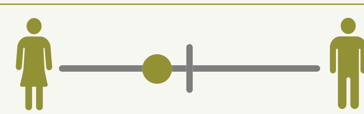
Copyright Material – Provided by Taylor & Francis

BUSINESS MODEL 13

Nutrient recovery from own agro-industrial waste

Miriam Otoo and Munir A. Hanjra

A. Key characteristics

Model name	Nutrient recovery from own agro-industrial waste
Waste stream	Vegetative waste, livestock waste
Value-Added Waste Products	'Regular' compost, enriched vermi-compost
Geography	Regions with significant livestock production, agro-processing enterprises
Scale of production	Medium: 5–40 tons/day; Large: 1,000–2,000 tons/day
Supporting cases in this book	Navaisha, Kenya; Pondicherry, India; Culiacan/Sinaloa, Mexico
Objective of entity	Cost-recovery [ ]; For profit [X]; Social enterprise [ ]
Investment cost range	USD 45,000–USD 2.5 million, depending on scale and technology
Organization type	Private, Public
Socio-economic impact	Cost savings, new revenue and income generation, job creation, reduction of water and land pollution, reduction of CO_2 emissions, averted human health risk
Gender equity	Where biogas is produced in addition to the agro-waste based compost, this can represent increased access to improved fuel options for women 

B. Business value chain

Many agro-industrial entities continue to face the increasing challenge of managing their waste. To ensure business sustainability (typically in compliance to legislative mandates for environmentally friendly waste management practices), agro-industrial entities set up subsidiary businesses to the parent company to convert the agro-waste (tea, horticultural products, sugar mill waste, livestock waste) generated from operations of the latter into an organic fertilizer. The concept is primarily based on the notion that parent agro-businesses generate sufficient business such that its sustainability justifies new capital investments in an onsite nutrient recovery entity to support its own back-end agricultural operations. The concept is simple but the impacts are multi-fold, due to the forward and backward linkages between the parent agribusinesses entity and subsidiaries engaged in nutrient recovery for self-supply to the parent entity but also entry into the larger fertilizer market.

This business model can be initiated by a public, private or public-private partnership entity seeking to address an internal business waste management challenge and additionally generate revenue and diversify their business portfolio. Although this business model is typically geared towards cost-savings, the agro-waste processing entity can generate significant revenue from compost sales

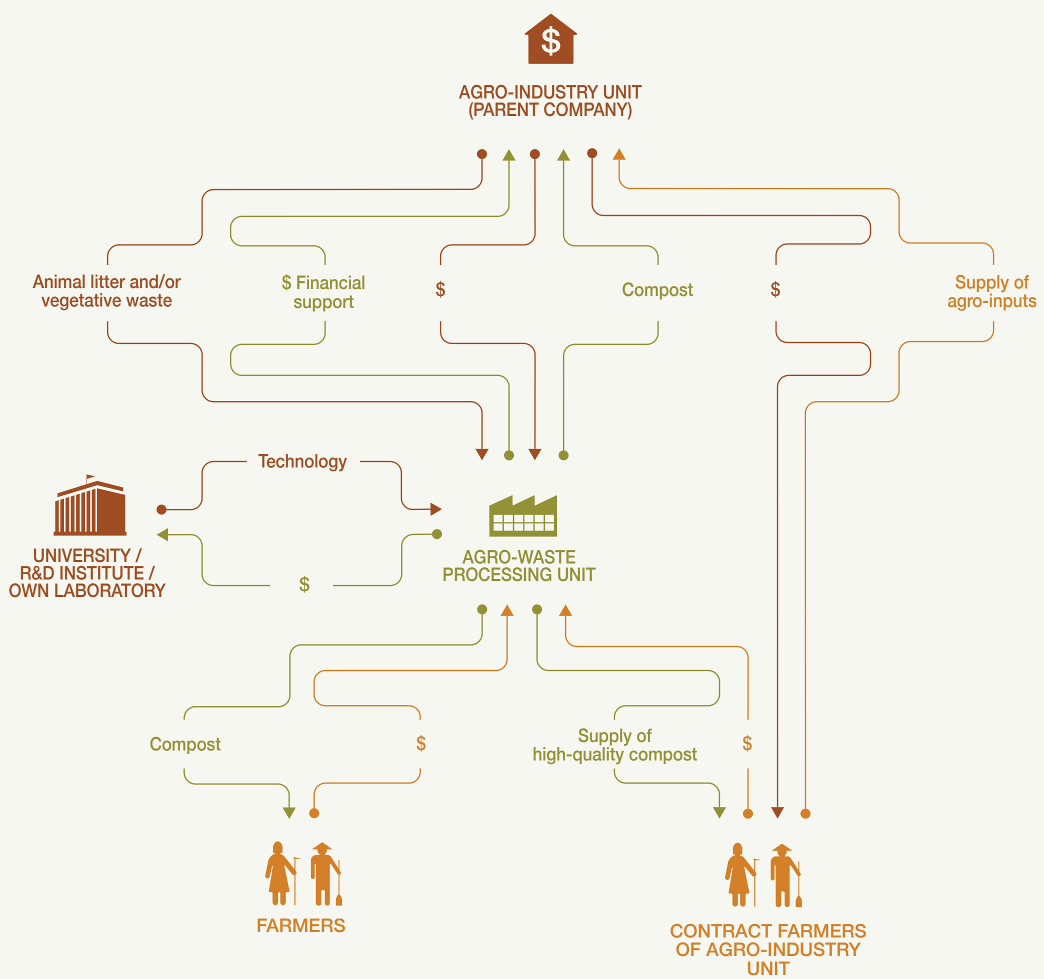
Copyright Material – Provided by Taylor & Francis

