How does it operate? Is it really sustainable? How can I pay for it? How can I make it true?

After a long work day, Roberto Mata and Hortencia Solís engaged in discussing the chances for Coopedota to develop and implement environment-friendly projects taking into account waste from both Coopedota and the community as a whole, in view of the company’s large amounts of waste and of community requirements. By doing so, they aimed at differentiating the coffee produced and exported by Coopedota.

The coffee produced in this region of Costa Rica, particularly that of Coopedota, is consumed in Europe, the United States, and Canada, with Starbucks as its key customer. An international chain, Starbucks has stores in the United Kingdom, Japan, Belgium, Saudi Arabia, Mexico, and Peru, among other countries. StarBucks has become widely known for coffee quality and for fair-trade goods.

Trends in the Coffee Market

Between 2007-2008, coffee production worldwide amounted to 122 million sacks, 9 million below the figure for the previous year mostly due to a decline of coffee harvest in Brazil. The world balance for 2008 showed a shortfall of between 6 and 11 million coffee sacks, one of the lowest inventory levels over the last few decades.
In spite of the global financial crisis in late 2008, coffee prices remained stable and even showed an increasing trend. This corroborates the idea that supply and demand remain balanced worldwide. Between January 2007 and November 2008, the prices in the C Contract at the New York Stock Exchange did not show a stable trend, ranging between US$1.10 and US$1.67/lb.² In spite of these price levels, on average the international price for coffee has ranged between US$1.30 and US$1.48/lb.³ See Exhibit A.0. for international price trends (2002-2008.)

Over the last few years, coffee consumption has remained stable at 2.5%. The graph below displays the trend for 1996-2008.

**Worldwide Coffee Consumption per Producer and Importer Countries 1996-2008**

[Figure: Worldwide Coffee Consumption per Producer and Importer Countries 1996-2008]

**Source:** Las principales cifras de la actividad cafetera, Colombia 2008, Bogotá, November 25, 2008, (Red de Información Cafetera)

This trend also impacts Costa Rica. Coopedota is an active player in this market, and looks at trends as a major indicator for new ways to differentiate its product.

**Company Background**

CoopeDota R.L. is located in Santa María de Dota, a coffee-producing town of 4,960 people⁴ in the Central Pacific Mountain Range of Costa Rica. It was started in 1960 with funding and technical advice from Banco Nacional de Costa Rica. Some people see this area as a symbol of

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² The New York Stock Exchange settles C coffee contracts. Each coffee contract is for 37,500 lbs (some 250 sacks of 69-kg gold coffee) i.e., one full container of Arabica coffee certified by NYSE. Coffee submitted to NYSE must be certified by NYSE itself and must meet the requirements set. This rating ensures that NYSE marketing focuses on price only. NYSE is used as a protection device by producers (usually large ones), importers, exporters, business firms or intermediaries, and coffee toasters, all with one aim: to hedge against price falls impact the physical market if they are exposed. **Source:** [http://www.elobservadoreconomico.com/articulo/259](http://www.elobservadoreconomico.com/articulo/259) July 21, 2009.

³ Taken and adapted from Las principales cifras de la actividad cafetera, Colombia 2008, Bogotá, November 25, 2008, (Red de Información Cafetera.)


Costa Rica’s economic and socio-cultural life 30 years back, with communities cherishing simple rural life and cooperation.

**Community-Firm Relationship**

Coopedota has 780 members processing some 65,000 on average every year. Its relationship with the community is based on mutual commitment, with Coopedota serving as a hub of community activity.

Within this cooperative framework, Coopedota engages in a number of different activities and projects to meet various needs both from its members and from the community as a whole. These include technology updating for its members, promoting coffee in both the local and the international market, and a yearly coffee fair held on its premises.

**Introduction**

Santa María de Dota is a thriving agricultural area with good socioeconomic performance for the last 10 years. As a result of economic growth, the area is currently facing a number of challenges, including implementing a sustainable landfill, as the capacity of the current one is not enough to meet demand.

