

SUSTAINABILITY THAT CAN BE MEASURED: 10 YEARS GENERATING VALUE



FUNDAÇÃO
ESPAÇO ECO

Sustentabilidade que se mede

10 ANOS

Established by:

 **BASF**
We create chemistry



Carlo Ferrer

We create chemistry for a sustainable future – with this purpose, we are proud to be part of people’s lives for 150 years, providing intelligent solutions for an ever-changing society. To make this happen, we have to work together with our stakeholders, giving priority to the long-term economic, environmental, and social benefits. In 2005, BASF established the FEE®, which uses scientific life cycle assessment methods to measure these results and share them with society. By sharing socio-economic efficiency knowledge, the FEE® is contributing to companies so they can assess their indicators and results, supporting managers in their decision-making process and helping society make more sustainable choices.

We are proud to see this strategy materializing in this book with ten successful stories, which demystify sustainability and clearly demonstrate its contribution to a better future.

Ralph Schweens,
BASF President for South America



ARTHUR CALASANS

Sustainability that can be measured: **10 years generating value**



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Acknowledgements

We would like to point out the many achievements accomplished by the Espaço ECO® Foundation throughout our first decade of operations. They would not be possible if it weren't for our partners and clients who, just like ourselves, affirm their commitment to sustainability and drive us to carry on our mission, inspiring us to build an even more promising vision for the future. We cannot go without thanking and mentioning all the organizations the FEE® has provided work for in this past decade: ABAL, Alcoa, BASF, Boticario, Braskem, Cargill, Corn Products, Fibria, Guarani, Grupo Andre Maggi, InpEV, Instituto do PVC, International Paper, Instituto Nacional de Tecnologia Industrial Argentina (INTI), National Cattlemen's Beef Association (NCBA), Pepsico, Quattor, Samarco, Santista, SLC Agrícola, Unimed, Vicunha, Vitopel, Votorantim, Yazigi, and Wenco; and also the agricultural cooperatives Agraria, Batavo, CAMDA, CAPAL, CRPAAA, CAROL, Castrolanda, COACRIS, C. Vale, COCAMAR, COAMO, COCARI, COOPATRIGO, COOPADAP, COOPERCITRUS, COMIGO, COOPSEMA, COPASUL, CAJ, COPLANA, COTRIPAL, COOXUPE, and LAR.

We also highlight the organizations with which the FEE® has developed strategic partnerships or of which we are members: Global Compact Network Brazil, Embrapa, GIZ, Brazilian Business Council for Sustainable Development (CEBDS), Brazilian National Confederation of Agriculture and Livestock (CNA), Administration Institute Foundation (FIA) of the University of São Paulo (USP), Fundação Dom Cabral (FDC), Editora Globo Publisher – Globo Rural Magazine, Ecoadvisor, Roundtable for Sustainable Beef (GTSP), Brazilian Life Cycle Association (ABCV), consulting firm Ideia Sustentavel, DOM Strategy Partners, Geodinâmica, The Nature Conservancy (TNC), the Green Corridor Association of Paraíba Valley (ACEVP), Bonsucro, Delta CO2, Pollution Prevention Group (GP2) – Polytechnic School/USP, Sao Paulo State University (UNESP), Federal University of the ABC Region (UFABC), Sao Paulo State University Foundation (Fundunesp), and Maringa State University (UEM).

Presentation

To celebrate the tenth anniversary of the Espaço ECO® Foundation (FEE®), we decided to publish this book with a selection of ten successful cases we recorded with our clients. These are initiatives that help us make tangible the value created by sustainability in the value chain.

Choosing these cases was not an easy task, as the FEE® has many others accomplishments that could be in here too – so we set criteria to have a representative sample encompassing the many different industries with which we have worked this past decade.

This book is the realization of an ambitious vision BASF had when it established the Espaço ECO® Foundation on June 22nd, 2005. Over these past 10 years, the FEE® has developed projects for more than 20 big companies and 23 agricultural cooperatives. We set partnerships with more than 20 organizations, such as universities, business schools, non-governmental organizations, research centers, and others.

