

## CASE

# Livestock waste for compost production (ProBio/Viohache Mexico)

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## Supporting case for Business Model 13

Location:	Culiacan, Sinaloa, Mexico
Waste input type:	Agro-waste (livestock waste)
Value offer:	Organic fertilizer – compost and nutrient-rich liquid fertilizer from processed leachate
Organization type:	Private
Status of organization:	Operational since 2003
Scale of businesses:	Large-scale processing 420,000 tons of animal waste per annum
Major partners:	SuKarne

## Executive summary

Productos Bioorganicos (ProBio) is Mexico's largest compost and vermicompost producer with the well-known Humibac brand. Although recently, its name changed to Viohache, this presentation is still using "ProBio". ProBio is a private company created in 2003 to manage the animal waste generated by SuKarne – the largest beef producer and marketer in Mexico. Given the significant quantities of livestock waste produced by SuKarne, traditional waste disposal (i.e. landfilling) systems no longer seemed sustainable and the identification of viable and environmentally safe alternatives was imperative. ProBio maintains a strategic partnership with SuKarne by providing pen-cleaning services in return for their feedstock – animal waste. The business processes 420,000 tons of livestock waste per annum to produce a total of 231,000 tons of compost and 500,000 liters of nutrient-rich liquid fertilizer from processed leachate. It operates in five locations around the country, and supplies a low cost, high quality organic fertilizer to the vegetable, fruit and grain crop sectors. ProBio implements a commodity-value based business model by using simple, low-cost and innovative strategies for the production and branding of the products they offer. It has garnered significant market demand through third party certification and the tailoring of its products to specific clients and agricultural purposes. The business also takes advantage of economies of scale and focuses on low cost, yet efficient technologies for organic fertilizer production and improved waste management. ProBio's operations have had a strong impact on society and the environment as its activities contribute to the reduction of greenhouse gas emissions, on-site waste odor, groundwater and surface water contamination, agricultural crop burning, and local air and soil pollution, among a few.

**KEY PERFORMANCE INDICATORS (AS OF 2015)**

Land use:	130 ha					
Capital investment:	USD 6,410,000 (land – USD 600,000; infrastructure – USD 377,240; machinery – USD 5,130,000; R&D – USD 100,000)					
Labor:	65 employees					
O&M costs:	USD 2.5 million per year					
Output:	231,000 tons of organic compost and vermicompost, 500,000 liters of nutrient-rich liquid fertilizer from processed leachate per annum					
Potential social and/or environmental impact:	Reduction of methane and CO <sub>2</sub> emissions, waste odor, groundwater contamination, local air and soil pollution, fertilizer requirements and improvement of agro-industrial waste management systems					
Financial viability indicators:	Payback period:	5 years	Post-tax IRR:	N.A.	Gross margin:	USD 1.9 million

**Context and background**

Grupo Viz is a family-owned business established in 1969 at Culiacan, Sinaloa, Mexico. Over the years, Grupo Viz has expanded its operations to other sectors of the cattle production value chain and now owns five subsidiary companies operating independently. The five subsidiaries of Grupo Viz are:

- SuKarne, a beef, poultry and pork producer;
- ProBio, dedicated to the production of organic compost and vermicompost from animal waste;
- Rendimientos Proteicos (RenPro), specialized in the processing of tallow, meat and blood meals for livestock and animal feed production;
- SuKuero, a leather commercialization business; and
- Agrovizion, an agribusiness dedicated to the promotion and commercialization of agricultural products such as corn, wheat, oats and roughage.

At the time of assessment, SuKarne owned five production facilities around the country, located in the states of Nuevo Leon, Baja California, Michoacan, Durango and Sinaloa. These five facilities maintain a daily average of 425,000 animals confined in open feedlots through the year. As the largest beef producer in Mexico, it significantly contributes to the generation of animal waste both nationally and worldwide. The national and local state legislation prohibit the unlicensed disposal and/or uncontrolled burning of animal waste, which results in significant quantities of waste that are left to decay in open-air landfills. This contributes to the production of large amounts of methane from the anaerobic process of landfilling, and invariably contributing to greenhouse gas (GHG) emissions. The above situation triggered the creation of ProBio in 2003, an independent private company with the objective of incorporating an efficient waste management solution for SuKarne's feedlot operations. The animal waste is removed from the feedlots at their facilities once every 6 months by ProBio and is processed into compost and vermicompost, a total of 231,000 tons per annum (70 and 30%, respectively), and an additional 500,000 liters of nutrient-rich liquid fertilizer from processed leachate. As SuKarne is the company's waste provider, this makes ProBio by far the largest compost and vermicompost producer in the country.