primarily to its parent company (usually if it is an agricultural producer) and local farmers. Investment in innovative technologies (e.g. inclusion of biologically active compounds that promote plant growth and health) can allow them to self-brand their compost product and invariably capture a share of the local fertilizer market. The agro-waste processing unit sources its waste input primarily from the parent company and its affiliates (contract farmers) thus ensuring a consistent supply of resources, oftentimes free of charge or at a lower cost. Quality monitoring activities can be performed by a local university/R&D institute at a fee or their own laboratory. The business concept involves a simple value chain schematic as depicted in Figure 179.

C. Business model

The business model is hinged on two value propositions: a) provision of sustainable waste management (collection and treatment) services and options (nutrient recovery) for 'primary' agro-industrial (parent company) business; and b) provision of affordable, high nutrient organic fertilizer

FIGURE 179. VALUE CHAIN SCHEMATIC – NUTRIENT RECOVERY FROM OWN AGRO-INDUSTRIAL WASTE



Copyright Material – Provided by Taylor & Francis

for agricultural production (Figure 180). Key success drivers of this business model are based on: a) mutually-beneficial partnership with its parent company – which ensures a consistent supply of waste input (vegetative and livestock waste) free of charge or at low cost and provision of capital investment which mitigates capital start-up risk; b) option of a diversified portfolio through the sale of biological control organisms and different grades of compost tailored to different markets; c) price differential gains from market segmentation for its compost product. Waste input used for compost production is sourced from the parent company. This is a win-win partnership as the latter has a reliable waste management system to ensure sustainability of its business and the former – a reliable source of waste input for production at a fee and start-up capital investment. The business model's main revenue generation streams are from: a) organic fertilizer sales to segmented markets; b) fees received from parent company for waste management.

The business typically sells its compost products primarily to its parent company (if it is an agricultural producer) and directly to local farmers often implementing a segmented-pricing approach with bulk sales to parent company and large-scale farmers at a lower price and a higher price to retailers and smallholder farmers. It is important to note however that depending on the contractual agreement between the parent company and the subsidiary (agro-waste processing) entity, the compost price may be adjusted to account for the cost of collecting and transporting the waste to the waste processing facilities. A competitive marketing strategy such as the provision of free samples of compost to first time users can help build the business' product brand and customer base. Also, by adopting a commodity-value (and using value-addition technologies) the agro-waste processing entity can produce high quality compost tailored to specific clients and agricultural purposes. The success of this approach is dependent on the partnership the business has with key research institutes that can provide support for the development of innovative technologies to produce high-quality products, and also provide product quality analysis services for certification. Third party product certification can help garner significant market demand and mitigate market competition effects from the often subsidized chemical fertilizer. Field demonstrations and semi-commercial tests (farmers, particularly crop farmers are able to initially try the product and observe actual benefits prior to payment) can be instrumental in creating greater market access.

The business can take advantage of economies of scale, depending on the scale of operations of the parent company, and focus on low cost, yet efficient technologies for compost production. Large-scale operations will permit the business to reduce its production costs and charge a lower price of its compost and help capture a larger share of the fertilizer market. The overall investment required for this type of business is relatively modest depending on the scale of operations and investments required at the start-up for R&D (development of innovative technologies), technologies and related equipment. This business model has the potential to generate significant socio-economic and environmental benefits including: job creation and reduced $C0_2$ emissions. Additionally, monetary gains to farmers are represented by increased crop yields and related incomes. This model has a high replication potential especially in developing countries with an increasing number of agro-processing businesses and related limited waste management options.

