CASE

Fecal sludge and municipal solid waste composting for cost recovery (Balangoda Compost Plant, Sri Lanka)

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Supporting case for Business Model 10	
Location:	Balangoda, Sri Lanka
Waste input type:	Municipal solid waste (MSW) and fecal sludge
Value offer:	Provision of MSW-based compost ('regular' compost), fecal sludge-based compost ('super' compost) and treated wastewater
Organization type:	Public entity
Status of organization:	Operational since 1999 but was privatized in 2003 and restored to government again in 2005
Scale of businesses:	Small to medium; processes more than 300 tons of MSW/month
Major partners:	Central Environmental Authority, Municipal Council, Universities, LIRNEasia

Executive summary

Balangoda Compost Plant (BCP) is a public entity that converts MSW into compost, and by adding also night soil[1] into super compost, as well as treating of water and trading of recyclables. It was set up to curb environmental and sanitation problems in Balangoda, in particular, indiscriminate disposal of night soil and solid waste accumulation. It uses the open-windrow processing technology to compost municipal solid waste. A simple approach with limited energy requirements is used in treating night soil, where water purifying plants and charcoal filters are used to treat the wastewater in the fecal sludge. Although geared towards cost-recovery and receiving partial financial support from the central government, BCP generates significant income from its multiple revenue streams – sale of compost and recyclables. MSW-based compost and super compost are sold directly to farmers through agro-outlets in local markets. Other government bodies, such as the Urban Development Authority and the Ministry of Agriculture, buy directly in bulk for landscaping. There is however no market for the treated water (leachate product). Resource centres where non-degradable waste is traded have been established in the city centre and at ten schools. BCP purchases segregated non-degradable waste from these resource centres and schools and resells to recycling companies at a higher price. This initiative has significantly reduced direct human contact with untreated waste and provided an improved environment for the community through proper waste management practices in the region. Additionally, it has created jobs and improved infrastructure via the construction of access roads to the project site. It has also caused an attitude change towards waste among the younger generation.

KEY INDICATORS (AS OF 2015)						
Land use:	1 ha					
Capital investment:	USD 352,000 including costs of 1 hectare of land					
Labor:	17 people (15 unskilled, 2 skilled)					
O&M cost:	USD 1,340 per month					
Output:	30 tons of compost, 5 tons of super compost and 180,000 litres of treated water, all on a monthly basis					
Potential social and/ or enviornmental impact:	17 jobs, production of high quality and affordable compost and super compost, treated water, changed attitude of children to waste, cleaner local environment					
Financial viability indicators:	Payback period:	N.A.	Post-tax IRR:	N.A.	Gross margin:	N.A.

Context and background

The Balangoda Compost Plant (BCP) was set up to process municipal solid waste into compost. The plant started as a project with the mission of providing a solution to the solid waste problem as a community service. However, it gradually evolved into a business while providing community service. Balangoda is situated in Sabaragamuwa province of Sri Lanka, with a population of more than 40,000 and a land area of 16.2 km^2. The plant was started in 1999 and it has undergone several changes in ownership structure; it was set up and managed by the government but privatized after a change in government. The ownership was again transferred to the government when the private entity neglected safe handling of waste and focused completely on profits. Construction cost of the compost plant and the access roads were funded by Central Environmental Authority and Provincial Council. The land was given to the project at no cost by the Land Reform Committee. As a rejuvenated project in 2003, it embarked on cleaning the city in the night including collection of waste which was appreciated by the people and the decision makers resulting in further allocation of funds to improve the plant. By 2005, funding and revenue received was used to purchase the required machines and with the help of the municipality, a resource centre was built to purchase non-degradable waste in the city. The plant procured plastic and polythene pelletizers to add value to the non-degradable waste which reduced related transportation cost from product distribution. In 2008, a fecal sludge treatment plant was established with funds from the "Pillisaru" project of the Central Environmental Authority. Funds were used to construct a receiving tank, 2 sedimentation tanks, a water treatment facility and a drying bed. The majority of the building has been constructed from the funds and subsidies provided by the government. BCP earns revenue from sale of compost, super compost and recyclables. A twelve-year target of making a 'Waste Free City' has been achieved by the plant whereby all generated waste in the city is collected and treated.