**Market environment**

According to the Mexican Secretariat of Agriculture, Livestock, Rural Development, Fisheries and Food ("SAGARPA"), 58% of Mexico's land, a total of 113.8 million hectares, is used for beef production. There is a total of 31 million cattle livestock in Mexico owned by 1.13 million breeders: 2 million dairy cattle and 29 million beef cattle (SAGARPA, 2015). According to the Mexican Ministry of

Environment and Natural Resources “SEMARNAT”, livestock production has shown an accelerated growth in the past two decades, increasing by 62% in comparison with the 90's (SEMARNAT, 2010). As a result of this progressive increase in the agricultural sector, 83% of its emissions were accounted to livestock production in 2002, equivalent to 8% of the total emissions in Mexico. Additionally, waste management systems currently adopted no longer seem sustainable. There is a growing need for environmentally sound waste management alternatives, particularly in the livestock sector, given increasing enforcement of legislative mandates related to environmental protection.

A key factor driving the development of businesses such as ProBio is increasing chemical fertilizer prices and a need for sustainable agricultural alternatives. Soils in Mexico have a high susceptibility to erosion especially in the high valleys, which are mostly formed from volcanic materials (with a high concentration of sand and silt). Farmers favor fertilizers that facilitate plant nutrient assimilation at soil level and promote the formation of mycorrhizae and root absorption. These factors are indicative of the increasing demand for organic fertilizers and in general the development of more waste reuse businesses in Mexico.