Developed more than 80 Eco-Efficiency and Socio-Eco-Efficiency



ARTHUR CALASANS

Roberto Araújo
of Head at Espaço ECO® Foundation

Analyses, plus other methodologies based on Life Cycle Assessment (LCA). Regarding Mata Viva® Program actions, the FEE® reached out to 95 cities and planted over 1.1 million native seedlings. In the socio-education field, more than 373,000 people were impacted, including +2,000 teachers and 188,000 students at public and private school.

All these achievements could only be possible with the commitment of our clients, suppliers, partners, and also the dedication of an excellence team and engaged professionals.

The cases presented in this book were written by Consulting Firm Ideia Sustentavel, under the coordination of their Chief Executive Officer Ricardo Voltolini, and tell the stories of projects and achievements that are an integral part of our history.

Enjoy your reading!

Roberto Araújo
of Head at Espaço ECO® Foundation

Applied Sustainability Tools and Solutions:

Life Cycle Assessment (LCA)

Life Cycle Assessment (LCA) is a technique to assess environmental impacts, from extraction of natural resources to final product disposal, and can be used, for example, for the following purposes:

- *Product development & improvement;*
- *Strategic planning & public policy making;*
- *Environmental impact management of products & services; and;*
- *Environmentally-responsible marketing.*

In this context, life cycle means the necessary steps to develop or conceive a product or service, make it fulfill their respective role, and then reach the disposing, recycling, or reusing stage. LCA abides by ISO 14040 standards, which describe the iterative phases of Definition of Goal & Scope, Inventory Analysis, Life Cycle Impact Assessment & Interpretation, and can help answer questions such as:

- *Which product has less environmental impact?*
- *How many kilograms of CO_{2eq} are generated to manufacture a product?*
- *Which life cycle stage is more significant in terms of water use?*
- *What is a less polluting energy source?*
- *What materials have less environmental impact?*

Source: Brazilian Life Cycle Association (ABCV).

Eco-Efficiency

Eco-Efficiency is achieved when goods and services are offered at competitive prices, meeting human needs and bringing quality of life while progressively reducing environmental impact and

resource intensity throughout their life cycle at a level at least in line with the Earth's estimated carrying capacity.

Source: WBCSD – World Business Council for Sustainable Development, represented in Brazil by the CEBDS

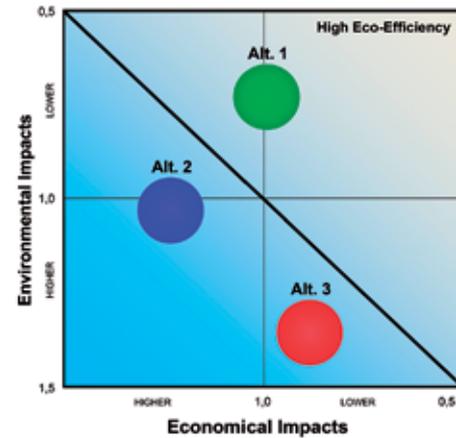
Eco-Efficiency Analysis

A methodology based on Brazilian standards NBR ISO 14040, 14044, and 14045 – Life Cycle Assessment, regarding the economic and environmental aspects of a product, service, or process. These studies have many phases, starting with defining a product's purpose (light, energy generation etc.), and the different premises for each comparative analysis. Then, product data are collected and analyzed, considering life cycle from extraction of the most basic raw material (known as “cradle”) to product use and disposal (also known as “grave”) or recycling (which would be going back to the “cradle” stage). **It is a trailblazing tool that provides consistent information for decision-making processes and investment in new technologies, products or production processes, in addition to creating a competitive edge.**

It is certified by TÜV Rheinland – an independent German technical inspection and certification institute, whose branch in Brazil is TÜV Brasil, where they use regional data and information.

Socio-Eco-Efficiency Analysis (SEEBALANCE®)

It is the most comprehensive sustainability measurement tool for products or processes, as it takes into account – in addition to environmental and economic aspects assessed by the Eco-



Efficiency Analysis – the social aspects involved in the entire life cycle of the alternatives analyzed, thus helping businesses and their supply chains improve social and environmental performance. A Socio-Eco-Efficiency Analysis compares products or processes considering environmental aspects, such as land use, energy consumption, natural resources, water use, and emissions, also including toxicity potential and risks, among other elements. It also analyzes, with the same level of attention, economic indicators such as price, investments, equipment maintenance, and others. Social indicators include salaries and wages, professional training, workplace accidents, occupational diseases, gender equality, toxicity potential for employees and consumers, and others.