Market environment

Waste accumulation in the city caused many problems including unpleasant odor, contamination of water bodies and paddy fields, giving rise to epidemic diseases like Salmonella typhoid and diarrhoea. This has resulted in a great need for the implementation of sustainable waste management solutions. Soils in the Eastern province of Sri Lanka are traditionally very sandy and chemical fertilizers leach out of the soil at a faster rate without the application of soil conditioners. Additionally, the over application of chemical fertilizers has damaged a considerable proportion of the soil structure and has rendered most of the lands unsuitable for agricultural production. Government and farmers in the Eastern province of Sri Lanka realize the importance of organic fertilizer use to mitigate the long-term damage of agricultural lands. This has resulted in an increased demand for organic compost in the Eastern Province. BCP sells an average of five tons of compost per month of which 40% is sold in the locality and 60% in the Eastern province and foresees an increasing trend in demand.

Macro-economic environment

The introduction of cash payment-based subsidies for chemical fertilizers may affect the demand of organic fertilizer in the locality. BCP is largely focusing on the Eastern province fertilizer market where organic fertilizer is in high demand due to the poor structure and declining fertility of the soils. The demand for chemical fertilizers is fairly high country-wide and this has been one of the driving factors for price subsidization by the government. A 50kg bag of chemical fertilizer at the subsidized rate is sold between a range of USD 2.75–3.07 and organic compost produced by Balangoda composting plant is sold for USD 3.14. BCP faces strong competition from both chemical and organic fertilizer businesses (Table 34).

TABLE 34. PRICES OF ORGANIC AND INORGANIC FERTILIZERS IN SRI LANKA 2015

FERTILIZER TYPE	PRICE (USD/50KG)
Organic fertilizer – Balangoda composting plant	3.14
Organic fertilizer – Nawalapitiya	2.74
Chemical fertilizer	2.75 – 3.07

Business model

Figure 126 provides an overview of the Balangoda Composting Plant's (BCP) business model. It is a public entity that processes municipal solid waste (MSW) and fecal sludge (FS) into organic fertilizers, treats leachate (wastewater) and sells recyclables (non-degradable waste). The enterprise was set up with the intent of providing community service and is not profit-oriented. The plant employs a value-driven model, where quality of the product is the main focus. For instance, the nitrogen content of the compost from MSW and FS are 1.68 and 2.9 respectively, compared to an average of 0.5–0.7 found on the market. It also adapts a demand driven approach where compost is sold to farmers that have need of the product, i.e. localities where soils are sandy in nature and thus require soil conditioner to bind soil particles together. Organic compost from both MSW (regular compost) and FS (super compost) are sold to farmers within the locality, as well as to the farmers in the Eastern province of Sri Lanka. As a part of its marketing strategy and to expand its customer base, BCP gave all its first-time customers free compost samples so that they could witness increased yields on their own farms. This has been instrumental in increasing its market share. An additional source of revenue is from the sale of recyclables which are bought from locals and sold directly to recycling companies at higher prices. There is no market for the treated wastewater. BCP has partnered with the Pillisaru Project which contributed funds for the construction of tanks and drying beds required for the production of the super compost. It is important to note that this was a one-time contribution, and whilst a partner to BCP, they are not a key partner in the business model, since it has no continued role in the business. Another key partner has been the local university for laboratory analysis of wastewater and with LIRNEasia[2] for technology development and skills training of the staff. A key success factor of this business has been its ability to liaise with the urban council to enact a waste tax for shops and institutions that fail to segregate waste. This has tremendously reduced the costs associated with waste sorting and sped up the entire production process. Waste resource centres have been implemented in schools. Students have been trained on waste segregation and the benefits of waste reuse which has resulted in an attitudinal change among the young generation.