D. Potential risks and mitigation

The business model presented here was designed and optimized based on the analysis of different case studies (see previous sections). In designing this optimized business model, risks related to safety, local acceptance by the community, and business attractiveness for investors were assessed.

Market risks: The main market risk is related to the business' strong focus and dependence on the launching customer (parent). This can induce the business to lose touch with the market and limit its

Copyright Material – Provided by Taylor & Francis

FIGURE 180. BUSINESS MODEL CANVAS – NUTRIENT RECOVERY FROM OWN AGRO-INDUSTRIAL WASTE

KEY PARTNERS

- Agro-industrial company (parent company)
- Local university/ R&D institute
- Small scale local livestock farmers

KEY ACTIVITIES

- Waste (vegetative and/or livestock waste) collection
- Production of organic fertilizer
- Brand management, marketing and sales
- Sales and distribution of organic fertilizer

KEY RESOURCES

- Partnership with parent company
- Equipment
- Labor (skilled and unskilled)
- Land and labor
- Vegetative and animal waste
- Partnership with university/R&D institute
- Branding and quality certification
- Contractual agreements

VALUE PROPOSITIONS

- Provision of sustainable waste management options for 'primary' agro-industrial (parent company) business
- Provision of affordable, high nutrient organic fertilizer for agricultural production

CUSTOMER RELATIONSHIPS

- Long-standing business relationship
- Direct sales between parent –sister company
- Personal at direct sales

CHANNELS

- Direct channel with parent company
- Direct sales to local farmers

CUSTOMER SEGMENTS

- Agro-industrial (parent) company
- Small- and large-scale farmers

COST STRUCTURE

- Capital investment (equipment, land, infrastructure)
- Operation and maintenance costs
- Laboratory and product certification costs

REVENUE STREAMS

- Sale of organic fertilizer to segmented markets:
  - Bulk sales to parent company and large-scale farmers (lower price)
  - Sales to smallholder farmers (higher price)
- Fees received from parent company for waste management

SOCIAL & ENVIRONMENTAL COSTS

- Potential contamination of soil and groundwater from disposal of untreated leachate on-farm

SOCIAL & ENVIRONMENTAL BENEFITS

- Job creation
- Reduction in chemical fertilizer use
- Reduction of carbon dioxide emissions
- Improvement in soil structure and nutrient composition
- Reduced nitrate contamination

Copyright Material – Provided by Taylor & Francis

opportunities for growth. Traditionally, farmers have a high acceptability of agro-waste based compost – especially given its high nutrient content. It is however important to consider quality testing by a third party to minimize market risks associated with consumers' negative perceptions. Whilst this approach can in turn allow the businesses to charge a higher price (from the 'branded' product), it may entail additional costs for which the compost producers have to take in account.

Competition risks: One of the key competition risks to be considered is supportive policies for chemical fertilizer use which may create a non-competitive market environment that negatively affects the sustainability of compost producers. This effect can be mitigated based on the scale of operation and targeted (assured) clientele – bulk purchases from government-owned agricultural department services and the parent firm. Innovative marketing strategies related to free samples and demonstration trials can be adopted to mitigate some of these effects. Resource/input (waste) supply risks are considered to be relatively low due to the assured supply of waste from the parent company.

Technology performance risks: The composting technologies (traditional windrow-composting and vermi-composting) considered under this model are relatively mature and freely available in the market. However, depending on the waste input and technology used, some residual risk may remain. For example, livestock waste-related diseases such as mad cow disease and foot-and-mouth infections need particular attention and quality monitoring and testing programs by a third party should be considered to reduce such risks.

Political and regulatory risks: Policies and regulations related to waste-based compost sectors differ by country. The oftentimes stronger political support for chemical fertilizer use (slow phasing-out of fertilizer subsidies) and lack of specific government guidelines for the certification of compost and internationally accredited third-party certification entities can represent a significant risk to the sustainability of the business model.

Social equity related risks: There are no distinctive social inequity risks anticipated for this business model in terms of poverty and gender. Smallholders could potentially benefit from improved agricultural productivity from increased access to comparatively inexpensive organic fertilizer, if the compost producers choose to sell the excess.