This methodology was designed by BASF in 2003-2005, also in Germany, and has been used by the Espaço ECO® Foundation since 2007.

AgBalance™

It is a Socio-Eco-Efficiency Analysis specially performed for agribusiness. It is focused on a broad sustainability analysis throughout the supply chain, where environmental, social, and economic aspects of agribusiness are considered jointly, an approach that sets this methodology apart. For this purpose, 69 indicators, each connected to one of the three sustainability pillars, are assessed with over 200 evaluation factors.

This methodology was designed by BASF and is implemented by the Espaço ECO® Foundation. It is certified by three international agencies: the Germany-based TÜV Süd, the Norwegian company Det Norske Veritas (DNV), and the American National Sanitation Foundation (NSF).



Mata Viva® Education and Environmental Conservancy Program

The Program is a BASF initiative which has been implemented by the Espaço ECO® Foundation since 2007, promoting recovery and restoration of areas of permanent forest preservation (Portuguese acronym APP) and legal forest reserves (LR) in compliance with the Brazilian environmental law and suggesting corrective measures. It targets agribusinesses, universities, research centers, and private companies. It is implemented to support farmers and rural communities in recovering degraded areas and contributes to biodiversity conservation and water resource protection. It also encompasses the social and environmental education front, addressing the subject of sustainability with a playful approach, promoting educational activities for students and teachers at public and private schools.

The Mata Viva® Education and Environmental Conservancy Program has been operating for 30 years and celebrates successful results in 95 cities:

- *Over 2,000 trained teachers*
- *188,000 public and private school students impacted by environmental education actions*
- *Over 1.103 million seedlings planted in partnership with co-ops*
- *More than 668 hectares (1,650 acres) restored*

Additionally, the Mata Viva® Environmental Atlas was published in German for the first time ever in Guarapuava, Paraná State.

Mata Viva® Feature Story

A great example of how successful the Mata Viva® Program has been is its implementation at Coopercitrus, Sao Paulo State's biggest cooperative working with agricultural inputs, machinery, and implements.

This co-op supports and drives its strategy toward sustainability, and just like us, believes in “Education as the only resource that grows when shared.” From this shared value, Coopercitrus, the FEE®, and BASF implemented the Mata Viva® Atlas in the city of Bebedouro, offering teachers a 64-hour training course and educational material specifically customized for local students. We also brought the Mata Viva® Theater to the city, which informs public school students and teachers about sustainability in a playful and fun way. We implemented the Mata Viva® Environmental Education Center (Portuguese acronym NEA), a space that intends to promote constructive processes of social values, knowledge, skills, and attitudes toward environmental conservation and conscious consumerism.



POLLINATOR & AVIFAUNA BIODIVERSITY ARCHIVE

Another remarkable initiative supported by Coopercitrus is the “Pollinator & Avifauna Biodiversity” survey written in partnership with the Social Insect Study Center of the Biology Department of the Sao Paulo State University (UNESP), and it is one of Brazil's first-ever researches on this topic. It was conducted at 3 farms from co-op members' located in the cities of Araraquara, Nuporanga, and Bebedouro, where patches of degraded forest were restored. With this survey we found over 195 bird species and around 50 bee species, which demonstrates that ecological restoration of native forests contributes to restore fauna and flora species, and also that sustainable farming practices can help intensive farming and environmental conservation coexist in harmony.

Article by Bruno Frizzarin, Environmental Conservation analyst, Taisa Caires, Education for Sustainability consultant, and Tiago Egidio, Environmental Conservation consultant at the FEE®.



Testimonial

“ I have been following BASF and Coopercitrus since they started planning the Mata Viva® Program together, and I'm a fan. This is the kind of program you build with solid partnerships between businesses and institutions over the course of time.

The Mata Viva® was first introduced to us in 2008 as a riparian zone restoration and environmental education program targeting local schools, with a seedling nursery and eco-hike.

The idea included farm diagnosis focusing on Areas of Permanent Forest Preservation set by environmental law, their respective restoration plans, planting and maintenance team training, and the effective planting and monitoring activities.