Value chain and position

Figure 127 provides an overview of BCP's value chain. The Balangoda compost plant is a public entity owned by the municipal council. It receives its major input, i.e. municipal solid waste and fecal sludge, from the council and commercial companies. It partners with universities and LIRNEasia for research

FIGURE 126. BALANGODA COMPOST PLANT'S BUSINESS MODEL CANVAS

KEY PARTNERS

- Central Environmental Authority
- Municipal Council
- LIRNEasia
- Universities

KEY ACTIVITIES

- Collection and separation of waste
- Production and sale of compost and super compost
- Trading of recyclables
- Awareness raising activities at educational institutions

KEY RESOURCES

- Machinery
- Land and labor
- MSW
- License (fertilizer manufacturing and environmental impact assessment)

VALUE PROPOSITIONS

- Provision of improved sanitation and waste management services
- Provision of high nutrient compost and super compost for farming activities and landscaping
- Recycling companies get to buy recyclable wastes at an affordable price

CUSTOMER RELATIONSHIPS

- Personal collection of waste
- Personal help at direct sales (marketing strategy adapted where samples are given to farmers free of charge the first time)
- Personal

CHANNELS

- Direct
- Local market through a well-constructed market chain and direct channel to bulk buyers
- Waste resource centres and school children to collect recyclables and direct sale to recycling companies

CUSTOMER SEGMENTS

- Commercial firms and residents of Balangoda
- Farmers within locality and Eastern province farmers
- Bulk buyers: Government authorities (Urban Development Authority for Landscaping and Ministry of Agriculture)
- Recycling companies

COST STRUCTURE

- Investment Capital cost (including receiving tanks, sedimentation tank, plastic and polythene pelletizer, water treatment facility and drying bed)
- Operation and maintenance (maintenance of machinery, quality control and labor cost)
- Purchase of non-degradable waste from resource centres

REVENUE STREAMS

- Waste collection funds from government and waste tax from commercial entities that do not segregate waste
- Waste collection fees collected directly from some commercial entities such as fish market, vegetable market etc.
- Sales of compost and super compost
- Sales from non-degradable waste

SOCIAL & ENVIRONMENTAL COSTS

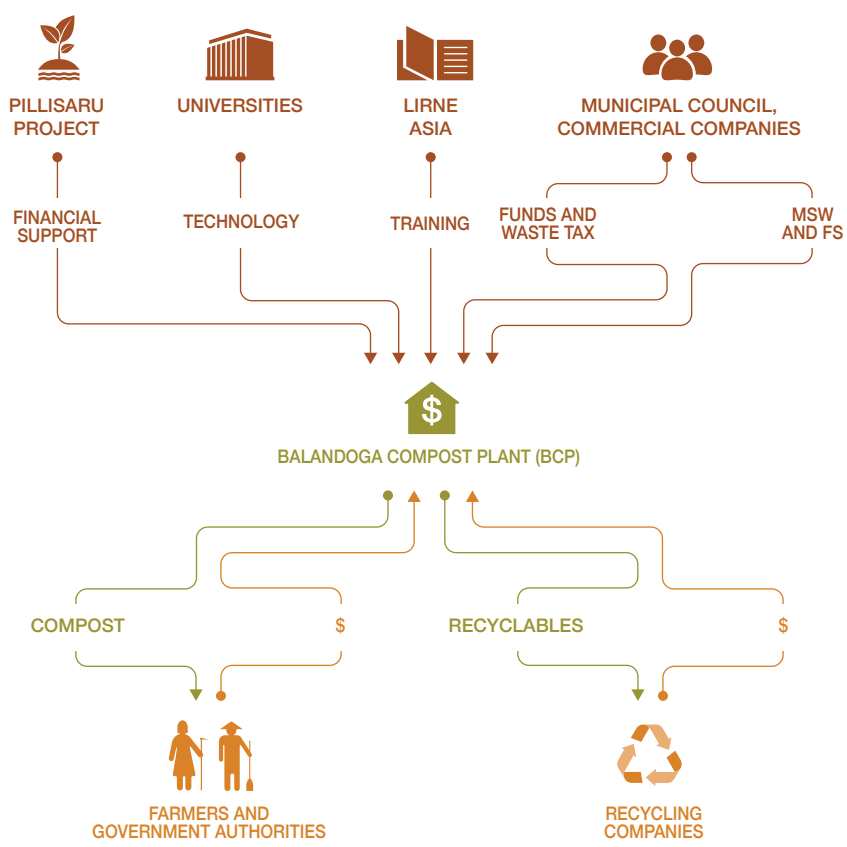
- Possible pollution of water bodies from leachate

