

CASE

Franchising approach to municipal solid waste composting for profit (Terra Firma, India)

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Supporting case for Business Model 12

Location:	Bangalore, Karnataka, India
Waste input type:	Municipal solid waste
Value offer:	Organic fertilizer, biogas, recyclable plastics
Organization type:	Public limited company
Status of organization:	Operational since 1994 (that plant was not receiving municipal waste at the time of final review in October 2017).
Scale of businesses:	Processes 1,400 tons of waste per day
Major partners:	Bruhat Bengaluru Mahanagara Palike (BBMP) – Bangalore municipality, Coromandel Fertilizer Limited, Karnataka Antibiotics and Pharmaceuticals Limited, Rallis India Limited

Executive summary

Terra Firma Biotechnologies Limited (Terra Firma) is one of the oldest operating municipal solid waste (MSW) processing companies in India. It is a public limited firm involved in the processing of MSW to organic compost, bio-methanation and the recycling of plastics and inert materials, with a processing capacity of up to 1,400 tons of municipal solid waste per day. With an increasing need for sustainable waste management options and agricultural inputs alternatives, nutrient recovery from different waste streams, particularly MSW is being promoted and showing promise in India. Terra Firma owns and operates several integrated resource recovery plants that receive MSW from the city of Bangalore. The success of Terra Firma's model rests on a multiple-revenue stream approach. Revenue is generated from five major streams: i) sales from organic fertilizer products; ii) service fees from the municipality and other private clients (townships and commercial establishment) for waste processing; iii) sales from recyclables; iv) consultancy fees; and v) franchising royalties. The diversification of their portfolio mitigates risk associated with fluctuations in demand for organic fertilizer products. Strategic partnerships have also contributed to the business' sustainability. The municipal corporation of Bangalore city and other commercial establishments and townships are contracted-out for the collection, separation and delivery of waste to Terra Firma for a fee – ensuring a consistent supply of high quality input (waste). It also partners with fertilizer companies and their network distributors to market and sell their compost whilst restricting its human resources to plant operations. These partnerships allow Terra Firma to sell compost under the fertilizer company's Coromandel brand name.

Terra Firma has also adopted a process of in-house technology development based on clear needs and locally appropriate solutions. The use of a simple and labor-intensive technology not only gives Terra Firma a competitive advantage for production, but also generates employment particularly for low-income persons who would otherwise be unemployed. Terra Firma's activities have helped to significantly reduce the city's waste management costs, reduce human exposure to untreated waste and contribute to the livelihoods of local communities.

KEY PERFORMANCE INDICATORS (AS OF 2015)

Land use:	42 ha					
Capital investment:	USD 527,996 (additional investments have been made with scaling-up of activities)					
Labor:	215 (200 unskilled 15 skilled)					
O&M cost:	USD 1,278,807 including cost of marketing					
Output:	20,000–22,000 tons of compost per year					
Potential social and/or environmental impact:	Significant job creation, reduced human exposure to untreated waste, reduced waste management costs					
Financial viability indicators:	Payback period:	7–8 years	Post-tax IRR:	N.A.	Gross margin:	N.A.

Context and background

Established in 1994, Terra Firma set out with the goal of transforming the agricultural production landscape by promoting organic agriculture and substantially replacing chemical fertilizer use with more sustainable options such as organic fertilizers. Terra Firma noted that its business activities of converting MSW to organic fertilizers would additionally address the significant waste management challenges faced by the city. Although having the capacity to process up to about 1,400 tons per day of solid waste, Terra Firma processes about 600 tons/day of solid waste on an average and has been instrumental in reducing garbage disposal burden in Bangalore. The company was set up by a group of professionals in the area of chemical engineering and agriculture technology hailing from rural backgrounds. The activities of the company can be broadly classified into 3 parts: a) resource (nutrients and energy) recovery from the city's waste; b) consultation and design of turnkey projects; and c) franchising operations. The company set up a vermi-composting facility from municipal solid waste and has successfully operated it from 1995 to 2007. From 1998 to 2003, the company promoted franchisee operations for the processing of municipal solid waste across 38 locations in the country. In 2007, the company scaled up its operations to a new facility in a 42 hectare integrated waste management facility (ISWM). The company also undertakes training of agricultural graduates in the area of composting and other agricultural activities.

