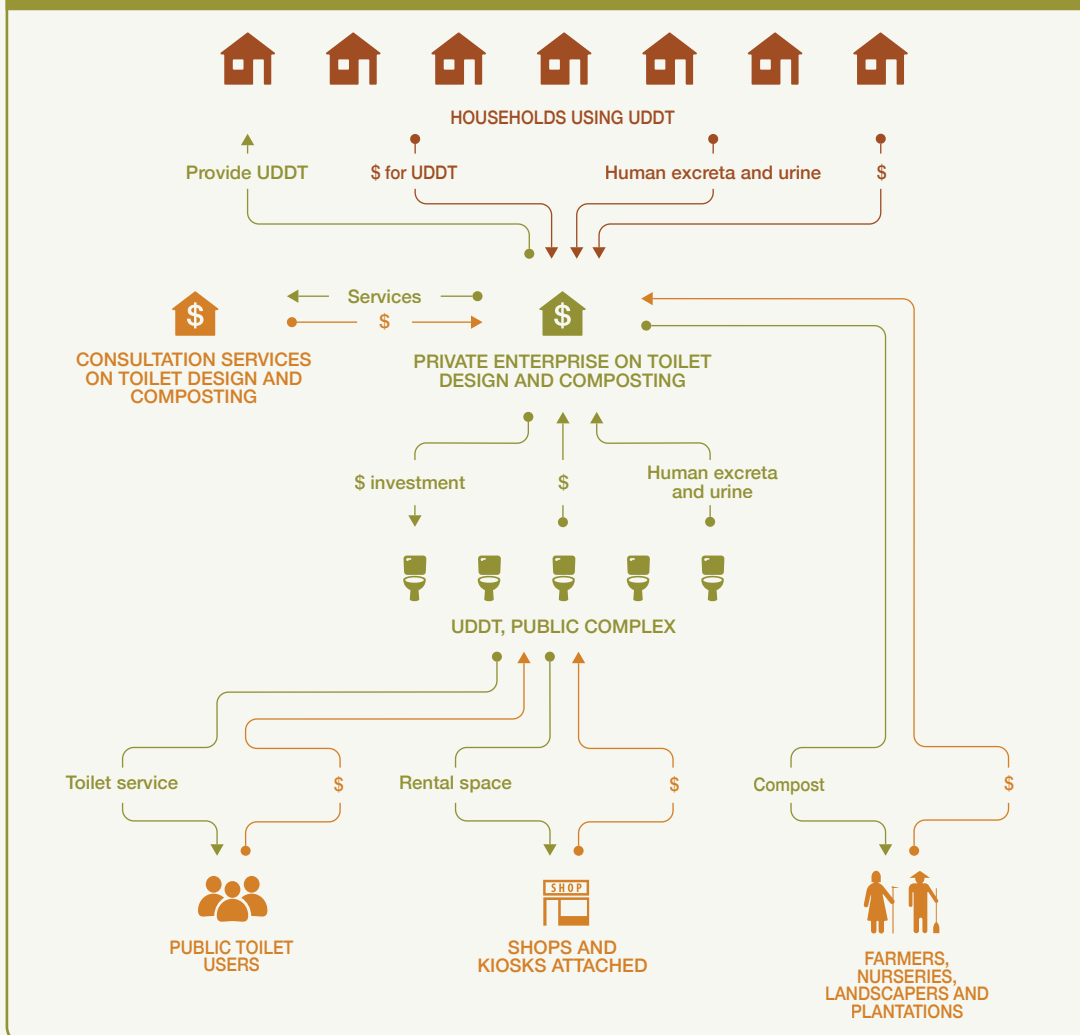
**B. Business value chain**

Many cities and towns across Africa and Asia have a huge gap in sanitation services and waste management – and are far below required international coverage standards. Open defecation continues to be a common practice in view of limited access to basic sanitation products such as toilets facilities suited to the local environment. Additionally, limited public funds to support waste management infrastructure and services has resulted in significant environmental pollution as the majority of the generated waste (e.g. human excreta), whether collected or uncollected is often disposed of untreated in unofficial and open spaces, water bodies and/or landfills (Kinobe et al., 2015). This situation is particularly exacerbated for large urban areas characterized by a growing population and rapid migration.