Safety, environmental and health risks: There are potential environmental and health risks that need to be considered under this model. Workers involved in all activities along the compost production value chain (waste collection, separation, compost production, etc.) can be potentially exposed to livestock waste-related diseases if technology performance is not up to par. To safeguard the health of workers, it is imperative that businesses provide and ensure the use of safety gear – hand gloves and rubber boots; conducts an annual medical check up. To address the safety and health risks to workers, standard protection measures are also required as elaborated below (Table 44).

E. Business performance

This model ranks high on scalability and replicability due to the increase in agro-industrial businesses and related limited waste management options especially in developing countries (Figure 181). Significant environmental benefits can be realized through nutrient recovery and improved waste management options, as the reduced release of nitrates and GHG emissions results in decreased environmental pollution. This business model however ranks low on social impacts, as aside from employment generation (and oftentimes labor is obtained from the parent company and used internally) and increased access to alternative fertilizers, leaner social benefits accrue to other economic actors along the value chain (e.g. waste collectors, compost retailers). It is noted that most entities either use

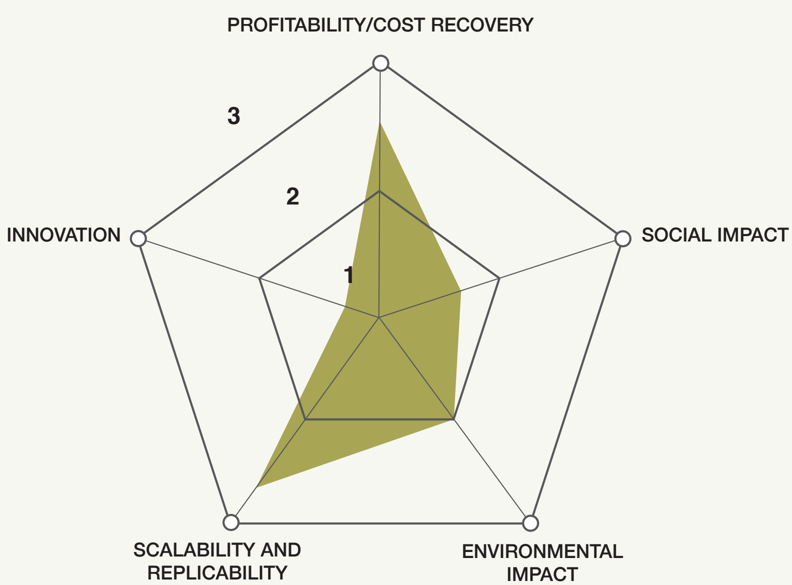
Copyright Material – Provided by Taylor & Francis

TABLE 44. POTENTIAL HEALTH AND ENVIRONMENTAL RISK AND SUGGESTED MITIGATION MEASURES FOR BUSINESS MODEL 13

RISK GROUP	EXPOSURE					REMARKS
	DIRECT CONTACT	AIR/ DUST	INSECTS	WATER/ SOIL	FOOD	
Worker						Potential risk of exposure to e.g. bovine parasites and diseases requires monitoring; Potential risk of dust, noise and chemical compost contaminants
Farmer/user						
Community						
Consumer						
Mitigation Measures		 				

Key: NOT APPLICABLE, LOW RISK, MEDIUM RISK, HIGH RISK

FIGURE 181. RANKING RESULTS FOR 'NUTRIENT RECOVERY FROM OWN AGRO-INDUSTRIAL WASTE' BUSINESS MODEL



the traditional open-windrow composting technology or vermicomposting or both, to produce regular compost and vermicompost. These technologies are simple, low cost and easily available (technical training) in the market such that the model ranks lowest on innovation. New technologies that help reduce energy costs could improve its rank on the innovation frontier.

Copyright Material – Provided by Taylor & Francis

11. BUSINESS MODELS ON COMPOST PRODUCTION FOR SUSTAINABLE SANITATION SERVICE DELIVERY

Copyright Material – Provided by Taylor & Francis

Introduction

Improved access to sanitation is one of the major policy goals throughout developing countries. An emphasis so far has been on the eradication of open defecation, hygiene and improved toilet facilities, ideally connected to sewer systems where urban centres are exploding. Global movements have to date increased access to basic sanitation products which has resulted in a significant percentage of rural and urban populations been connected to household-based latrines and septic tanks (CSE, 2011), however the majority of the population in developing countries still lack access to toilet facilities and substantial efforts are continuously being needed to close this gap. An increasing number of private businesses are setting up public toilet facilities to cater particularly to migratory populations and slum inhabitants who still have marginal access to sanitation products and services, however limited septage collection and treatment can undermine the sustainability of these services.