Market environment

The waste management service provided by Terra Firma to the city of Bangalore is unparalleled given the magnitude of MSW it processes daily. With increasing urban population growth and the resulting generation of significant amounts of waste, BBMP will continue to heavily depend on resource recovery businesses such as Terra Firma. Another key driver for the development of Terra Firma is related to the high demand for organic fertilizers for agriculture. The extensive use of chemical fertilizers has degraded the soil to a great extent and this has necessitated the demand for alternative agricultural inputs to replace synthetic fertilizers. With increasing farmers' awareness of benefits accruing from organic fertilizer use from government programs and increasing fertilizer prices, a surge in demand has been observed in Karnataka and neighbouring states. Although demand for organic fertilizer – compost is seasonal, with a few number of existing players in the organic compost sector, market demand in

Karnataka and neighbouring states still exceeds supply. Additionally, the recovery of biogas represents a revenue-generating opportunity for Terra Firma in the instance where it generates power in excess of its own energy and power requirements, which can be sold to the electricity grid. Given the shortage of electricity supply in Karnataka and India as a whole, there is a growing demand for alternative sources of energy production. Furthermore, with increasing national urban populations and limited waste management budgets, the demand for waste management solutions in other states and cities in India is growing as is the demand for consultation and design services for turn-key waste reuse projects by businesses like Terra Firma. The current market environments for Terra Firma's business activities are very supportive for its sustainability and indicates a foreseeable up-scaling their operations.

Macro-economic environment

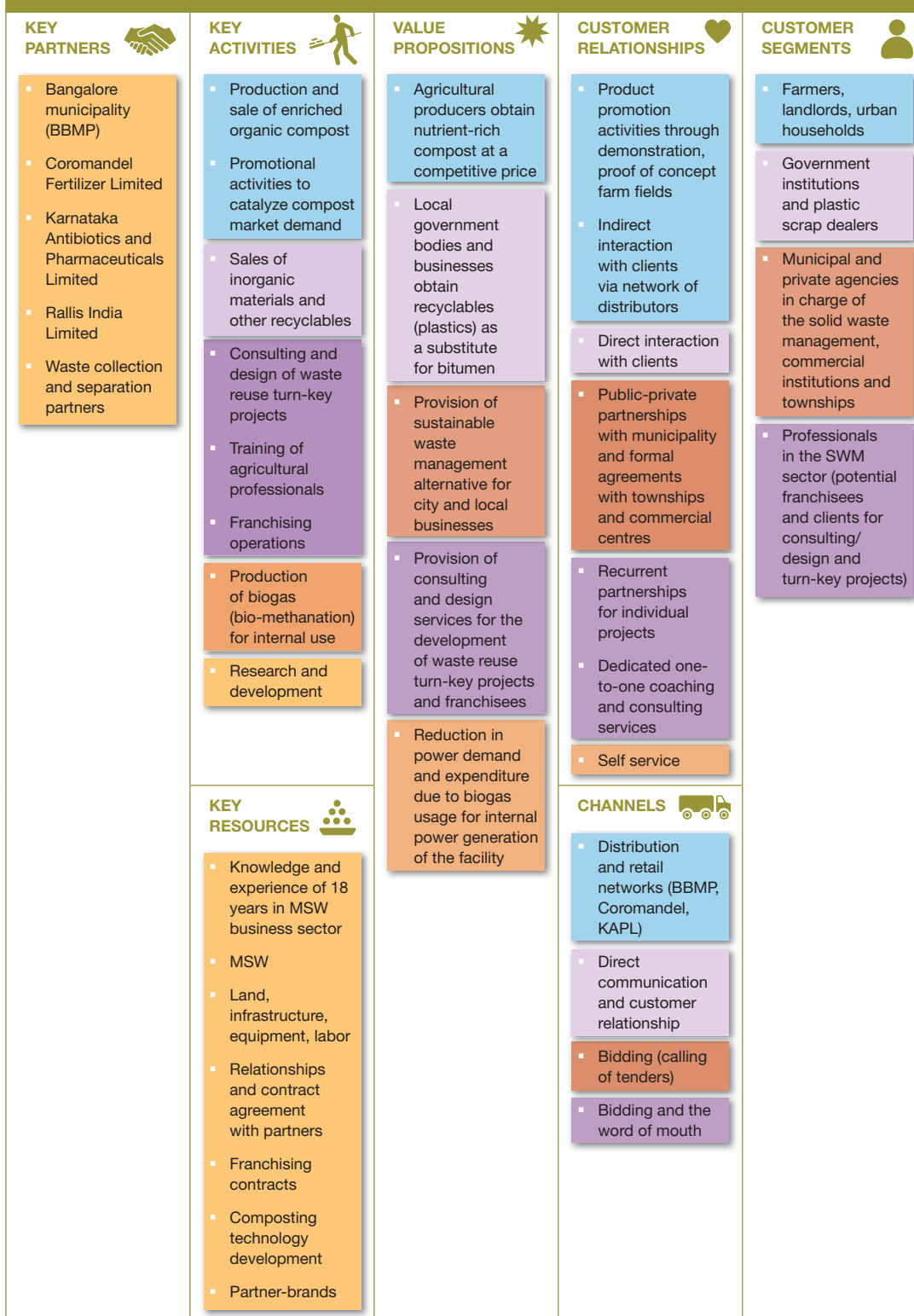
Chemical and synthetic fertilizers are highly subsidized in India and this has not only led to inefficient use by farmers and high costs to the government; significant soil degradation has also been observed as a result. Even with the promotion of bio- and organic fertilizers via local research institutions and businesses, chemical fertilizer subsidies continue to be one of the key barriers for entry of organic fertilizer producers into the fertilizer market. With a growing need to increase the availability and quality of bio-fertilizers and composts in the country to improve agricultural productivity while maintaining soil health and environmental safety, the Indian government has set up a scheme to augment the infrastructure for production of quality organic and biological inputs.