The business model – sustainable sanitation service delivery system – can be initiated by a private entity or a business-oriented foundation seeking to fill the gap in sanitation service delivery value

chain by providing products and services particularly to poorer segments of society (e.g. slums) in greatest need of these services, and also converts collected fecal sludge from households and public toilets into a valuable resource: organic fertilizer for agricultural use (Rao et al., 2016). In the primary market, the business entity provides sanitation products (toilets) and services (i.e. public toilets, waste collection services) to two main customer segments: households and public masses at a fee (Figure 187). The value for customers in the primary market is increased access to toilet facilities, and reliable and clean removal of fecal sludge. In the secondary market, the collected septage is converted into a nutrient-rich organic fertilizer and is sold to peri-urban farmers. In the secondary market, increased availability of environmentally safe fertilizer alternatives will contribute to reducing water and soil pollution from reduced nitrate release attributed to chemical fertilizer, and also represent significant savings for farmers.

FIGURE 187. VALUE CHAIN SCHEMATIC – COMPOST PRODUCTION FOR SUSTAINABLE SANITATION SERVICE DELIVERY



A unique feature of this model is its viability potential which is driven by a multi-revenue stream and hinged on its primary market. The business generates the majority of its revenues from the sale of toilet facilities, provision of public toilets and waste collection services. It is able to generate sufficient funds to additionally cover the compost production costs, if needed. This is crucial as the sustainability of the primary market largely depends on the business been able to reuse or dispose of the human excreta safely.

C. Business model

The business model is hinged on three value propositions: a) supply and maintenance of ecological sanitation systems (such as urine diversion dry toilets (UDDTs)); b) provision of reliable waste management (collection and treatment) services to poorer segments of society in greatest need of these services; c) provision of affordable and high quality organic fertilizer for agricultural production. This translates into a multiple revenue stream strategy comprised of: sale of eco-san toilets, toilet user fees, kiosk and shop rentals, compost sales and consultancy service fees from the provision of and technical assistance in the maintenance of eco-san toilets and latrines, which ensures sustainability in business operations. This reflects the important success driver for the model which is the diversification of its portfolio which cuts across the entire sanitation value chain in the provision of toilets, waste collection services and organic fertilizers. Additionally, this business model adopts a service oriented approach in which it uses revenue generated from the provision of toilet facilities to run the composting section, which safeguards the business from shocks such as delayed payment for compost or seasonal demand, which could otherwise halt the smooth running of operations and affect the sustainability of the business.