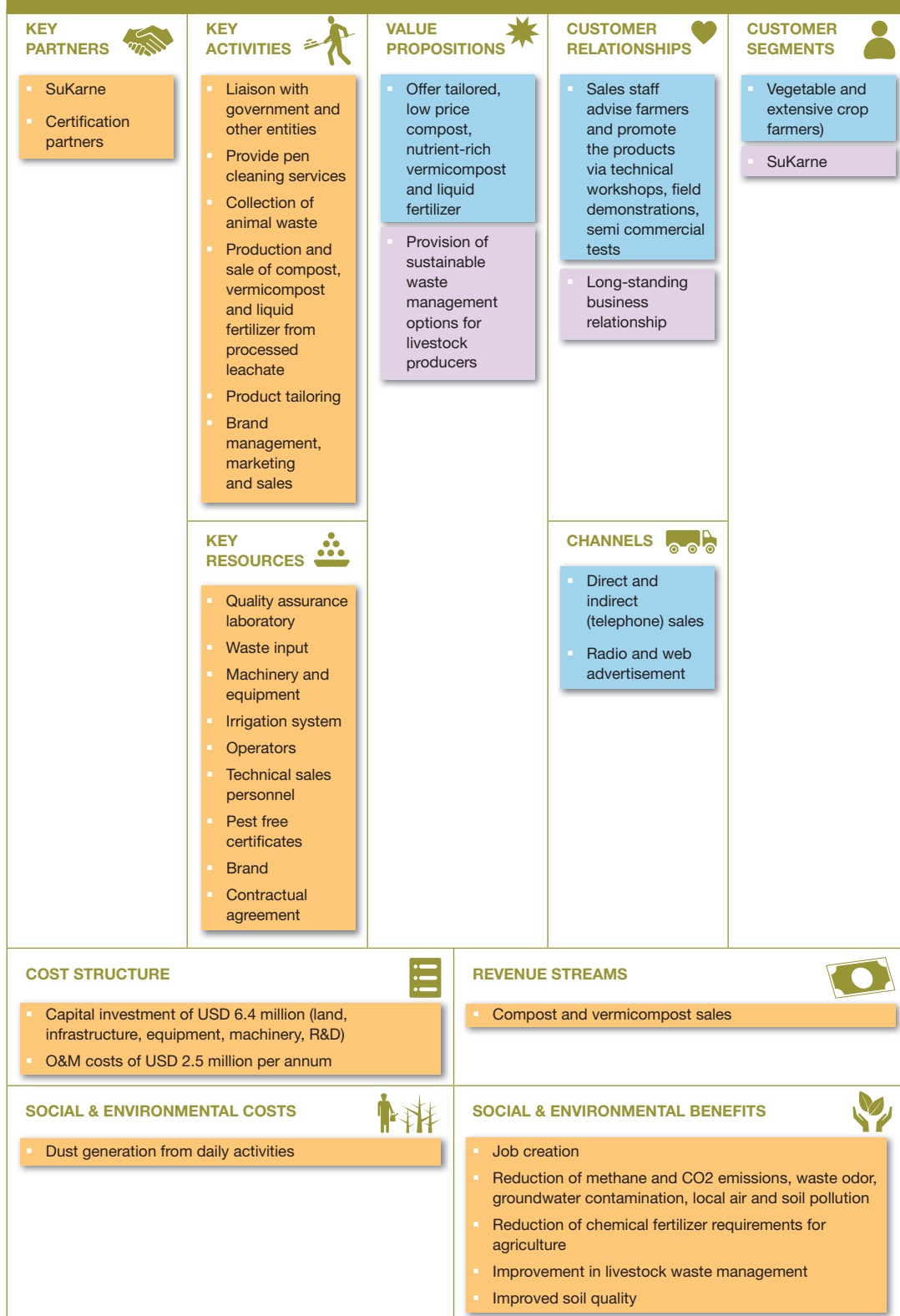
### Macro-economic environment

The increasing demand in higher food safety standards and organic products has triggered an increased use of vermicompost as high quality soil conditioner in several regions across the world. Since the 90's, the global market for organic food products has grown rapidly, reaching US \$63 billion worldwide in 2012. This demand has driven a similar increase in organic agricultural inputs, including fertilizers (Willer et al., 2013). Mexico is estimated to have more than 110,000 organic farmers, considered the greatest number in any country worldwide. As demand for organic food in the United States expands, Mexico's certified organic acreage has been growing at a rate of 32 percent per year. A 2009 study found an annual organic production value of more than \$370 million with 80% destined for export (Agri-Food Trade Service, 2009). Nutrient management has also become increasingly relevant with the price increase of chemical fertilizers and their inherent accountability for human health issues and environmental contamination. To date, there are few organic fertilizer producers in Mexico with large-scale capabilities – most producers constitute small operations. Affordable organic fertilizers have strong market potential for Mexico in the agricultural sector.

### Business model

Figure 175 summarizes ProBio's business model. By using simple and low-cost yet effective technologies, ProBio produces high quality organic fertilizers tailored to specific customer segments and agricultural purposes. This, in addition to third-party product certification has garnered significant market demand. Its three main products, compost, vermicompost and nutrient-rich liquid fertilizer from processed leachate are sold directly to vegetable, fruit and grain crop farmers. Product promotion is achieved through field demonstrations and pre-commercial tests and have been instrumental in creating greater market access. A key aspect of ProBio's model is its partnership with SuKarne, an important waste generator. Initially, ProBio established an agreement with SuKarne to provide pen-cleaning services in exchange for the waste and a small fee. Additionally, SuKarne aided ProBio financially in order to start up the business as establishing a waste management system was a pressing issue for the beef producer. Nowadays, ProBio is a well-established profitable business and no longer charges SuKarne pen cleaning fees. Close proximity of ProBio to SuKarne's plant operations eliminates significant transportation and labor costs associated with the acquisition of waste. Yet, transportation and waste collection costs constitute the largest share of all operational costs at 68%. ProBio has recently restructured its business model and made a significant investment in machinery and increasing operative personnel as most equipment and required resources for operative activities were initially outsourced. This will significantly reduce O&M costs and yield higher long-term margins.