A capital investment subsidy scheme for compost production has been introduced under the National Mission for Sustainable Agriculture (NMSA). The scheme provides 100% financial assistance to state governments and government agencies up to a maximum limit of about USD 300,000 per construction unit, and for individuals or private companies up to about USD 100,000 per unit (max 33% of project costs) through the National Bank for Agriculture and Rural Development (NABARD). Moreover, the Government of India is providing a Market Development Assistance of about USD 23.4 per metric ton to fertilizer companies for sale of city waste compost (Ministry of Agriculture, 2017).

Business model

Figure 153 provides an overview of Terra Firma's business model, which is centred on a multiple-revenue stream approach. Revenue is generated from five major streams: i) sales from organic fertilizer products; ii) service fees from the municipality and other private clients (townships and commercial establishment) for waste processing; iii) sales from recyclables; iv) consultancy fees; and v) franchising royalties. The diversification of their portfolio mitigates risk associated with fluctuations in demand for organic fertilizer products. The value proposition of provision of a nutrient-rich compost comes from the desirable social impact of providing an environmentally safe and cost-effective alternative agricultural input to local agricultural producers. It partners with Coromandel Fertilizer Limited and other retail distribution networks for sales and marketing of their organic fertilizer products whilst restricting its human resources to plant operations. Product demonstration, proof of concept farm fields and sustained interactions with agricultural producers was instrumental in garnering market demand for their products. Another key element of their model is the provision of waste management services to the municipality BBMP and other large scale generators via the processing of their wastes for a fee. This is a win-win partnership as all parties benefit: a) municipalities save on landfill costs; b) local businesses are to comply to waste management ordinances; and c) Terra Firma generates revenues, ensuring the sustainability of the partnership. Terra Firma also implements a franchise-based approach to increase revenue streams and capture additional markets. Terra Firma has entered into franchise agreements with several enterprises all over India. By this agreement, Terra Firma provides training on the composting technology at no cost but charges a cost-price fee for method trainings on bio-fertilizers production to the franchisee. Terra Firma markets the compost produced by the