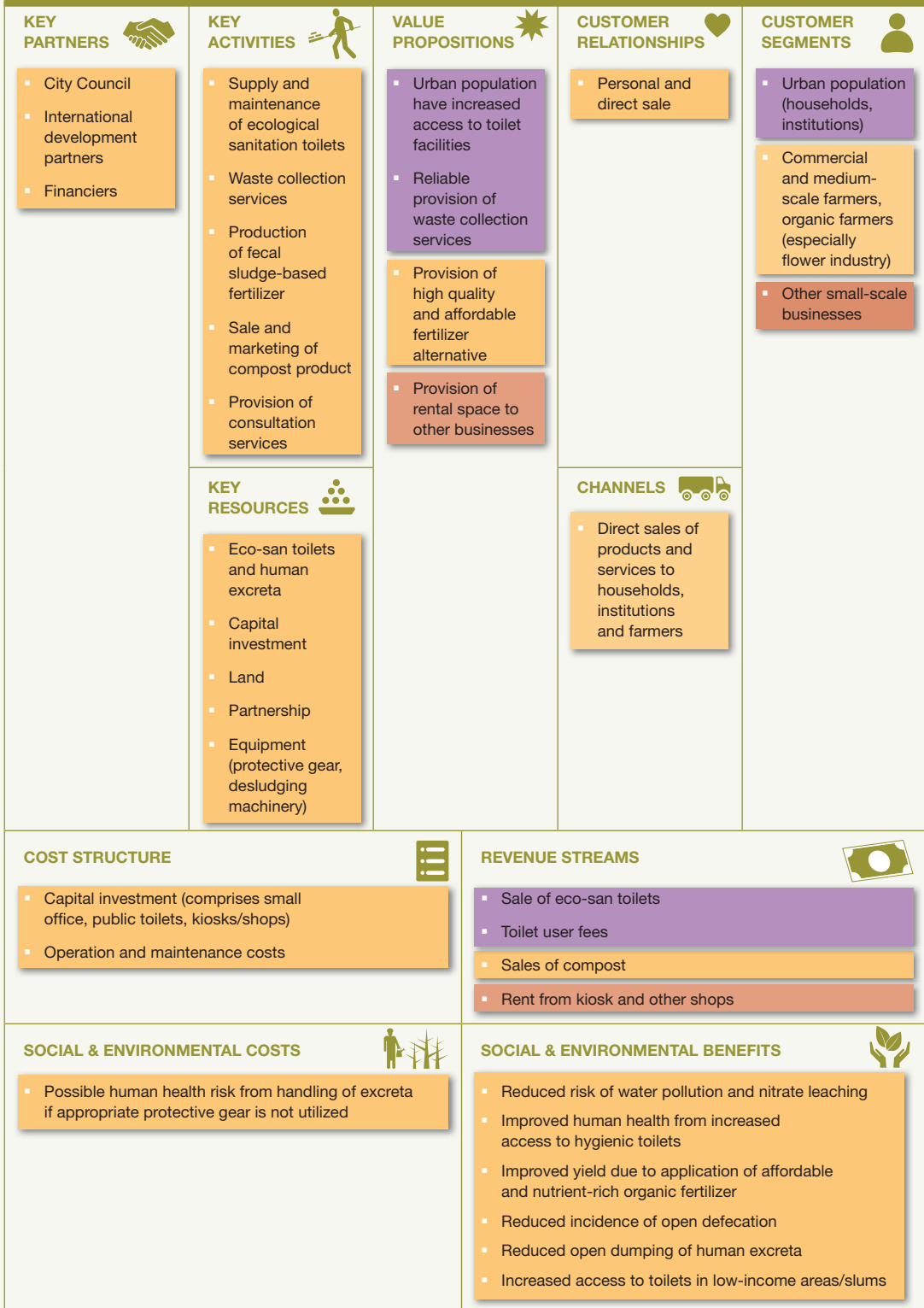
The overall investment required for this type of business is relatively modest depending on the scale of operations, with major investments required at the start-up for the purchasing of toilet facilities and construction of the public toilets. Strategic partnerships with local government, municipalities, city councils, agriculture department and international financiers are instrumental not only for the purposes of gaining access to start-up financing but also customer segments for their compost product. The business model described in this chapter presumes the operation for a standalone private enterprise (Figure 188), and could also be useful for festivals and music events.