In view of this, Coopedota is looking for alternative solutions. Hortencia and Roberto are considering a new alternative to solve this issue while at the same time protecting the environment. To do so, by 2005 some cooperative units producing large amounts of solid waste were considered to develop an internal pilot plan as a preliminary platform for a solid waste management program.

As a part of this initiative a number of projects were planned to start simultaneously as follows: 1) developing a management project for water from vinasse to build biodigesters in order to produce energy from this waste; 2) promoting a project to take advantage of dried skin and coffee shell as fuel for Coopedota’s furnace, to reintroduce energy in production processes; 3) in the same vein, an ethanol production project from coffee mucilage, another byproduct of coffee processing. All of these are added to the pilot plan previously mentioned.

In line with these undertakings, there is also a project to compost coffee pulp. Coffee pulp is a strong river and basin pollutant. When placed directly on the ground, it helps restore soil that has been degraded as a result of coffee cultivation and high erosion levels from climate conditions and plantation management.

With support from management, Hortencia, the leader of these set of initiatives engaged in creating a sustainability program to produce income from waste, under a comprehensive vision to have coffee recognized not only for taste and quality but also for sustainability.
Managing the sustainability program: waste in Coopedota

Supported by a formal company program, this set of projects is based on research and development and promoted by the general manager, taking advantage of the opportunity to use the human capital available to Coopedota.

On average, over the last four years Coopedota has processed some 65,000 fanegas of coffee\(^5\) per year, with waste accounting for 81.4\% of the entire process (see Exhibit A.2.) In view of such quantities, research was started to provide process wastewater with value added. The original idea was to conduct experiments to obtain methane to simulate biodigestion.\(^6\)

Another important issue in the biodigestion process is the amount of water used to convey coffee berries within the coffee mill. In Costa Rica, less than a cubic meter is allowed for fanega of processed coffee. Coopedota succeeded in setting the level entering the process in 0.4 cubic meters of water.

Large quantities of waste consisting of mucilage, pulp, dry skin, and water result from a conversion using harvest averages for Coopedota residues per harvest, as described in Exhibit 3.

Wastewater was previously dumped into rivers still with physical/chemical contents that were unbearable for river ecosystems, thus leading to their destruction. However, Coopedota has recently focused on looking for new alternatives to research, develop, and validate industrial-scale projects. These aim at obtaining new products and processes creating value from waste.

A-Biodigesters Project

Stage one

At stage one of research a prototype was designed to measure methane generation at hermetically-sealed 3.8 liter container, measuring temperature and pH for wastewater comprising mucilage, pulp juice, and conveyor water with different amounts of lime, as pH\(^7\) is a standard to be controlled for so that bacteria can develop and generate methane gas. The ideal pH level is above six and the stock solution to be assessed had a level-five pH.

The reason to choose this material is that it is chiefly made of reducing and non reducing sugars, plus other components. Mucilage normally undergoes fermentation or else it is separated through mechanical means to allow for coffee-bean washing. As a result, mucilage dilutes, leading to a need for treatment. Using less water results in a chance to use this byproduct of coffee processing.

Twenty different types of treatment were assessed, showing a positive reaction of the mix in an environment where pH, temperature, and lack of oxygen were controlled to generate methane gas. After the tests, Coopedota resolved to install a biodigestion system based on a plastic pipe structure to create an anaerobic environment (i.e., one lacking oxygen) using bacteria growing in a 6 – 7 pH. For this reason, the mucilage decomposition process had to be studied in an system

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\(^5\) See Exhibit A.1, coffee berry composition.

\(^6\) Data provided by Coopedota RL. Updated: March 2009.

\(^7\) That is, alkalinity or acidity degree of a substance.
simulating biodigestion by analyzing pH, temperature, and lack of oxygen to scale up the project later on. The cost for this preliminary research amounted to US$64,000.