FIGURE 153. TERRA FIRMA'S BUSINESS MODEL CANVAS



COST STRUCTURE  ▪ Land and infrastructure: USD 4,589,675 to 4,956,849 ▪ Material inputs: USD 17,624 ▪ Marketing costs: USD 475,673.92 ▪ Manufacturing costs: USD 392,325.42 ▪ Administrative expenses: USD 206,351 ▪ Interest and finance charges: USD 292,086.92 ▪ Savings from in-house energy production ▪ Waste collection and separation fees ▪ R&D	REVENUE STREAMS  ▪ Sales of organic fertilizer products ▪ Service fees from the municipality and other private clients (townships and commercial establishments) for waste management services ▪ Sales from recyclables ▪ Consultancy fees ▪ Franchising royalties
SOCIAL & ENVIRONMENTAL COSTS  ▪ None noted based on information provided by business	SOCIAL & ENVIRONMENTAL BENEFITS  ▪ Reduced existing pollution of water bodies ▪ Reduced existing waste management cost for the municipality ▪ Reduced human exposure to untreated waste ▪ Job creation for the poor without any gender discrimination ▪ Contribution to restoring degraded soils and food security ▪ Savings in landfill area

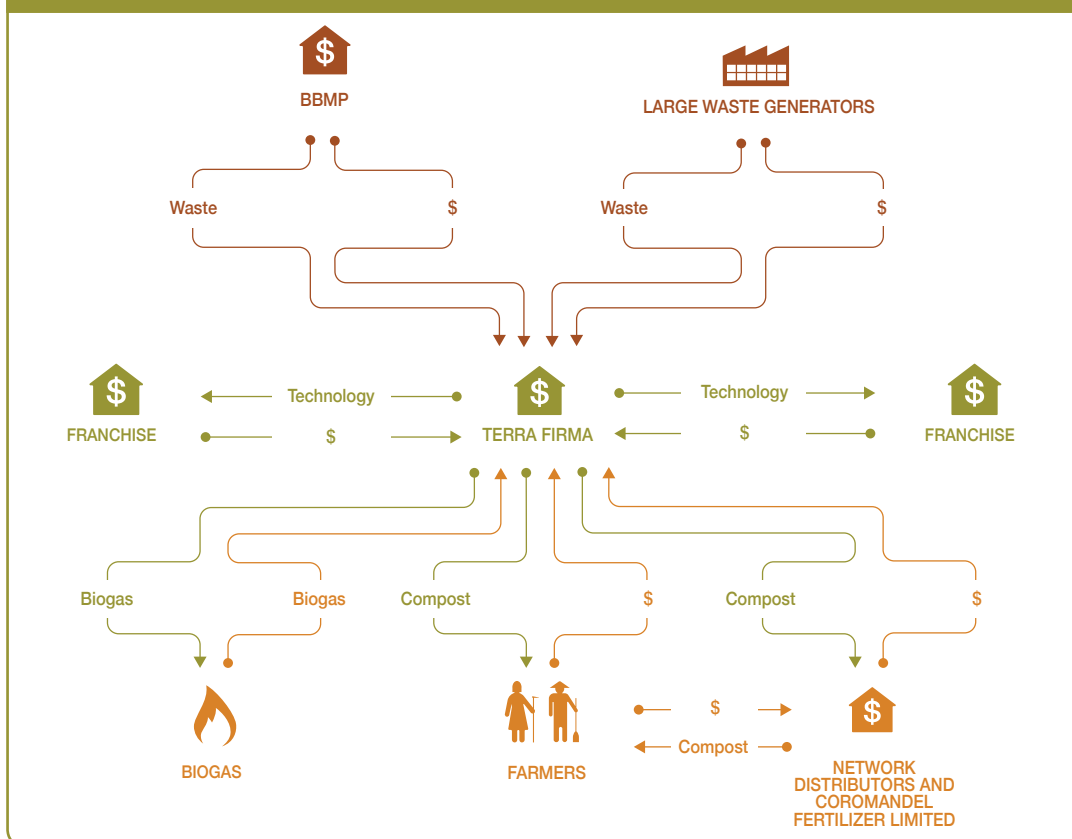
franchisees through a partner – Rallies India. In return, Terra Firma retains 24 percent of the equity with the franchisee and 10 to 20 per cent of the profit margin goes to the franchisee. Additionally, Terra Firma produces biogas, which is used internally to reduce production costs. Labor is employed on contractual terms to further reduce production cost especially during low production periods as well as when they are not in production. Terra Firma has established and demonstrated that it is possible to run a waste business sustainably over a long period based primarily on non-municipal tipping fee revenues. The company provides employment to about 200 people at its facility and about 15 people for management and administration. The indirect employment for transport, dealers, distributors and waste recycling industry supported is estimated to be at least twice these numbers.