D. Alternate scenarios

Scenario I: Franchise model for safe and sustainable sanitation service delivery

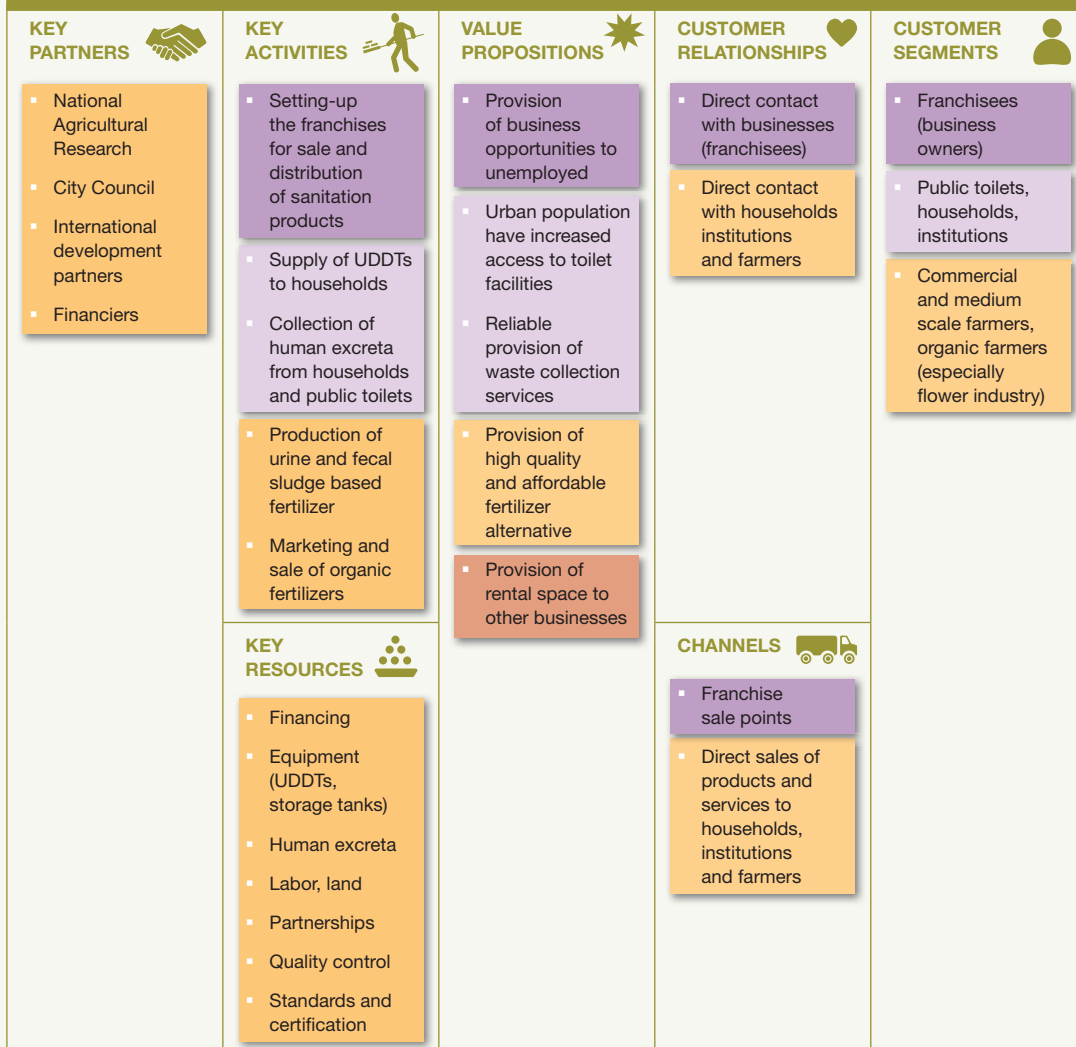
An alternative to the generic business model of sustainable service delivery is the inclusion of a franchising system (Figure 189). It is assumed that at this scaling-up stage of the business, the private entity has sufficient private equity or collateral to obtain financing in order to set up the franchise system. The private/business entity (franchiser) creates a network of entrepreneur managed toilets and composting units. The network is organized within the framework of a franchise. The franchiser supplies the toilet and composting units on demand to its franchise partner network across several cities. The use of the franchiser's name brand and access to their business strategy comes at a cost to the franchisee. The franchisees deliver their composted material to the nearest franchise collection point which the franchise purchases. The franchisees have a sustainable system where they are able to earn revenue from toilet user fees and sale of composted materials without worrying about having a market for their product. The franchiser has the opportunity to sell to bulk buyers such as commercial farmers and large-scale organic food producers, given their increased scale of production. They are able to monitor the quality of the compost via their own product testing and occasional checks. Whilst the franchisor's success depends on the success of the franchisees, the franchisee has a greater incentive than the direct employee because they have a direct stake in the business. There is a risk