Table 1. Preliminary Biodigestion System Data

<table>
<thead>
<tr>
<th>Data</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction of daily input or waste (mucilage) L (liters)</td>
<td>600</td>
</tr>
<tr>
<td>Total biodigester volume (m3)</td>
<td>272</td>
</tr>
<tr>
<td>Total biodigester volume (days)</td>
<td>35</td>
</tr>
<tr>
<td>Fire time</td>
<td>8</td>
</tr>
<tr>
<td>COD at biodigester gate (mg/l)</td>
<td>16.1</td>
</tr>
<tr>
<td>Methane generation per COD kilo ratio (m3 CH4/kg COD)</td>
<td>0.35</td>
</tr>
<tr>
<td>Biogas production (m3 CH4/kg COD)</td>
<td>5.6</td>
</tr>
<tr>
<td>Kilowatt/hour/COD kilogram ratio for energy produced (KWH/Kg COD)</td>
<td>3.3</td>
</tr>
<tr>
<td>Energy produced (KWH/kg COD)</td>
<td>53110</td>
</tr>
</tbody>
</table>

Source: Sustainable I&D Projects, Coopedota R.L., 2009

Starting wit the 600 liters mentioned in the table above, a simple savings calculation can be made as follows: a cubic meter of biogas equals, on average, 1.25 kWh of electricity. Currently, the biodigester can contain 272 cubic meters, with 80% of volume in the liquid stage (water with suspended particles) and 20% as biogas (some 54.4 cubic meters.) Once you know the amount of biogas, (54.4 cubic meters in this case), you multiply it times 1.25 kWh to get 68 kWh every two days, that is, 1020 kWh per month on average.

This accounts for a 5% saving in purchasing fuel used to pre-heat the entire coffee toasting system. Keep in mind that the average cost per kilowatt/hour in Costa Rica is about US$0.10.

Stage two

Ethanol Project

Once biodigestion tests were over, the chemical characteristics of the mix were analyzed in terms of sugars. Upon finding sugars that could be turned into alcohol, the decision was made to conduct an experiment to ferment mucilage and wastewater simulating controlled fermentation and taking into account yeast percentage and type, fermentation time, ratio of the mucilage and pulp leaching mix, temperature, and pH. Lab tests resulted in 60 G.L\(^9\) alcohol. These were the first experimental fermentation tests driving the development of the first prototype in a middle scale including a fermentation system, preheating, and a distillation column to process 1,200 liters of ferment per day to obtain 120 liters of 80 G.L. alcohol. Even though the system per se was nothing short of a success, alcohol degrees remained low, as the minimum requirement was close to 90 G.L.

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\(^8\) Chemical oxygen demand (COD) from a liquid. This is a standard used to measure the amount of a liquid sample that can be oxidized by chemical means. It is useful to find the degree of pollution in the sample.

\(^9\) That is, degrees of alcohol.
**Stage three**

A strategic alliance was started in 2007 between CoopeDota R.L. and Colombia’s Centro de Agricultura Tropical (CIAT) to disseminate the general experience in Costa Rica and CIAT in relation to alcohol alcohol production from coffee byproducts. Colombia was also in the preliminary stages of an I&D program in production of ethanol from waste like coffee mucilage. Thus, the decision was made to participate in an international project to look for research funding and other raw materials different from coffee to produce alcohol. The project was called “*A new market for small banana and plantain producers: innovation in technology for sustainable production of alcohol.*”

The main idea for the project is using coffee byproducts produced between September and March, as well as some varieties of musaceae [banana and similar plants] used to provide shade in coffee plantations. Currently musaceae are not grown for food or trade purposes in the region. The key interest in this initiative is purchasing these materials to producers to help them increase income from their coffee plots and then combine coffee byproducts and musaceae to serve as raw material for fermentation/distillation. In addition, different mixtures and ingredient concentrations were evaluated to look for improved alcohol yield per ferment liter.