Value chain and position

The City of Bangalore generates about 3,500 tons of waste per day. Like most cities in India, Bangalore faces a huge challenge in processing all the waste generated in the city. Terra Firma has a supply contract agreement with Bruhat Bengaluru Mahanagara Palike (BBMP) for supplying a minimum of 600 tons of waste daily. There is no short to medium term threat about availability of waste as a raw material to Terra Firma or to any other waste processing facilities in Bangalore. Terra Firma additionally has an independent collection system from large waste generators like commercial establishments (hotels, industries, institutions) and residential townships for their solid or organic waste. About 25–30% of the capacity is collected from these sources. This partnership ensures continuous waste (input) supply thus mitigating any production risk associated with input supply. Terra Firma also partners with Coromandel Fertilizer Limited and other network distributors to market its compost. This partnership allows Terra Firma to sell compost under Coromandel's brand name. Terra Firma has invested in

product demonstrations and proof of concept farm fields to penetrate the fertilizer market and create a niche for itself. Currently, it serves between 35,000 farmers annually. It competes with other organic as well as chemical fertilizer producers. The organic fertilizer produced by Terra Firma is lower in price and thus has a competitive advantage over other organic fertilizers however highly subsidized chemical fertilizer still represents a great threat. Existing players in the organic fertilizer sector are currently unable to meet market demand in Karnataka and neighbouring states; and the demand is expected to grow in the near future; thus great opportunities exist for Terra Firma to increase its market share. Additionally, increasing urban populations and related waste management challenges along the promotion of integrated resource recovery facilities suggest that municipalities in India will continue to demand consultancy services of business like Terra Firma for the establishment of waste reuse turnkey to projects. Figure 154 above provides a diagrammatic overview of Terra Firma's value chain.