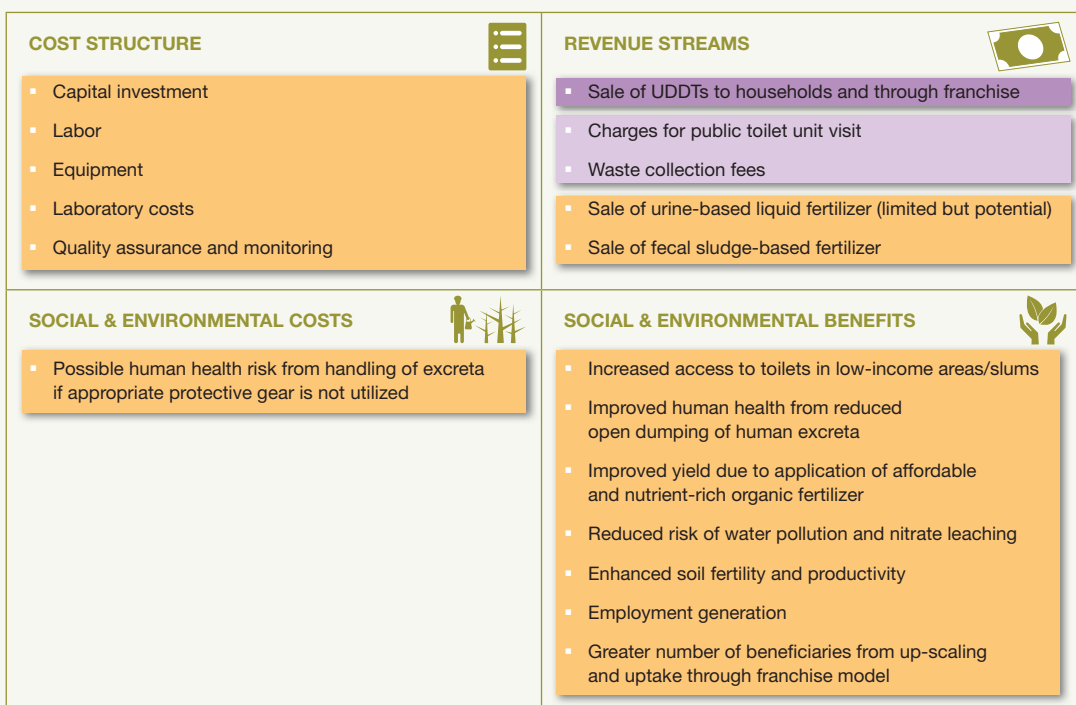
FIGURE 188. BUSINESS MODEL CANVAS – COMPOST PRODUCTION FOR SUSTAINABLE SANITATION SERVICE DELIVERY



for the people that are buying the franchises as failure rates are noted to be higher for franchise businesses than independent business start-ups. Factors related to fair pricing of equipment and supplies from the franchisor, fees for training and advisory services charged by the franchisor, royalty fees, amongst others can influence the sustainability of the franchises. Overall, the franchising model has great potential to generate significant benefits to multiple economic actors in both the sanitation and agricultural value chains as it provides not only an opportunity for the franchisor to increase its profits but it also represents increased access to toilet facilities and waste management services for a greater number of households and improved fertilizer options for agricultural producers.

FIGURE 189. BUSINESS MODEL CANVAS – FRANCHISE MODEL FOR COMPOST PRODUCTION AND SUSTAINABLE SANITATION SERVICE DELIVERY





E. Potential risks and mitigation

The business model presented here was designed and optimized based on the analysis of different case studies and literature review. In designing this optimized business model the risks such as safety, local acceptance by the community and business attractiveness for investors were addressed.

Market risks: There is a huge imbalance between the demand and supply of sanitation products and services especially in fast growing cities in developing countries, such that open defecation and open dumping signals huge market potential but in some settings the affordability comes into question due to the very low income and socio-economic status of the communities. Households' low-ability to pay for sanitation products and services may pose a market risk for this model. This model has proven some initial success and social acceptability despite the stigma associated with waste-based fertilizers. Farmers' low willingness to pay for the compost in view of chemical fertilizer alternatives poses a risk to the sustainability of the model. This risk can however be mitigated from revenue generated from other streams. Additionally, storage and transportation challenges of the liquid-based urine fertilizer may also require an agricultural community nearby for reuse.

Competition risks: Competition risk could come from other suppliers of comparable sanitation products and services, more evidently from the chemical fertilizer sector. Policies and programs such as fertilizer subsidy programs make chemical fertilizer prices relatively lower than compost prices, and thus more cost-effective for farmers. Comparable incentives are needed to mitigate these effects for waste-based organic fertilizer businesses.

Technology performance risks: There are minimal to no technical performance risks associated with the composting technology. Whilst the technology is quite new in most developing country settings, it is relatively simple to implement. The sustainable sanitation technology design separates urine and









keeps the fecal matter dry to eliminate strong odor. Dry fecal matter can be processed into compost and directly used as fertilizer. After storage the separated urine can be directly used as liquid fertilizer in dilution with water, and after storage for two to six months for unrestricted application. The compost production is also low cost and flexible in terms of scale and has relatively simple quality assurance procedures and does not require a high-level of technical expertise.