As time went by, the Mata Viva® Program at Coopercitrus was able to diagnose more than 22,000 hectares [54,300 acres] and plant more than 126,000 native seedlings, and now there is a really nice forest in a 75-hectare [185-acre] area. Part of those seedlings, approximately 7,000 of them, were planted in a 4.2-hectare [10.3-acre] area at Santa Irene Farm, run by the Abilio Alves Marques Cancer Prevention Foundation, as a carbon offset to compensate for the Unidos da Vila Isabel Samba School and Recreational Society parade in 2013, an initiative by BASF to honor Brazilian farmers at Rio de Janeiro's Carnival.

The Mata Viva® Environmental Education Center (NEA) was established right by our experiment station to engage the local community. Every year teachers get training and support materials there. An education team at Coopercitrus was also trained to welcome local primary and secondary school students and carry out playful educational activities to move them and provide experiences in contact with nature at our eco-hike activity and native seedling nursery.

In 2008 through 2014, we welcomed 10,640 students from 166 schools and 13 cities at the NEA Coopercitrus, and 479 teachers were trained and visited our program as well.

The city welcomed the Mata Viva® Theater, an environmental education project with theater performances about environmental awareness and preservation targeting children and youth. Over 2,000 local public school students aged 6 to 12 watched plays that addressed topics such as water use, energy conservation, and recycling.

Another education initiative carried out in partnership with the FEE®, BASF, and the City administration as part of the Mata Viva® Program was the Bebedouro Environmental Atlas. It gathers geographical, environmental, historical, and cultural information about Bebedouro and makes life easier for local teachers. By 2014 the Environmental Atlas had helped more than 9,000 local students and over 100 schools. A lot of people have been asking for a copy of the Atlas, as it is really good material to work with children from 7 to 70. It is very well-written and easy to read, and tells, among other stories, how the city came to be, the reason why it has its name (“bebedouro” means “drinking fountain” in Portuguese), and also current affairs, such as global warming, water cycle, waste disposal and recycling, and others.

Coopercitrus has been nurturing a relationship with the Espaço ECO® Foundation for 7 of our 10 years of life. Over this period, we have shared so much knowledge and impacted a lot of people, promoting social and environmental responsibility actions. ”



COOPERCITRUS

João Pedro Matta
Deputy Chairman of
the COOPERCITRUS
Board of Directors



Evolution of sustainability practices at paint and varnish production site over the years



YVES SAINT-JUNIPER

“ One of the great merits of the partnership with the Espaço ECO® Foundation was our employees’ engagement with the company’s sustainability goals. ”

Antônio Carlos Lacerda

*Functional Solutions
Senior VP at BASF for
South America*

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Presentation

After conducting Eco-Efficiency Analysis for several Brazilian and foreign businesses, the Espaço ECO® Foundation accepted BASF¹'s challenge to accomplish something absolutely new: an Eco-Efficiency Analysis for an entire factory at Demarchi's production site in Sao Bernardo do Campo (SP), where the German multinational company manufactures paints, varnishes, and resins. The pioneering Organizational LCA study, acknowledged by the UNEP (United Nations Environment Programme) as a successful case (a 'First Mover' story), assessed the plant's environmental and economic impacts and developed sustainability education work with employees and their families.

Challenge

To assess the social, economic, and environmental impacts of manufacturing one ton of products (mostly paints and varnishes), aiming to come up with continuous improvement opportunities, and spread the word about sustainability among employees. The initiative compared production site indicators in 2010, 2011, and 2012².

Solution & tools

Named Demarchi + Ecoeficiente³ ("A More Eco-Efficient Demarchi"), the project conducted by the Espaço ECO® Foundation's Education for Sustainability and Socio-Eco-Efficiency areas intends to help BASF's production site in São Bernardo do Campo become more eco-efficient, in addition to engage its internal audience and their families to adopt more sustainable practices in their

daily lives, creating interactions in a quest for better results. The Espaço ECO® Foundation set four major guidelines for the Demarchi + Ecoeficiente Program: environmental and economic impact analysis from the standpoint of eco-efficiency, continuous improvement, definition of performance indicators, and team development. The goal is to be able to replicate the program afterwards at other production sites.