FIGURE 154. TERRA FIRMA'S COMPOST VALUE CHAIN



Institutional environment

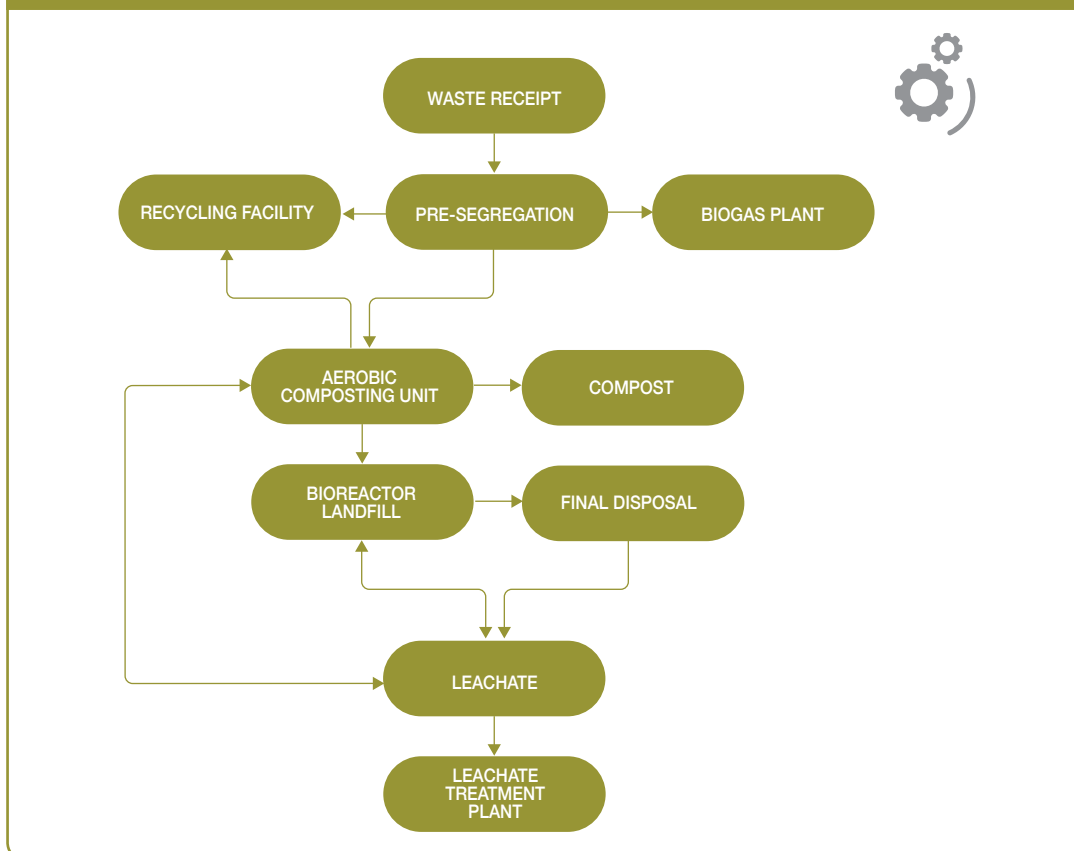
Terra Firma is a public company registered under the Indian Companies' Act of 1956. The company has more than 50 shareholders. Waste processing facilities are usually not accepted by communities due to visual, odor and traffic pollution. This issue snowballed into a political, social and cultural resistance. It has been necessary for Terra Firma to manage the socio-political environment on an ongoing basis. It has garnered local support with its community works and corporate social responsibility. Terra Firma has also generated employment to large number of local residents near the facility.

Technology and processes

Terra Firma developed their technology for treating MSW in house (Figure 155). All developed technologies meet the requirements of environmentally, safe waste handling processes and being cost effective to ensure business viability. The company started with the vermi-composting of organic waste, then as it started receiving mixed waste, a microbial culture based waste composting method was adopted. As the waste included plastics, new techniques for plastic cleaning and conversion were incorporated. Terra Firma receives an average of 1,400 tons of MSW per day. About 650 tons of this waste is treated in the aerobic composting facility and 350 tons utilized for bio-methanation purposes daily. The remaining waste is sent to the bioreactor landfills.

- 1) **Composting** – An aerobic windrow composting process is used for the treatment of the organic waste. After the unloading of the waste, water is sprinkled on the waste to achieve a desired moisture level. The waste heap is then pushed by a tractor blade or front-end loader, which is used to make high heaps of the waste, which is then sprayed with water and formed into a minimum of three meters heaps (maximum height five meters). A cow dung solution or bio-culture act as a catalyzing agent and accelerates the process. The heap is then turned by tractor blade or front-end loader into another windrow to allow aeration. This process is repeated after another seven to ten days. At the end of the three to four weeks period, the green or fresh compost may have fully decomposed but not the cellulosic content. The mixture is, therefore, stored in large sized windrows under a covered/roofed area for maturation for four to eight weeks. The mixture is then sieved to meet client requirements.
- 2) **Bio-methanation** – The bio-methanization of organic wastes is accomplished by a series of biochemical transformations. In the first step hydrolysis, acidification and liquefaction take place and in the second step acetate, hydrogen and carbon dioxide are transformed into methane. At Terra Firma, all these reactions take place simultaneously in a single reactor.
- 3) **Recycling of inorganic materials** – Metals, plastic, glass and paper separated, cleaned, packaged and sold.
- 4) **Bioreactor landfills** – The bioreactor landfill technology is an accelerated process of decomposition of municipal waste in the landfill. This technology involves placing the waste in specially designed cells. The cells have provision for leachate collection and recirculation. As one cell gets filled, it is covered and closed with an impervious liner. Gas extraction pipes are placed. The leachate from the landfill and the bio-methanation effluents are sprayed / injected to accelerate the bio-methanation process. The degradation time is reduced from about 10–15 years to about two to four years. Subsequent to the gas extraction the inert waste is removed from the landfill, compost and other recyclables are mined and the balance materials are sent for final disposal in a sanitary landfill.
- 5) **Final disposal** – The final disposal is proposed in a sanitary landfill. The incoming waste is spread in thin layers and compacted using landfill compactors to achieve high density of the wastes. The waste is covered immediately or at the end of each working day with a minimum of 10cm of soil, inert debris or construction material. Prior to the commencement of the monsoon season, an intermediate cover of 40–65cm thickness of soil is typically placed on the landfill to ensure proper compaction and prevent soil infiltration during monsoon.