Political and regulatory risks: National regulations on the reuse of human excreta for agricultural purposes differ, and this determines the scope within which sanitation businesses can engage in resource recovery. Even in cases, where reuse is permitted, the lack of regulations and standards on products and associated certification and quality monitoring pose significant risks for businesses. The provision of ecological sanitation facilities in cities is generally well-received by the governmental entities, in many developing countries.

Social equity related risks: This business model does not have any known social inequity risks. On the other hand, it significantly increases access to sanitation products and services, especially for migratory populations and slum inhabitants. From an agricultural perspective, farmers have improved livelihoods given their increased access to high nutrient organic fertilizers which contributes to improved agricultural productivity.

Safety, environmental and health risks: Also where UDDTs are used, potential pathogenic health risks to different actors along both the sanitation and agricultural value chains remain, associated with the collection, treatment, processing and use of human excreta (Table 45). In particular, workers that collect the (largely dried) fecal sludge and composted materials are at risk. The provision of protective gear for chamber emptying operations should be mandatory. For the compost buyer, microbial standards can provide trust, while from the food consumer perspective, careful washing and boiling should be a routine measure. Additionally, farmers must be trained on the appropriate application methods for the waste-based fertilizer products. Recommendations of national agriculture agencies must also be implemented in tandem, in association with agricultural extension agents.

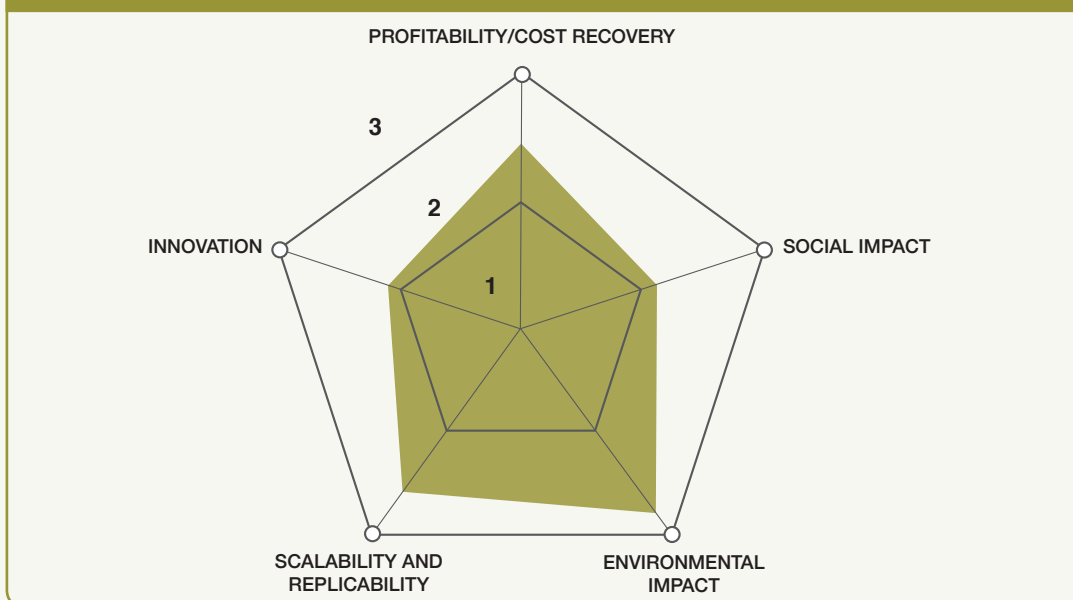
TABLE 45. POTENTIAL HEALTH AND ENVIRONMENTAL RISK AND SUGGESTED MITIGATION MEASURES FOR BUSINESS MODEL 14

| RISK GROUP | EXPOSURE | | | | | REMARKS |
|---------------------|---|--|--|--|--|---|
| | DIRECT CONTACT | AIR/DUST | INSECTS | WATER/SOIL | FOOD | |
| Worker | | | | | | Potential health risks to different actors along both the sanitation and agricultural value chains are associated with the collection, treatment, and processing of human excreta |
| Farmer/user | | | | | | |
| Community | | | | | | |
| Consumer | | | | | | |
| Mitigation measures |  |   |   |  |   | |
| Key | NOT APPLICABLE | LOW RISK | MEDIUM RISK | HIGH RISK | | |