Regarding eco-efficiency, our work started with a survey regarding the impacts of Demarchi's production site in terms of land use, accident hazards, products' toxicity levels, emissions, and consumption of natural resources and energy. With this information in hand, we identified trailblazing solutions that would be able to improve the production site's performance, leading to financial benefits as well, reducing costs and optimizing processes.

In the field of education for sustainability, our work's goal was to spread knowledge about sustainable development and engage employees and their families, building social and environmental values, raising awareness of efficient use of natural resources, and promoting more insightful decision-making. The production site's 1,200 employees attended 86 workshops from February 2012 through January 2014, which addressed subjects such as sustainability, products' life cycle, eco-efficiency, and related topics.

Based on Unesco's definitions of Education for Sustainable Development⁴, the Demarchi + Ecoeficiente Program promoted experiential activities to help sustainable values really sink in. Participants were introduced to the topic (being moved by it) and then put major concepts conveyed into practice (Awareness). For the next step, they formed groups to discuss action plans that could be

¹ | BASF is one of the biggest companies in the world. Based in Ludwigshafen, Germany, it operates in the chemical industry, with production site in 39 countries and clients in over 170 nations. Its portfolio comprehends 8,000 products for the agricultural, nutrition, chemical, plastic, and oil and gas industries. ² | This survey is ongoing, as we analyze 2013 and 2014 indicators and expect to deliver them in the second half of 2015. ³ | The Exame Magazine 2014 Sustainability Guide considered it a reference.

⁴ | In December, 2002, the UN defined 2005-2014 as the UN Decade of Education for Sustainable Development (UNDESD). This initiative aimed to encourage improvement in education quality; review of teaching programs; boost technical and professional qualification; and move as much people as possible on the concept of sustainable development.

put into action in the company's everyday activities and also at their own homes (Training). Finally, they were encouraged to adopt more sustainable habits (Innovation).

As part of the awareness-raising activities, we organized a team-building exercise called Measuring Eco-Efficiency In Real Life, to map the environmental impacts of employees' homes. Gathered in groups, participants reported their ecological footprint⁵ in practice by filling out a spreadsheet with information regarding their electric bills (energy consumption), water bill (water resources), the distance in kilometers between their homes and BASF (land use), how many garbage bags are consumed in a week (total emissions), cleaning supply consumption (alcohols, toilet paper, and detergents), and possible household accidents (risk potential). By the end of the activity, the group with the best eco-efficiency score won the game and a visit to São Paulo's Catavento Museum and Municipal Market, two major tourist attractions in the city.

Concurrently, we set up 150 More Eco-efficient Minutes, with discussions about many different aspects of sustainability in the workplace to help make the subject part of employees' daily lives.

Results achieved with the team-building activity (education module), as well as the production site's results, were made public so that employees could assess their knowledge on sustainability, their responsibilities and impacts.

After the project was completed, all employees who participated in the training received a question sheet to find out how each of them internalized the topics of sustainability and eco-efficiency.

Results

Investing more in more eco-efficiency processes has resulted in better environmental indicators in 2010 through 2012. One of the aspects analyzed is energy consumption: in the entire life cycle, it dropped 1,105.97 megajoules for each tonne of product (equivalent to one year's estimated energy consumption of approximately 42,600 households), reducing 21,991.71 tonnes CO_{2eq} (equivalent to a 14-tonne truck's emissions driving 414 times around the Earth).

Most environmental indicators recorded dramatic changes. One of the most relevant ones was natural gas consumption, which dropped 18% in 2012 over 2010. Moreover, we recorded cost reductions regarding shipments of industrial waste to landfill (16%) as the volume of waste reduced as well (7.7%). Nevertheless, water consumption increased 9% at the production site in the period.

The survey also found that despite energy efficiency gains, production costs were up 4%. One of the reasons for that is the imported inputs purchased by the factory, which are subject to currency fluctuations. Furthermore, there was a shortage of essential raw material in the market, such as titanium dioxide, while demand increased in 2012, leading costs to rise.

Another relevant eco-efficiency analysis input is regarding loss reduction and raw material reuse, which by the end of the process are very beneficial in and out of the supply chain.