Once evaluation was completed, Coopedota hired a chemical engineer to design an effective distillation column. The following data were obtained upon completion of the evaluation by a third party:

**Table 2 Ethanol Project – Background Information**

<table>
<thead>
<tr>
<th>ETHANOL PRODUCTION BACKGROUND INFORMATION</th>
<th>FIGURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area (hectares per year)</td>
<td>1,500</td>
</tr>
<tr>
<td>Pure alcohol production (liters/80 days, production peak)</td>
<td>182,433</td>
</tr>
<tr>
<td>Pure alcohol production (liters/day)</td>
<td>2,281</td>
</tr>
<tr>
<td>Alcohol yield (liters of pure alcohol/day)</td>
<td>2</td>
</tr>
<tr>
<td>Amount of fermented mucilage (liters/hectares per year)</td>
<td>741,741</td>
</tr>
<tr>
<td>Amount of fermented pulp juice (liters/hectares per year)</td>
<td>2,298,981</td>
</tr>
<tr>
<td>Amount of juice and mucilage to ferment (liters/year)</td>
<td>3,040,722</td>
</tr>
</tbody>
</table>


Some processes were specifically designed for this system in order to achieve maximum system effectiveness. These are shown in sequence in **Exhibits A.4** and **Exhibit A.5**. The project is currently under implementation, based on data shown in Table 2 (ethanol production ranges.)

To implement stages two and three nearly US$80,000 have been invested. Of these, US$61,400, come from a FONTAGRO donation, with the remainder as an investment from Coopedota RL. Costs and estimated investment for part A are shown in the table below.
Table 3. Financial Project Background Information

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total investment</td>
<td>$144,000</td>
</tr>
<tr>
<td>Variable cost (per month)</td>
<td>$600</td>
</tr>
<tr>
<td>Fixed cost (per month)</td>
<td>$300</td>
</tr>
<tr>
<td>Labor cost (operator) (per month)</td>
<td>$500</td>
</tr>
<tr>
<td>Maintenance cost (per month)</td>
<td>$1000</td>
</tr>
<tr>
<td>Cost of inputs</td>
<td>$0</td>
</tr>
<tr>
<td>Machine useful life (years)</td>
<td>20</td>
</tr>
</tbody>
</table>

Source: Author estimates based on information provided by Coopedota R.L., 2009.

B- Compost Project

Coopedota is constantly looking to innovate and develop clean, low-cost, high-yield technologies, to fully take advantage of available resources and coffee waste.

Coffee pulp is another byproduct of coffee milling. It accounts for 42% of coffee berry weight. A volume ratio (m3)\(^{10}\) would show pulp accounts for 56%. Coffee pulp must be treated in line with the organic waste act. Coopedota’s farm is located outside the community to prevent odors, flies, and public health issues.

Implementing this project over the entire community is highly significant, as a result of the holistic approach to obtaining an environmentally-friendly product. This benefits producers and improves competitiveness levels by cutting down production costs in terms of fertilizers, enhancing farmers’ capacity to invest in coffee plots and enhancing quality, yields, and price per fanega.

The importance of the project is closely linked to its constant treatment of organic waste and its economic, social and environmental impact on the community. Based on this, the project called “Manejo de los desechos orgánicos para el mejoramiento del ambiente y el suelo en Santa María de Dota” focuses on reducing social and environmental problems and improving soil structure and quality, as these go hand in hand with new marketing trends focusing on sustainable productivity and profitability in relation to society and environment.

Waste management and composting follow a logical sequence since the time pulp is produced to finished product packaging. Once separated from the bean, pulp is taken to a yard area where it is partially dried (see Exhibit A.6 for further detail.)

The two products from the process are compost and lombricompost. Coopedota is a socially-oriented company differentiating sale prices for members and those outside the cooperative. Most of the compost goes to members with only transportation cost paid. Lombricompost, on the other hand, is sold in 46-kg bags for a unit price close to US$1 to members and US$2.4 to outsiders. The project aims at developing a high-quality product to incorporate organic matter to improve soil quality. Investment so far amounts to US$70,000 in the entire project. Estimated cost and investment data for the compost project are shown below.