F. Business performance

This model can be scaled up and decentralized through franchise operations across cities in Africa and Asia. A greater opportunity for scaling up and out the sanitation products (UDDTs) and services (waste collection, composting) exist particularly for slum areas due to limited provision of sanitation services. This model ranks highest on environmental impacts due to its catalytic role in protecting human and environmental health by reducing open defecation and unsafe disposal of human excreta. The model ranks second on scalability and can be replicated extensively in cities and neighbourhoods lacking toilet facilities (Figure 190). The model ranks next highest on profitability, because the model generates several revenue streams including toilet visit fees, sale of urine-based liquid fertilizer, sale of compost, fees for waste collection services and rental from shops in the toilet complex and even consultancy services where applicable. For the generic business model, the technology involved is simple, low cost and easy to use, and hence innovation rank is the lowest.

FIGURE 190. RANKING RESULTS ON COMPOSTING MODEL FOR SUSTAINABLE SANITATION SERVICE DELIVERY



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12. BUSINESS MODELS FOR OUTSOURCING FECAL SLUDGE TREATMENT TO THE FARM

Introduction

With a limited number of septage treatment systems in many parts of the developing world, business entities that empty latrines or cesspits often discharge the sludge onto open lands, in landfills or into wetlands, instead of driving to remote official dumping sites. There is an urgent need to address this challenge through more fecal sludge treatment plants. Where this is not possible also farm based systems can offer safe treatment while directly recovering nutrients from fecal sludge for agricultural production.

Fecal sludge is an abundant and valuable resource as the dominating urban sanitation system in both South Asia and Sub-Saharan Africa are septic tanks and latrines (Chowdry and Koné, 2012; Dodane et al., 2012). Its low chemical and metal contamination in household based on-site treatment facilities makes the collected fecal sludge (septage) a valuable soil ameliorant similar to other organic manure such as farmyard manure with high application potential in farming and landscaping (Otoo et al., 2015). The reuse opportunity that lies in the fecal sludge waste stream is especially important where soils are poor and the availability of alternative inputs is expensive. In particular, in areas where affordable fertilizer production or its access is limited, smallholder farmers might use the fecal sludge for fodder, tree (crop) plantation or cereal production. Farmers in West Africa and South India, for example, re-direct cesspit truck operators to their fields to obtain the nutrient rich manure (Drechsel et al., 2011; Evans et al., 2013; Kvarnström et al., 2012). In Northern Ghana, this typically occurs after cereal harvest in the dry season (Cofie et al., 2009). Due to the aridity and heat, the sludge dries over several months and is then incorporated into the soil.

The observed reuse business model between farmers and truck operators reverses the cash flow, as farmers pay the drivers for farm-gate delivery, while otherwise the transporter must pay a tipping fee for desludging into a treatment pond. In an optimized business model, the revenue would ideally support the operation and maintenance costs of the cesspit operation, supplementing the fecal sludge household collection fee. However, an economic drawback to the sustainability of the system is the seasonality in demand for fertilizer, which are often only applied once or twice over the cropping cycle. Fecal sludge is applied as a basal fertilizer at the start of the dry season, allowing it sufficient time to dry over several months before it is incorporated into the soil, and cereals are planted. Sludge marketability is different with (tree) plantation crops, like in India, which can benefit from fecal sludge throughout the year. However, where farmers do not have spare land for the fecal sludge to be initially stored, the voluminous characteristic of the raw fecal sludge can become a constraint. This bottleneck has been bypassed in parts of Karnataka where sludge is collected and sun-dried by larger enterprises, for auctioning to farmers.