SOCIAL & ENVIRONMENTAL BENEFITS

- Reduction of waste generated in the municipality
- Reduced existing waste management costs
- Possible reduction of pollution of water bodies from reduced indiscriminate disposal of fecal sludge
- Reduced human exposure to untreated waste
- Creation of job opportunities
- Improved food security

into technology development and skill training respectively. The partnership with the university is a win-win situation where students from the universities (Sabaragamuwa and Jayawardena) use the composting site for research activities and the enterprise also benefits from the resulting research outputs. Key products, i.e. compost and non-degradable, are sold directly to locals through the local markets from agro-shops. Government institutions such as Road Development Authority are continuous buyers, but no agreements or partnerships exist between them. Products are supplied on occasional demand. The municipal solid waste used by BCP is collected and managed by the urban council. BCP has the urban council as its primary supplier of waste and hence the supplier power is high. Subsidized chemical fertilizer has a lower price compared to the organic fertilizer and has reduced the demand of organic fertilizer in spite of its nutrient retentive capacity. BCP must thus maintain a price lower than the subsidized chemical fertilizer to penetrate the market. Chemical fertilizer and other organic compost are good substitutes of the organic fertilizer produced by BCP. High price of organic fertilizer attributable to subsidies on chemical fertilizer and high application frequency has created demand for chemical fertilizer over organic fertilizers. The threat of new entrants into municipal solid waste processing is low due to the fact that the urban council owns waste and a permit is required to collect or process waste. In addition, waste recycling businesses are limited by institutional structures.

FIGURE 127. BCP'S VALUE CHAIN



Institutional environment

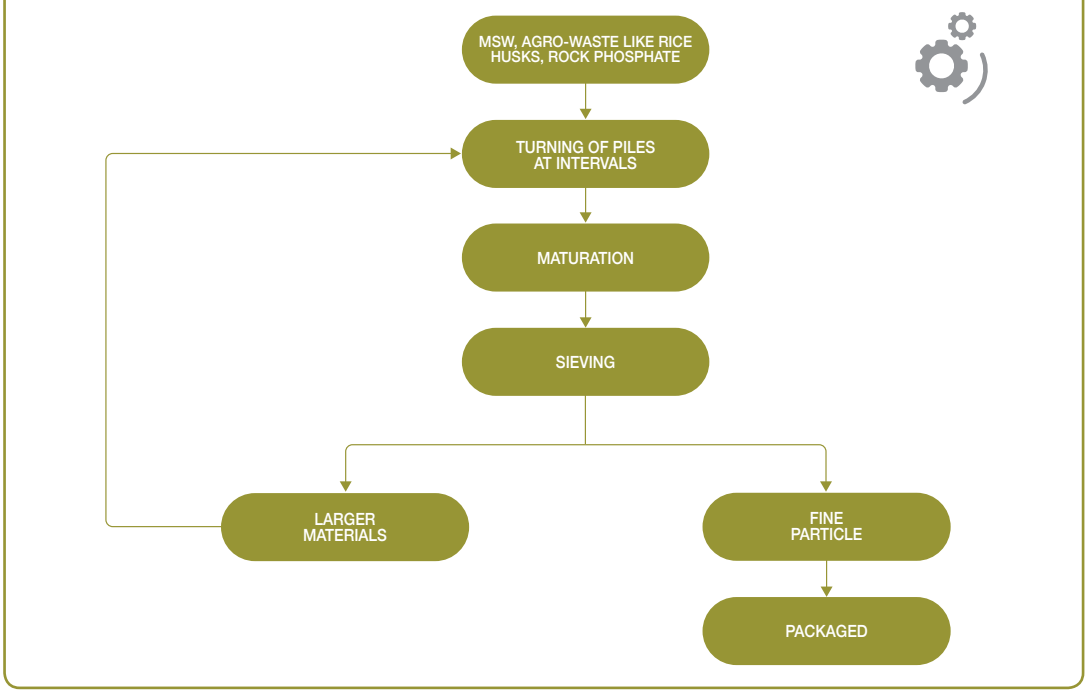
In 2000, the Government of Sri Lanka passed the national strategy for solid waste management that targets waste minimization, reuse of waste, recycling and appropriate final disposal of waste. In 2007, a new policy was formulated and implemented – the National Policy on Solid Waste Management to replace the 2000 National Strategy for Solid Waste Management. Under this new policy, the government annually allots funds for the capital investment of solid waste management projects such as Balangoda. There are currently no laws that limit the reuse of treated MSW or FS. However, all waste reuse businesses in Sri Lanka require permits and certifications prior to starting operations. This is inclusive of an environmental impact assessment to be conducted by a certifiable third party on an annual basis. The Sri Lanka Standards Institution (SLS) is responsible for the development of national standards for products and services used mainly in the industrial and trade sector. The division consists of sections namely agriculture, food, chemicals and cosmetics and textiles. SLS has developed standards for the production and marketing of compost and other organic inputs – SLS 1246:2003, UDC628.477.4 (SLS, 2014). This standard requires quality monitoring of the compost product by certified third party local authority and submission of results to the SLS monitoring committee. Additionally, this standard has set requirements for nutrient levels, biological and microbiological requirements and limits of heavy metals. Compliance to these standards not only ensures the sustainability of compost businesses, but it allows them to self-brand their product and increase their market share.