FIGURE 175. PROBIO'S BUSINESS MODEL CANVAS

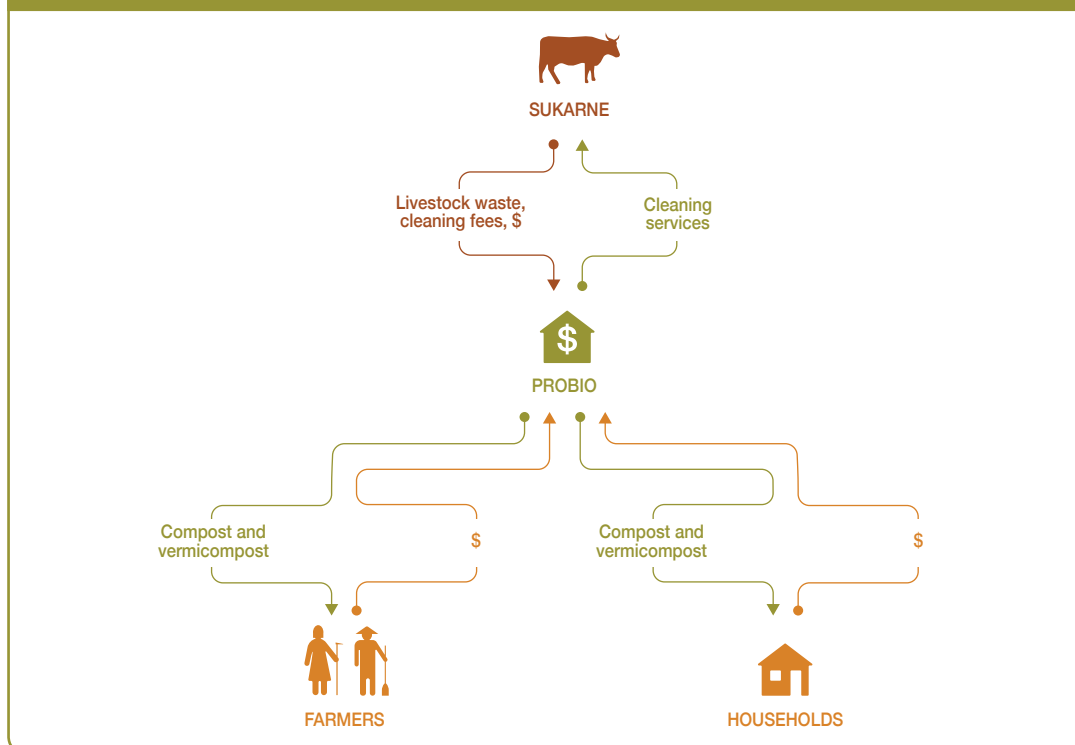


ProBio has demonstrated that waste reuse businesses can be profitable with government support and generate significant benefits to both industry and society. The next step for ProBio is set to be a more technological and innovative-based business, already with available technologies being tested at pre-commercial stages.

### Value chain and position

ProBio's value chain is depicted in Figure 176. It benefits from SuKarne's capability to provide constant and large volumes of animal waste (feedstock), which enables the company to produce significant quantities of organic fertilizer. ProBio also takes advantage of other waste streams such as leftover corn stover and paunch from SuKarne's feed mill and slaughterhouse to use them as nutrient additives into their process. Such scale allows ProBio to develop optimization strategies in order to maximize its efficiency and increase profit margins. Through its economies of scale, both compost and vermicompost are priced significantly lower than the competition's products, mainly chemical fertilizer and smaller organic fertilizer producers, and thus providing an important competitiveness factor. Product demand relies on two customer segments, the vegetable and extensive crop farmers; the latter particularly expected to grow given the increasing demand for organic food products. ProBio has a strong sales team that is strategically divided by regions with important agriculture operations, where they establish product promotion programs with local farmers.

FIGURE 176. PROBIO VALUE CHAIN



## Institutional environment

Livestock production units are bound by the Mexican Official Standard 001, which sets forth the maximum limits of solid and liquid waste allowed to be disposed of and discharged to federal water channels or bodies, respectively. This standard has forced livestock producers to develop waste management systems to meet those maximum limits, especially in the face of increasing production scales. This regulation implicitly incentivizes livestock companies to invest in businesses like ProBio to ensure their compliance and sustainability. Whilst there are no specific governmental guidelines for the certification of compost, several internationally accredited third party certification entities exist (e.g. Bioagricert and Metrocert) in Mexico. Product certification conveys a message of assured product quality to consumers (assuming they trust the certification body), which enables entities such as ProBio to increase their credibility and market share.