---

\(^{10}\) Cubic meter.
Table 4. Financial Project Background Information

<table>
<thead>
<tr>
<th>Item</th>
<th>Information (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total investment</td>
<td>$70,000</td>
</tr>
<tr>
<td>Variable cost (per month)</td>
<td>$500</td>
</tr>
<tr>
<td>Fixed cost (per month)</td>
<td>$250</td>
</tr>
<tr>
<td>Labor cost (operator) (per month)</td>
<td>$500</td>
</tr>
<tr>
<td>Maintenance cost (per month)</td>
<td>$500</td>
</tr>
<tr>
<td>Cost of inputs (per month)</td>
<td>$0</td>
</tr>
<tr>
<td>Machine useful life (years)</td>
<td>10</td>
</tr>
</tbody>
</table>

Source: Author estimates based on information provided by Coopedota R.L., 2009.

C- Energy from Biomass Project

As a part of this great project, Coopedota is using coffee shell and dried skin as additional fuel in the production process. It recently invested US$40,000 to enhance furnace efficiency. Consumption now is 75 kWh versus traditional furnace consumption of about 450 kWh. This account for more efficient energy per kilogram of biomass processed in fuel consumption. The improved furnace allows to burn nearly all types of waste (see Exhibit 7.)

This furnace was built in the United Kingdom and it was designed by Roberto Mata from Coopedota working together with the engineering team of Bioflame, the manufacturer of the integrated system. Some components (e.g., air extractors) were built by the company taking advantage of local skills, which led to a 50% reduction from the original cost. As a result of this investment, energy efficiency increased, leading to significant savings. The following tables, based on a 500-fanega coffee-berry pattern as the basis to estimate company savings, are offered to provide further illustration.

Table 5

<table>
<thead>
<tr>
<th>AVAILABLE BIOMASS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average amount of coffee berries per fanega</strong>&lt;sup&gt;12&lt;/sup&gt;</td>
</tr>
<tr>
<td>Coffee shell</td>
</tr>
<tr>
<td>Dried skin</td>
</tr>
</tbody>
</table>


This table shows how biomass is turned into raw material for fuel, once water and moist are extracted from coffee shells and dried skins. Thus, at the end of the process 1,383 kg of effective

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<sup>11</sup> Traditional furnace. Reference as per Behlen Berico brand provided by Coopedota, 2009.

<sup>12</sup> A volume measure traditionally used in Costa Rica for coffee, equal to nearly 254 kilograms. Source: ICAFE 2009.

<sup>13</sup> From 50,000 fanegas of coffee berries. Source: Coopedota 2009.

<sup>14</sup> The coffee shell and dried skin mass shrinks to smaller quantities due to lower amounts of liquid when it dries. These percentage reductions depend on environmental temperature and moist. Source: Coopedota 2009.

<sup>15</sup> Idem 10.
biomass from coffee shell and 435,202 kg of biomass from dried coffee skins are obtained. From these date, the table below, estimating energy production and savings, in constructed.

Table 6

<table>
<thead>
<tr>
<th>Raw Material</th>
<th>Useful Biomass (Kg.)</th>
<th>Thermal Power (kJ/kg)</th>
<th>Energy (kJ)(^{16})</th>
<th>Available Energy (kWh)</th>
<th>Furnace Efficiency</th>
<th>Net Process Efficiency</th>
<th>Efficient Energy (kWh)</th>
<th>Cost per KWh</th>
<th>Estimated Savings (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coffee shell</td>
<td>12.383</td>
<td>14.361</td>
<td>177.830.359</td>
<td>49.397</td>
<td>0.7</td>
<td>0.35</td>
<td>12.102</td>
<td>0.10</td>
<td>1.210</td>
</tr>
<tr>
<td>Dried skin</td>
<td>435.202</td>
<td>15.855</td>
<td>6.900.120.861</td>
<td>1.916.700</td>
<td>0.7</td>
<td>0.35</td>
<td>469.592</td>
<td>0.10</td>
<td>46.959</td>
</tr>
</tbody>
</table>

Source: Author adaptation from Sustainable I&D Projects, Coopedota R.L., 2009

Conversion data:

J (Joule) = 0.1020 kpm = 2.778 10-7 kWh = 2.389 10-4 kcal = 0.7376 ft.lbf = 1 kg.m2/s2 = 1 watt second = 1 Nm = 1 ft.lb = 9.478 10-4 Btu.\(^{17}\)

The table above details, from left to right, how dried biomass is turned into energy through a thermodynamic process. The thermal power of these two byproducts is very similar to that of rice dried skin, i.e., about 13 800 kJ/Kg\(^{18}\). Available energy stated in terms of KWh is not necessarily the efficient energy applied to process, as this is impacted by equipment effectiveness, in this case, the furnace, as benefit depends of furnace design and construction.