Technology and processes

Production of MSW-based compost

BCP uses the open-windrow system for the processing of municipal solid waste into compost (Figure 128). The technology has a high rate of recovery for bulky materials, and is thus suitable

FIGURE 128. PROCESS DIAGRAM FOR PRODUCTION OF BCP'S MSW-BASED COMPOST

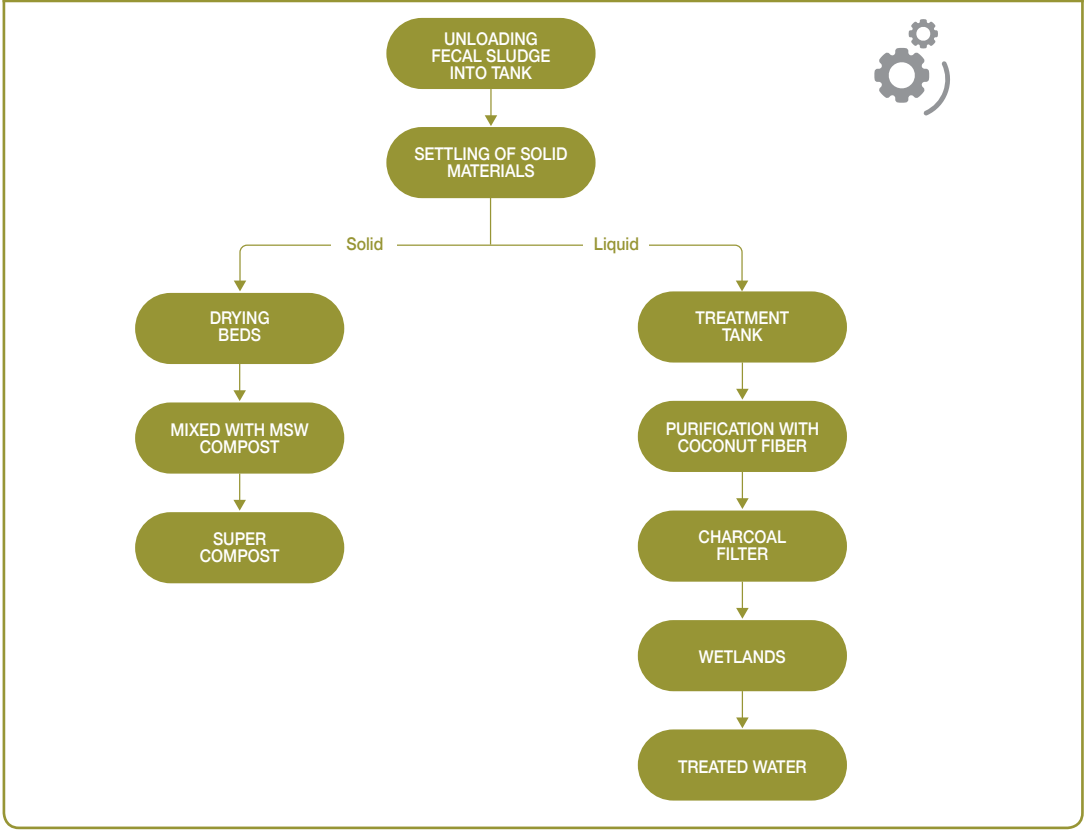


for composting large volumes of waste. The equipment is locally manufactured which considerably reduces the investment cost. However, the maintenance cost of equipment is high and it is not space efficient. Sorted MSW is piled up to a size of 5x5x12 feet. Every pile is maintained for six weeks. A temperature of nearly 70°C is maintained inside the pile, which minimizes pathogens including harmful helminths (worms) and fly larvae. Rock phosphate is also added to increase the phosphorus content of the final product. Since the composting site is situated just 25 feet away from the households, efforts are been made to maintain the aerobic conditions thus the piles are mixed at appropriate intervals (at least once a week) maintaining temperature, moisture and amount of air inside the pile. Leachate is collected six hours after the open windrow preparation and this is mixed with water in the ratio of 1:1,000 and sprinkled back on the composting piles for temperature regulation. Once the composting process is over, the piles are left for maturation for one to two weeks where pathogenic fungi such as Aspergillus are eliminated due to the drop of moisture level to around 5%. The compost is then sieved through a 6mm sieve to get fine particles of compost (the stated standard range for particle size is 4mm to 10mm). Before packaging, the moisture level of the compost is increased to 15%.

Production of fecal sludge and municipal solid waste-based co-compost

The treatment of fecal sludge involves a simple approach that does not require any energy except sufficient sunshine (Figure 129). The collected fecal sludge is unloaded into settling tanks and kept there for 45 minutes for the solid material to settle. The liquid portion is then taken into a treatment

FIGURE 129. PROCESS DIAGRAM FOR PRODUCTION OF BCP'S 'SUPER' COMPOST



tank where coconut fibres are used to create microenvironments rich with micro-organisms that purify the wastewater. This water is passed through a charcoal filter to a constructed wetland for further treatment. The solid matter is sent to two drying beds where they are stored for 28 days. This dried fecal matter is mixed with the MSW-based compost to produce a co-compost (super compost). The product is termed '*super compost'* because the addition of the dried fecal sludge increases the nutrient content and levels of the final product.