## Technology and processes

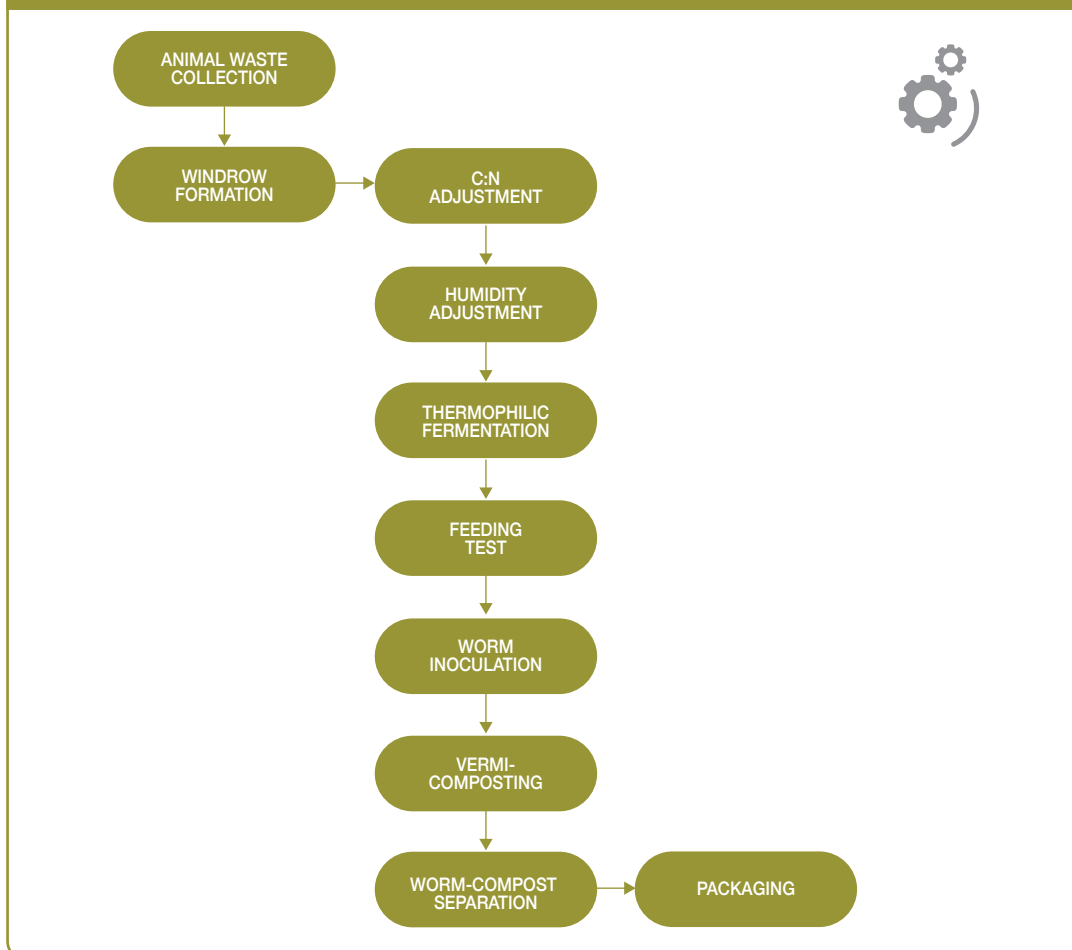
Figure 177 provides an overview of the technological processes used by ProBio for the production of its organic fertilizers. The animal waste is collected from the feedlot pens every 6 months using a scraping system and stockpiled near their operations. Waste is constantly removed from this pile to enter the composting process. For such a process, windrows of 200 m length  $\times$  6 m wide  $\times$  3 m height of animal waste are formed, and corn stover and some paunch is added to the mixture to adjust for carbon and nitrogen requirements. Additionally, water is added to reach optimal humidity content for the fermentation process to start (this takes about a week). This part of the process undergoes an aerobic thermophilic fermentation stage for about 8 weeks, where temperatures of up to 70°C are reached and promote pathogen elimination. Further aerobic degradation is achieved throughout an approximate 14-week mesophilic stage where temperature drops to 25–30°C to enter a final compost maturation stage. Finally, the compost is screened to remove stones and other unwanted particles. The overall composting process lasts from 120–160 days.