The technologies developed by Terra Firma are focused on cost-effectiveness within the regulatory frameworks. The outputs of the company have been tested and approved by the regulatory authorities and are acceptable by the clients. But there are technological constraints with the changing nature of municipal solid waste; there is a significant quantity of waste which cannot be processed. The company is now facing issues on managing large amounts of inert materials, about 15% of the waste received (100 tons per day). The conventional method of sanitary landfill would exhaust the land

FIGURE 155. PROCESS FLOW CHART AT THE TERRA FIRMA-GUNDLAHALLI INTEGRATED SOLID WASTE MANAGEMENT FACILITY

very quickly, thus the company is exploring new technologies for processing this waste including converting them into refuse derived fuels and panel blocks.

Funding and financial outlook

The capital investment for the company was through equity infusion from diverse sources including private financiers, the municipality, in a total amount of USD 6,237,402. Of this amount, the municipality contributed USD 366,906 at no interest as an advance against tipping fees. Terra Firma uses working capital loans from banks and its own financial resources to cover operational and maintenance costs. Terra Firma generates revenue via five streams: a) sale of MSW-based organic fertilizer; b) waste management fees; c) sale of recyclables; d) consultancy fees; and e) franchise royalty fees. Of the total revenue, sales from compost contribute the most, that is, USD 770,000 per annum followed by sales from recyclables mainly plastics. Tipping fees of USD 280,320 per annum contribute the least. Terra Firma has been making profit since its inception, except the financial year 2009–2010 (a loss of about USD 352,435). The company was scaling up its operations at a new facility and incurring additional investment costs in the process. Table 40 below provides the percentage contributions of total revenue and expenditure. It is noted that administrative expenses including maintenance of the facility, utilities, rent, salaries to the staff is the highest contributor to the expenses.

TABLE 40. TERRA FIRMA'S REVENUES AND EXPENDITURES EXPRESSED IN PERCENTAGES

ITEM NUMBER	COMPONENT	
A	Revenues	Percentage of total revenue
1	Sale of compost	41%
2	Other revenues	59%
B	Expenditure	Percentage of total expenditures
1	Raw material consumed	20%
2	Manufacturing expenses (includes labor charges)	24%
3	Administrative expenses (includes rent and utilities)	36%
4	Selling and distribution	18%
5	Interest and financing charges	1%
6	Depreciation and other charges	1%

Socio-economic, health and environmental impact

Terra Firma has established and demonstrated that it is possible to run a waste business sustainably over a long period based on non-municipal tipping fee revenues. The company is a leading example in support of privatizing the municipal solid waste business to maximize recovery of resources from waste. The company influences a series of economic activities as part of its process. The polluter pays principle is implemented via direct payments to Terra Firma by large waste generators for the management of their waste. The transport sector is organized to collect and transport over larger distances in an efficient way thereby setting standards for similar operations. The concept of component-wise treatment of waste using smart segregation strategies has been exemplified by the company. The economic valuation of the enterprise can be assessed from its internal economic activities. Terra Firma set up the plant facility on its own land which in itself is trend setting in India, reducing the burden on the municipal agencies for provision of land to solid waste management operators. The company provides employment to about 200 people at its facility and about 15 people for management and administrative purposes. The indirect employment for transport operators, dealers, distributors and waste recycling industries supported is at least twice the current number of total employees. Terra Firma's activities additionally will in the long term reduce chemical fertilizer imports, resulting in foreign exchange savings. Averted greenhouse gas emissions and groundwater contamination from indiscriminate waste disposal are among the additional benefits of Terra Firma's activities.