An effective and sustainable sanitation service delivery is one that provides products and services across the entire sanitation value chain, interlinks with the agricultural or other sectors to generate benefits to all economic actors in the respective value chains, and creates connectivity of resources among physical, and biological systems (Figure 182). Resource recovery and reuse of urban septage as peri-urban fertilizer has so far been largely an informal sector activity (Kvarnström et. al., 2012). But with the increasing interest in a green economy, and new technical innovations for fertilizer generation, there is scope for resource recovery to play an increasingly significant role (EAI, 2011). The business model on **sustainable sanitation service delivery** via nutrient recovery from fecal sludge presented here generates the double value proposition of:

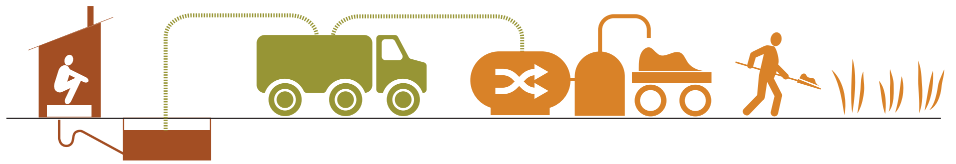
- Provision of sanitation systems/ products (such as urine diversion dry toilets (UDDTs)), and reliable waste management (collection and treatment) services to poorer segments of society in greatest need of these services;
- Provision of an affordable, sanitized and nutrient-rich compost product for farmers.

The crux of the business model is hinged on the desirable social impact of providing hygienic sanitary facilities to society, particularly the masses at public places, whilst also providing an effective way to meet agricultural input needs of the farming community via compost production from human excreta. The business approach works because it is built around harnessing economic value from human waste whilst providing sanitation services to the poorer segments of society which represents the greatest percentage of population in need of such services, particularly in developing countries. By re-branding human waste as a needed input instead of a waste output, sanitation/waste reuse-based businesses can create both a physical and financial demand for waste, completely reinventing the economics of sanitation (Murray, Waste Enterprisers, pers. comm., 2014).

In this chapter, we describe a case from **Rwanda** which recognized the opportunities in human waste and is gradually playing an important role in leveraging private capital to help provide sustainable sanitation services and realize commercial the value in waste by shifting the focus from treatment for waste disposal to treatment of waste as a resource for reuse for the ultimate benefit of poor farmers and households (EAI, 2011; Murray and Buckley, 2010).

Copyright Material – Provided by Taylor & Francis

FIGURE 182. SUSTAINABLE SANITATION VALUE CHAIN WITH RESOURCE RECOVERY



References and further readings

AECOM International Development, Inc. and SANDEC/Eawag. 2010. A rapid assessment of septage management in Asia: Policies and practices in India, Indonesia, Malaysia, the Philippines, Sri Lanka, Thailand and Vietnam. Report for USAID Regional Development Mission for Asia.

Chowdhry, S. and Koné, D. 2012. Business analysis of fecal sludge management: Emptying and Transportation Services in Africa and Asia. Seattle, WA, USA: Bill and Melinda Gates Foundation Report.

Centre for Science and Environment (CSE). 2011. Policy paper on septage management in India. Delhi.

Dodane P., Mbeguere, M., Sow O. and Strande, L. 2012. Capital and operating costs of full-scale fecal sludge management and wastewater treatment systems in Dakar, Senegal. Environmental Science and Technology 46 (7): 3705–3711.

EAI. 2011. Sustainable recovery of energy from fecal sludge in India. Report for BMGF. Energy Alternatives India. Chennai.

Kvarnström, E., Verhagen, J., Nilsson, M., Srikantaiah, V., Ramachandran S. and Singh, K. 2012. The business of the honey-suckers in Bengaluru (India): The potentials and limitations of commercial faecal sludge recycling – An explorative study. (Occasional Paper 48) [online] The Hague: IRC International Water and Sanitation Centre. www.irc.nl/op48 (accessed November 8, 2017).

Murray, A. Waste Enterprisers, personal communication. 2014.

Murray, A. and Buckley, C. 2010. Designing reuse-oriented sanitation infrastructure: The design for service planning approach. In Wastewater Irrigation and Health: Assessing and Mitigation Risks in Low-Income Countries, edited by Drechsel, P., Scott, C.A., Raschid-Sally, L., Redwood, M. and Bahri, A. UK: Earthscan-IDRC-IWMI, 303–318.