Finished compost is utilized to feed the vermicomposting process. New windrows are formed and California Redworms (*Eisenia fetida*) are added. The redworms further contribute to the organic matter degradation, producing a compound called 'humus', or vermicompost, a nutrient-rich organic fertilizer with important soil conditioning properties. Once the worms are well established, additional compost is added weekly in order to "feed" them and increase the production of vermicompost. The windrows are watered every day through an automated irrigation system in order to maintain a humidity level between 60–70%. Windrows are placed over a sloped terrain to enable natural leachate collection throughout the process, where it is then pumped into large containers for further oxygenation and packaging. After a period of 5–6 months the worms are removed using a trommel and further reincorporated into a new vermicomposting process; the humus or vermicompost is finally screened and ready for sale. Both finished compost and vermicompost are analyzed to determine nutrients and other constituents. Overall, the whole process from waste to final product has a conversion efficiency of 55%. The final product contains a nitrogen, phosphorus and potassium content of 0.5–1%, 1–1.5%, and 1–1.5%, respectively, and provides a crop yield (tested e.g. for potatoes) increase of 15–30%.

## Funding and financial outlook

The business required an initial capital of USD 2.2 million, for land, infrastructure, machinery and equipment. The payback period for such an investment is estimated at three years. Overall, the business has production costs of USD 5.5 million (Table 43), where 46% is accounted for operation and maintenance, which breaks down in the following way: 68% for transport and waste collection, 15% for machinery lease related to the composting and vermicomposting processes, 10% for equipment maintenance, 6% for fossil fuel, 1% for tools and equipment and the balance for final

FIGURE 177. PROCESS DIAGRAM OF PROBIO



product packing. Land lease accounts for 20% of production costs, while labor constitutes 17%. Services, which account for 2%, comprise costs such as water, security, mail, etc. Quality control refers to laboratory analyses conducted by external entities and accounts for 2%. Finally, depreciation and administration costs comprise 1% and 12% of production costs, respectively.

ProBio has three key income streams. The main income streams are sales of compost and vermicompost. A minor income is acquired from sale of the nutrient-rich liquid fertilizer from processed leachate. In total, ProBio had revenues of USD 5.7 million in 2013, with a total net income of USD 1 million. The volume of sales for compost and vermicompost is estimated at 231,000 tons per year at a price of USD 30 per ton and USD 70 per ton, respectively. ProBio has been generating profit for several years; indicating that with increased production and demand, aside from incorporation of more innovative-oriented processes, the business stands to attain higher profits and benefits to its shareholders. ProBio restructured its business model in 2014 and made a USD 4.2 million investment in machinery and R&D infrastructure, which will significantly contribute to a cost reduction, particularly in transport and process maneuvers (over 50%) as well as in so far outsourced laboratory analyses (up to 100%).

**TABLE 43. BREAK-DOWN OF OPERATIONAL COSTS (2013)**

<b>COST ITEM</b>	<b>TOTAL COST (PER ANNUM)</b>
Land lease	USD 1,114,400
Labor	USD 970,700
Operation and maintenance	USD 2,565,500
– Fossil fuel	USD 158,000
– Equipment maintenance	USD 245,000
– Transport and waste collection	USD 1,750,000
– Machinery lease	USD 391,000
– Tools and equipment	USD 15,000
– Product packing	USD 6,500
Quality control	USD 98,000
Depreciation	USD 31,500
Administration costs	USD 798,600
Total	USD 5,578,700

### Socio-economic, health and environmental impact

Agricultural operations have become increasingly more intensive to execute economies of production and scale around the world, as pressure to become more efficient continues to grow. This is especially true in livestock operations (swine, dairy cows, etc.), which can generate serious environmental consequences, such as GHG emissions, odor, and water/soil contamination, all a result from improper storage and disposal of animal waste. Confined Animal Feeding Operations (CAFOs) use similar Animal Waste Management System (AWMS) options to store animal residues. These systems emit both methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) resulting from anaerobic decomposition processes (Clean Development Mechanism, 2007). Additionally, displacement of chemical fertilizers conveys a set of environmental and health benefits that may be achieved by production of organic fertilizers processed from agricultural waste. Businesses that incorporate cleaner waste management solutions such as ProBio have important environmental benefits such as:

- Reduction of CH<sub>4</sub> and CO<sub>2</sub> emissions by avoiding landfill anaerobic conditions;
- Reduction of waste odor, local air and soil pollution by accelerating the decomposition of organic matter present in waste streams;
- Reduction of groundwater contamination and health issues related to nitrogen accumulation derived from chemical fertilizer demand;
- Overall improvement in livestock waste management;
- Overall soil quality improvement from prolonged organic fertilizer application.