Funding and financial outlook

The Central Environmental Authority and the Provincial Council funded the construction of the compost plant and roads at the cost of USD 300,000. The land was provided by the Land Reform Committee at no cost. Operation and maintenance cost is estimated at around USD 1,340 per month. The initial operation costs were catered for by the municipal council until the project began making profit. The Central Environmental Authority together with the urban council funded the construction of the fecal sludge treatment plant at a cost of USD 51,000. Collection centres for non-degradable and associated infrastructure were also established at a cost of USD 3,200. Apart from the recovered resources from organic material, the municipality sells non-degradable materials to recyclers. Acting as middlemen in the business, the urban council doubles the price paid for non-degradable products and earns 100% profit. Collection fees are taken only from several private fish markets, private farms and private meat markets. They are very few in the town. But significant revenue is generated from the waste tax charged to entities that do not segregate their waste. This sums up to USD 3,900 per annum. In 2011, the council made a profit of USD 165 from compost and USD 1806 from sales of non-degradable products. BCP envisions earning additional income from the sale of processed plastics.

Socio-economic, health and environmental impact

The benefits from BCP's activities are multi-fold. This plant has considerably reduced the municipality's waste management cost and also generates additional income beyond cost-recovery. Seventeen workers from the locality are provided with employment. Farmers benefit from the use of high quality and affordable organic fertilizers. The composting plant, in addition to managing municipal solid waste, treats fecal sludge from onsite sanitation systems in Balangoda, thus reducing indiscriminate dumping of fecal sludge. Residents of Balangoda have thus benefited from reduced exposure to untreated waste and improved sanitation which has reduced considerable health risk and surface and groundwater contamination. BCP is an example of an initially fully subsidized compost plant which has been able to transition to a financial self-sufficient business via the implementation of a suitable marketing scheme and strategic partnerships.