Thermal machines tend to turn a large amount of the energy from the system into heat. However, machine efficiency cannot reach high levels. In contrast, electric machines’ efficiency is close to 90% or even more, depending on manufacturer and technology.

Under this production estimate for efficient energy and with the US$0.10 kWh average cost for electric power in Costa Rica, total savings amount to US$48,000 per coffee harvest. This is a significant saving for Coopedota, as it makes it unnecessary to purchase fossil fuel such as bunker, which have a stronger impact on environment and company funds.

\(^{16}\) Joule (J) are units for work and energy in the International Labor System. They are defined as work done by the strength of one newton within one meter of distance. They are named after the physicist James Prescott Joule. A jule is also equal to one watt per second, so, in electrical terms, it is the work carried out with a one-volt potential difference with a one-amper intensity for one second. Taken from: http://www.convertworld.com/es/energia/kJ.html June 22, 2009.


Table 7. Financial Project, Background Information

<table>
<thead>
<tr>
<th>Data</th>
<th>Información US$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total investment (USD)</td>
<td>$40,000 *</td>
</tr>
<tr>
<td>Variable cost (per month)</td>
<td>$500</td>
</tr>
<tr>
<td>Fixed cost (per month)</td>
<td>$2000</td>
</tr>
<tr>
<td>Labor cost (per month)</td>
<td>$800</td>
</tr>
<tr>
<td>Maintenance cost (per month)</td>
<td>$1000</td>
</tr>
<tr>
<td>Cost of inputs (per month)</td>
<td>$0</td>
</tr>
<tr>
<td>Machine useful life (years)</td>
<td>30</td>
</tr>
</tbody>
</table>

Source: Author estimates based on information provided by Coopedota R.L., 2009.

Note: *This investment price results from Coopedota being a co-designer for this innovative furnace. Innovation in this case results from design requirements from the company. The furnace patent is still pending.

D- Waste Management Project

Coopedota began a recycling project at its facilities in 2005 in order to provide adequate handling to waste from different units such as Management, Supplies, Coffee Mill, Coffee Toaster, Coffee Shop, and Farm. Materials were sorted at the preliminary stage of process as follows:

Containers: Plastic, glass, and aluminum containers.

Paper: cardboard, newspaper clipping, white and colorful.

To develop a recycling culture in company, Coopedota trained 87 employees in 2005. Next, the entire community adopted recycling and began to bring recycling material to the stock-up center. In view of the increase in the amount of materials, Coopedota was forced to build a new facility to increase plant capacity and operation.

As a result of community interest, Coopedota launched a pilot plan in 2007, in cooperation with a community project, with participation from six students of a vocational school (Colegio Técnico Profesional José Daniel Flores Zavaleta) previously trained in ordinary waste handling. The project involved training as well as collection of reusable material in El Guabayal, a neighborhood with 53 housing units with 44 occupied. These were taken into account to research and validate the recycling system (see Exhibit A.8.)

At the beginning of the eight-week program 24 households did not sort waste. By the time of completion, only 16 households in the entire neighborhood did not do so. Thus, 28 households adapted to the recycling system.

In 2008 Coopedota decided to expand the recycling program to the entire community of Santa María de Dota. To do so, an agreement was entered between CoopeDota R.L. (to stock up and dispatch waste) and the community’s local government (to collect waste) aimed at:

- Supporting the environment.
- Keeping a clean, healthy community.
• Fostering a culture to take advantage of current resources.
• Increasing the useful life of the municipal landfill.