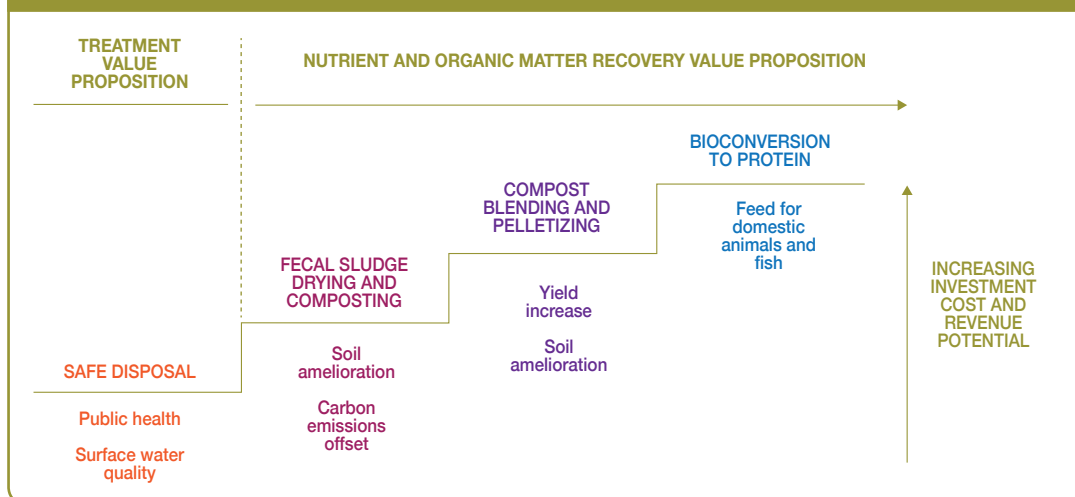
In most developing countries, fecal sludge as a source of fertilizer has not received much recognition, due to both the informal nature of reuse and possible cultural or perception barriers. Moreover, the disposal of fecal sludge onto land, particularly agricultural land, is often prohibited by law – or is, at least, a grey area governed by ‘tacit approval’. In other words, ‘culprits’ have not been punished, especially where engineered, official dumping places are still an exception and the authorities are left with little choice. Where official dumping sites exist, cesspit truck owners pay to use them. Health concerns by authorities concerning the use of raw fecal matter in food production limit the extent of this activity, although with sufficient solar drying as observed in Ghana, and crop restrictions, the risks can be minimized (Seidu, 2010; Keraita et al., 2014), even where no other regulations govern the process. Most pathogens die during sun exposure, so health risks for consumers of cereals grown on this land are minimized (Seidu, 2010). To mitigate also health risks for farmers, they are required to use protective gear.

Other controlled resource recovery approaches can further reduce the potential health and environmental risks associated with fecal sludge use, and increase farmers' accessibility and usability. These steps and trajectories of increasing value proposition have been realized in different regions and are illustrated as shown in Figure 191. An observed pathway of value proposition for agricultural reuse is:

- 1) Direct land application of the raw fecal sludge for agricultural purposes – where value addition occurs in the form of sludge collection and transportation to the farm or plantation, usually followed by natural solar-treatment (sun drying) or incorporation in the soil as an alternative treatment and risk reducing option (Keraita et al., 2014).
- 2) To limit the risks for farmers, the fecal sludge can also be dumped on designated unplanted drying beds followed by composting (or co-composting with other organic waste to improve the carbon–nitrogen ratio) before sale. The value addition lies in removing pathogens, reducing the volume and concentrating the nutrients. Moreover, co-composting is an approved Clean Development Mechanism (CDM) activity. The bulky nature of composted fecal sludge can however act as a barrier to the transportation of the product to markets, increasing the distribution costs, which are borne by the end-users.
- 3) To increase the accessibility and usability of the composted product, pelletization and blending of fecal sludge-based compost with rock-phosphate, urea/struvite or any industrial fertilizer will allow the product to have nutrient levels specific for target crops and soils, and a product structure improvement (pellets) to improve its competitive advantage, marketability and field use. Several business cases have been identified in Nigeria, Ghana¹, Sri Lanka and South Africa which offer related value proposition (Rao et al., 2016). While farmers generally show a positive perception, for those who already use raw sludge (for free or a low fee), they may require field demonstrations to appreciate any other form of sludge with a higher price tag.

This chapter presents the business model on **Outsourcing fecal sludge treatment to the farm** and a supporting case from India, demonstrating how the informal business sector can support the sanitation value chain for the benefit of agricultural production.

FIGURE 191. VALUE PROPOSITIONS FOR NUTRIENT AND ORGANIC MATTER RECOVERY AND REUSE FROM SEPTAGE



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Note

1. <https://goo.gl/wfCksE> (accessed November 8, 2017).