Scalability and replicability considerations

The key drivers for the success of this business are:

- Strong business partnerships that reduced capital investment risk and eased entry into a highly competitive fertilizer market.
- Solid multi-revenue stream based business model that mitigated initial risk associated with fluctuations in market demand.
- Marketing strategies based on product demonstrations and proof of concept farm fields garnered the market demand for their organic fertilizer products.
- Increasing need for alternative sustainable agricultural production inputs and waste management services.
- Increased awareness among farmers about the advantages of organic fertilizers and in the face of increasing fertilizer prices.
- Strongly increasing urban populations and associated MSW problem.

Terra Firma's model has a high replication potential especially in large urban areas facing solid waste management challenges. High initial investment costs may represent barriers for entrepreneurs in developing countries where accessing capital investment is one of the key constraints for business development. Implementation of institutional policies such as the polluter pays principle, especially for large waste generators would be essential to ensure the viability of one of its revenue streams.

Summary assessment – SWOT analysis

Figure 156 presents the SWOT analysis for Terra Firma. Its model demonstrates that waste reuse businesses can be successful without government subsidies. By diversifying its portfolio, Terra Firma mitigates risk associated with fluctuations in demand for its organic fertilizer products. It has been particularly successful in leveraging its business partnerships to gain entry into a fiercely competitive fertilizer market via using the well-established marketing and distribution channels of other companies. This marketing strategy is however highly dependent on partners, exposing Terra Firma to some buyer power risk. Terra Firma has been conducting product demonstrations and proof of concept farm fields to establish its product brand and gain some market share. Increasing governmental support along with growing demand for organic fertilizers will represent key opportunities for replication and up-scaling of the business. Local community support programs may help dissipate occasional community

FIGURE 156. SWOT ANALYSIS FOR TERRA FIRMA

	HELPFUL TO ACHIEVING THE OBJECTIVES	HARMFUL TO ACHIEVING THE OBJECTIVES
INTERNAL ORIGIN ATTRIBUTES OF THE ENTERPRISE	STRENGTHS - Well-established multiple revenue streams - Good local buy-in for products due to establishment of brand name - Strong and strategic business partnerships - Independent decentralized franchisee operations - Reduced production costs due to generation of energy for internal use	WEAKNESSES - High capital investment - Operational pulls and pressures by municipal authority in waste supply which result in management issues of waste - Marketing strategy currently highly dependent on fertilizer companies
EXTERNAL ORIGIN ATTRIBUTES OF THE ENVIRONMENT	OPPORTUNITIES - Absence of other key competitive organic fertilizer suppliers in the market - Up-scaling potential of CDM project to earn carbon credits - Tax free policy for organic fertilizer in India - Production and sale of refuse-derived fuels - Sale of electricity to national grid from increased production	THREATS - Possible human health risk of being exposed to waste at collecting, sorting and processing - Village protest against frequent waste transportation across their village - Chemical fertilizer subsidies hamper organic fertilizer growth

protests against waste transportation through community neighbourhoods. Several opportunities exist for Terra Firma to further expand its operations. These include: a) the production and sale of refuse-derived fuels; b) sale of excess electricity to national grid; and c) the establishment of a CDM project for sale of carbon credits. Terra Firma is an example of an innovative business utilizing a multi-revenue approach and strategic partnerships to address some of the major waste management and environmental challenges in Bangalore, India whilst generating significant profits and benefits to society.

Contributors

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Josiane Nikiema, IWMI, Ghana

Reference and further readings

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Personal communication with business owners and plant managers. 2015.

Terra Firma Biotechnologies Ltd. <http://terrafirmabiotech.com/>. Accessed May, 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. At the time of final review (October 2017), for example, the plant was noted to not be receiving municipal solid waste.