Waste collection took place every Tuesday on different areas of town to improve collection, stock-up, and material dispatch effectiveness. Non-recyclable waste was collected on Friday and taken to the landfill.

The project was seen as a success from Coopedota. The project trained 17 students from the local vocational school on solid and organic waste management, divided into five community projects groups. As a result, the community was divided into different sectors in order to cover every single household to explain the way to hand recycling materials every Tuesday. As a result, 660 received explanations. Of these, 656 agreed to sort waste and four declined. In addition to households, the same was done for 62 stores, 378 elementary-school students and 131 high-school students.

In view of satisfactory adoption of the project, the local government resolved to collect recyclable material every Tuesday, starting on February 10, 2009. The total cost for the project amounted to US$30,000, of which US$8,700 were invested by Coopedota, US$ 15,500 were provided by the Agricultural Promotion Program of the Ministry of Agriculture, and the remainder was donated by the local government.

Project Sustainability

Project Impact

These projects aim at achieving economic and environmental sustainability over time to provide added value both to Coopedota and the community as a whole. Also, they help Coopedota cut costs and enhance members’ income.

Preliminary estimates put compost production in 26,000 46-kilogram bags resulting from solid waste from coffee production.

The project has impacted 750 producers who are members of CoopeDota R.L. Of these, women account for 31%, men for 65%, and the remaining 4% is made up of neighbor associations directly linked to Coopedota. Benefits include lower production costs and improve soil quality.

In relation to ethanol production, Coopedota in considering to process 182,400 liters of wastewater to produce ethanol accounting for 10% of total wastewater from the fermentation and distillation system. The project is expected to have other parallel initiatives in the next few months. As a result of the ethanol project, 7,000 tons of carbon equivalents (resulting from methane combustion) are expected to be captured. These result form wastewater processing under controlled fermentation rather than from oxidization ponds.

In addition for public health benefit for the community resulting from keeping wastewater away from rivers, the project is also linked to the biodigester project aiming at capturing 2,000 tons of methane per year through biodigestion systems in order to mitigate climate change. In addition, it
aims at a 30% reduction of standards such as BOD$_5^{19}$, COD, and pH, among other wastewater pollution standards. In relation to waste handling, the following quantities have been collected and sold between October 2008 and May 2009:

<table>
<thead>
<tr>
<th>PRODUCT NAME</th>
<th>UNITS (KG)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glass</td>
<td>10,060</td>
</tr>
<tr>
<td>Cardboard and paper</td>
<td>16,122</td>
</tr>
<tr>
<td>Aluminum</td>
<td>474</td>
</tr>
<tr>
<td>Plastic</td>
<td>5,378</td>
</tr>
<tr>
<td>Cans and metal</td>
<td>1,128</td>
</tr>
<tr>
<td>Tetrabrik</td>
<td>1,618</td>
</tr>
</tbody>
</table>


Waste sales account for monthly income equal to US$ 355 that is invested in the same project to pay a worker coming two days per week to sort waste and provide maintenance to the facility. This impacts the community by reducing health and environmental risk as a result of a waste-handling program bringing in extra income and providing effective service in relation to waste.

Coopedota is always looking for new ways for members to produce larger quantities of better-quality coffee at a lower cost. To some degree, the project aims at attaining this goal by producing energy from waste, recycling and reusing waste, and providing associates with new inputs. Cooperatives in Costa Rica are exempt from income tax.

Does the business model really integrate corporate social responsibility into the cooperative?

Challenges in the medium term

After completing these projects, Coopedota is now engaging in internal evaluation. As shown, investment for these initiatives has been significant, but payoff is still to be demonstrated. On the other hand, generally speaking, the response has been positive for both Coopedota and the community as a whole.

Coopedota’s general management is now promoting these projects among American and European wholesalers visiting the cooperative. In highlighting them, it aims at having Dota coffee recognized not only for quality and gourmet taste, but also by its commitment to continuous improvement and sustainable development of the community.