Scalability and replicability considerations

The key drivers for the success of this business are:

- Strong funding support from the government and policy that encourages reuse and recycling.
- 2007 government act enabling self-branding.
- Diverse customer base in terms of geographical outreach and strong awareness amongst from farmers in the Eastern province on the need for organic fertilizer.
- Clear awareness among farmers concerning soil degradation and the different effects of organic and chemical fertilizers.

BCP uses a near holistic approach to resource recovery and reuse where almost all waste types, both degradable and non-degradable, are either reused or recycled. The technology adopted is simple, requires limited expertise and energy, making it highly replicable. Waste segregation is a primary cost component while processing waste as well is a major source of inefficiency. BCP mitigates these inefficiencies via the creation of waste resource centres for the segregation of the non-biodegradable

waste and thus significantly reducing production costs. A major limitation with implications for replication is the high capital investment requirements for land and in localities that are yet to be developed –infrastructure, e.g. roads. Another challenge to replicating this model is getting support from municipal council to enable a company (private or public) institute a waste tax to reduce the receipt of unsorted waste and essentially minimize costs so as to ensure sustainability.

Summary assessment – SWOT analysis

The SWOT analysis for BCP is presented in Figure 130. The key strengths of the business are: a) the low-cost technology; b) segregated waste delivered to this composting plant; c) funding from government to cover capital and initial operating cost; and d) governmental support to institute waste tax for entities who do not segregate waste. The BCP business however has a couple of weaknesses related to limited land availability for future expansion and its dependency on external entities for waste segregation. In the future if waste resource centres are unable to manage their operation cost, BCP will have to heavily invest in both capital and operational costs for segregating their waste. There are several opportunities in which BCP can tap into: a) compliance to certification standards will not only contribute to the sustainability of the compost business but it will allow them to self-brand their product and increase their market share; b) the enterprise can develop different formulations of

FIGURE 130. SWOT ANALYSIS FOR BALANGODA COMPOST PLANT

	HELPFUL TO ACHIEVING THE OBJECTIVES	HARMFUL TO ACHIEVING THE OBJECTIVES
INTERNAL ORIGIN ATTRIBUTES OF THE ENTERPRISE	**STRENGTHS** ▪ Receives segregated waste thus reducing production cost ▪ Technology compatible with the topography and requires limited energy ▪ Low cost technology ▪ Technology requires low level technical skills or expertise to operate ▪ Strong funding support from government and favourable policy	**WEAKNESSES** ▪ Current land available is sufficient to handle existing quantum of waste, however if they have to expand, availability of land will limit large scale expansion ▪ Enterprise dependent on waste resource centres for segregation
EXTERNAL ORIGIN ATTRIBUTES OF THE ENVIRONMENT	**OPPORTUNITIES** ▪ Developing different formulations of organic compost including pelletization of fecal sludge compost ▪ Municipal tax for non-segregators ▪ 2007 government act, enabling self-branding and obtaining waste management funds ▪ Replication of similar model for other towns in Sri Lanka ▪ Tapping carbon market as an additional revenue source	**THREATS** ▪ Subsidies on inorganic fertilizers represent competition and may impact sales of organic compost ▪ Cultural barriers – farmers unwillingness to use compost mixed with dry fecal matter

compost to meet farmers' requirements; c) with increased scale, BCP can consider tapping into the carbon market as an additional revenue source; and d) increasing government support for solid waste management has created a demand for this model which can be replicated in other towns and cities in Sri Lanka. A significant threat to BCP's business is increasing competition from subsidized chemical fertilizer which may affect the demand for their compost products.

Contributors

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Josiane Nikiema, IWMI, Ghana

References and further readings

Personal communication with Mr. Nimal Prematilaka (Officer in charge of Balangoda Compost Plant). 2015.

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 2015. As business operations are dynamic, data can be subject to change.

Notes

1 Night soil is a euphemism for human excrement, (formerly) collected at night from households. In our context, it refers to fecal sludge collected from on-site sanitation facilities, like septic tanks and pit latrines.
2 http://lirneasia.net (accessed November 8, 2017).