### Scalability and replicability considerations

The key drivers for the success of this business are:

- Strong relationship and win-win partnership with SuKarne – main input supplier.
- Assured and continuous supply of large quantities of waste – free of charge, aiding economy of scale development.
- Guaranteed high quality product sold at a competitive market price.
- An effective market development strategy.
- Incorporation of efficient and innovative technologies across its operations.
- Increasing chemical fertilizer prices.
- Increasing demand for organic fertilizers due to soil stability issues.
- Fast-growing livestock markets and subsequent insufficient waste management capacity.



There is great potential for ProBio to expand its services to other livestock producers, however land availability for operation set-up close to the waste source may be a constraint. Regarding market share, one of its customer segments, the grain crop sector, is not fully aware and certain of the benefits of organic fertilizers, and considers them an additional cost rather than a long-term sustainable alternative. Further development of this segment will have a significant impact in market access as such crops represent the vast majority of cropland in Mexico. SuKarne's scale in terms of waste generation is probably one of the biggest success factors for ProBio since they are able to provide a constant and high amount of feedstock to the business. This model has a high potential for replication in agrarian countries with large-scale livestock production systems. It is important to note however that the implementation of such a model requires significant start-up capital investment – which is among the most cited barriers for business development in developing countries. In ProBio's case, SuKarne provided key initial financial support as it is obliged to comply with legislative mandates for waste disposal and the implicit cost of non-compliance would be significantly higher – so an incentive for the private sector to invest in such initiatives should exist if similar legislation applies.

### Summary assessment – SWOT analysis

Figure 178 provides an overview of the SWOT analysis for ProBio. ProBio is a successful company that reuses the animal waste generated by the beef producer SuKarne to produce compost and vermicompost, and then sells it directly to farmers and households. Essential in its business model is the certification and branding of their organic fertilizer products. This in addition, strategic marketing and sales programs have increased ProBio's market share. Additionally, their agreement with SuKarne has ensured consistent supply of feedstock, mitigating production risk associated with fluctuation in input supply. The establishment of the compost facility in close proximity to the waste source significantly reduces related transportation and labor costs. Technology and related production efficiency, on the other hand, must be improved in order to increase the profit margin, since ProBio takes advantage of economies of scales to generate profit. Opportunities exist for ProBio to fully access the grain crop market segment. This would significantly increase its market share and profit margins due to its important cropland area in Mexico. The latter however requires a bold incentive program for farmers where they would be able to initially try out the product and experience tangible benefits prior to any investment, as uncertainty drives them to consider such fertilizers as an additional cost rather than a strategy to displace high-priced chemical fertilizers. ProBio is willing to bear this risk given its confidence in the quality of its products, as this practice has already proven to be effective. ProBio, however, solely relies on SuKarne to provide livestock waste. Although unlikely given their contractual agreement, in the event that SuKarne would decide to divert its waste supply to another purpose or business, ProBio would face a significant production risk. ProBio is an example of a novel business using a commodity-value approach and a solid partnership with an agro-waste generator to address some of the major waste management and environmental challenges in Mexico whilst generating significant profits and benefits to society.

### Contributors

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FIGURE 178. SWOT ANALYSIS FOR PROBIO

	<b>HELPFUL</b> TO ACHIEVING THE OBJECTIVES	<b>HARMFUL</b> TO ACHIEVING THE OBJECTIVES
INTERNAL ORIGIN ATTRIBUTES OF THE ENTERPRISE	<b>STRENGTHS</b> <ul style="list-style-type: none"> <li>Strong business partnership</li> <li>Low price and high nutrient value of products</li> <li>Access to cost-free inputs</li> <li>Creation of image through positive impact on the environment</li> </ul>	<b>WEAKNESSES</b> <ul style="list-style-type: none"> <li>Technology improvement to increase profit margins</li> <li>Customers not fully aware of benefits of products</li> <li>Lack of an effective marketing and branding campaign</li> </ul>
EXTERNAL ORIGIN ATTRIBUTES OF THE ENVIRONMENT	<b>OPPORTUNITIES</b> <ul style="list-style-type: none"> <li>Up-scaling of business operations to cater to other large-scale livestock producers</li> <li>Increasing market share of extensive crop farmer segments</li> <li>Market expansion to the United States</li> </ul>	<b>THREATS</b> <ul style="list-style-type: none"> <li>Chemical fertilizer market mature and well-established</li> <li>Waste provider diverting waste for different purposes</li> </ul>

### References and further readings

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*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 2015/2016. As business operations are dynamic data can be subject to change.*