The key feature highlighted by Coopedota is research and development, which it thinks differentiates Coopedota from other sustainability projects. As an innovative coffee cooperative, Coopedota feels it is a project pioneer as they are setting models in terms of coffee cultivation in

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19 Biological oxygen demand for five days, used to measure the amount of a liquid sample that can be oxidized by biological means. It is useful to find the degree of pollution in the sample.
the country. As a result, they are willing to share knowledge acquired with whoever chooses to come and learn from them.

Hortencia Solís thinks the key challenge of the project is maintaining viability over time and growing the composting and waste handling project in addition to launching the ethanol project in such a way that these can coexist over time. At the same time, to develop a business model in conjunction with the current one employed in coffee production.

The Decision

Hortencia and Roberto are trying to find out whether they can set a framework to define a business model that will be permanent over time. They are considering reinforcing R&D projects with a unit helping continue with these projects while also allowing to sell service resulting from insights gained from projects already implemented.

Based on available evidence, would you recommend them to continue with their projects and promote this new department?

Do you think this model can be replicated and utilized in the future, both in Costa Rica and throughout the region, on the basis of a comprehensive CSR culture? Or rather, is CSR inherent in the cooperative model and thus are cooperatives expected to promote this type of initiatives?

Will the new ethanol project, to enter in operation in the near future, have a financial impact on the program?

Are these projects providing value added for coffee and are they helping maintain current coffee trends?
Exhibit A.0

International Coffee Price Evolution Graph - December 2002 - November 2008

Source: Las principales cifras de la actividad cafetera, Colombia 2008, Bogotá, November 25, 2008, (Red de Información Cafetera.)

Exhibit A.1

Coffee Berry Composition

Exhibit A.2

Coffee Berry Components (% per weight)

- Skin: 4.0%
- Fresh pulp: 42.4%
- Mucilage: 15.0%
- Gold coffee: 18.6%
- Water: 20.0%

Source: Coopedota RL. Engineer Hortencia Solis. R&D Sustainable Project Manager, 2009.

Exhibit A.3

MILLING PROCESS
400 liters of water per fanega

AVERAGE COFFE BERRY HARVEST AMOUNT (16,510.00 kg)

- MUCILAGE: (2,476.500 Kg)
- COFFEE PULP: (7,000.240 Kg)
- GRAIN WATER: (3,302.000 Kg)
- GOLD COFFEE: (3,070.860 Kg)
- SKIN: (660.400 Kg)
- CONVEYOR WATER: (400 L)

Source: Coopedota RL. Engineer Hortencia Solis. R&D Sustainable Project Manager, 2009.

Exhibit A.4 Waste Use - Part I

Coffee processing → Byproducts: coffee shell and water syrups + musaceae → Fermentation process 3 - 4 days → Fermentation distillation → Final products: ethanol & vinasse → Ethanol (Combustion, transport) → VINASSE (Biodigestion, Fertilirrigration)

Source: Coopedota RL. Engineer Hortencia Solis. R&D Sustainable Project Manager, 2009.
**Exhibit A.5 Waste Use - Part II**

Vinasse → Addition of lime to control pH → Biodigestion system → Byproducts:

- Biogas → Combustion
- Wastewater → Fertiirrigation in grazelands
- Retained for 35 days

**Source:** Coopedota RL. Engineer Hortencia Solís. R&D Sustainable Project Manager, 2009.

**Exhibit A.6**

**MILLING PROCESS**

COFFEE BEAN (100%) → TOTAL PULP (36.400M3) + PULP TO MAKE COMPOST (14.560 M3) + PULP TO MAKE LOMBRICOMPOST (21.840 M3) + COMPOST BAGS (87.360) + LOMBRICOMPOST BAGS (131.040)

**Source:** Coopedota RL. Engineer Hortencia Solís. R&D Sustainable Project Manager, 2009.
Exhibit A.7. Coopedota’s Proposed Model to Use Waste

Source: Coopedota RL. Engineer Hortencia Solís. R&D Sustainable Project Manager, 2009.

Source: Coopedota RL. Engineer Hortencia Solis. R&D Sustainable Project Manager, 2009.