Based on the information the eco-efficiency study gathered, Demarchi's pro-

⁵ | Ecological footprint is the impact of human activities (commerce, industry, agriculture, transportation, consumption) on the environment. The bigger an activity's ecological footprint, the greater the damage caused to the environment (Source: WWF).

duction site was able to simulate scenarios and define more accurate ways to pursue goals and improvements regarding its processes:

- Reducing natural gas consumption by approximately 6% after setting up an economizer in the steam-producing boiler to improve energy efficiency;
- Reducing titanium dioxide and aluminum silicate consumption by optimizing and reusing the production process;
- Reducing greenhouse gas emissions by improving raw material logistics.

Education for sustainability actions carried out with Demarchi employees also led to very impressive results. Through our workshops we were able to gather improvement suggestions both for the factory and workers' homes. Moreover, polls conducted with employees on-site showed 75% of surveyed employees had assimilated sustainability concepts, goals, and the importance of the Demarchi + Ecoeficiente Program.

In 2015, BASF's production site has been developing the Aterro Zero ("Zero Landfill") program under the Demarchi + Ecoeficiente umbrella, a decision made by the company's high ranks. This initiative aims to reduce wastes shipped to the local landfill, and for that purpose, it proposes more appropriate disposal and changes in employee behavior.

Article by Camila Honório, Education for Sustainability consultant, and Max Silva, Socio-Eco-Efficiency analyst at the FEE®



The Espaço ECO® Foundation plays an important role, sharing the tools that allow measuring businesses' sustainability indicators with the market, and pointing out ways to improve their processes. Very inclusively, BASF wanted to share this knowledge with its partners, competitors, and society as a whole.

Testimonial

Our experience with the Espaço ECO® Foundation started in 2010. We've always discussed eco-efficiency concepts internally, and eventually it was time to measure our own indicators with an external perspective. That was when we launched the Demarchi + Ecoeficiente project at our São Bernardo do Campo production site. As indicators improved, we proved our perception right, demonstrating that our factory has low environmental impact, despite operating in a very sensitive industry such as the chemical industry.

One of our most important eco-efficiency analysis results is regarding our annual waste generation at the plant. The goal is to reuse 30% of all waste produced at that facility. We have ongoing conversations with our supplies to find opportunities to improve the assembly line and further reduce our impact. According to the survey, there is a possibility we could reuse up to 60% of our total waste.

One of the great merits of our partnership with the Espaço ECO® Foundation was to engage our employees with the company's sustainability goals. Now they know how much energy and water we use, how much waste we generate, and how much CO_{2eq} we emit for each tonne of product we manufacture. So now everyone is committed to our goals and knows what to do to reduce the ecological footprint in their operational areas.

In 2015, we are developing a three-year plan aiming to set long-term impact reduction strategies throughout our supply chain. In May this year, the Brazilian National Environment Council (Portuguese acronym CONAMA) updated its Resolution 307/2002, according to which paint packaging is no longer considered toxic and can now be recycled. It is a change that gives us the opportunity to do a great job in structuring this chain with informal waste collectors and recyclers, in order to reinsert packages in the industrial processes and turn them into reinforcing steel bars used in beam and column structures, which are later filled with concrete. ”

**Antônio Carlos
Lacerda**

*Functional Solutions
Senior VP at BASF for
South America*



ARTHUR CALASANS

Using Eco-Efficiency in decision-making



BRASKEM ARCHIVE



“We have carried out 12 different studies with the Espaço ECO® Foundation so far, addressing, among others, the eco-efficiency of plastic bags, packless pallets (made from plastic resin), and green polyethylene. They made us think about how relevant a life cycle analysis is to manufacture our products.”

Jorge Soto

*Sustainable Development Director
at Braskem*

Braskem

Presentation

In 2005, Braskem¹ formed its first great partnership with the Espaço ECO® Foundation. In 10 years of this relationship, the two organizations carried out projects with extremely relevant results for both the company and society regarding environmental, social, and economic impacts of the many different materials that are part of people's everyday lives.

A work that stands out here is the analysis of plastic bags consumers use to carry their groceries and shopping items from major supermarket chains, encompassing the period between July, 2009, and April, 2011. This unprecedented study compared two types of bags: disposable bags made from resins such as traditional polyethylene (PE), green PE, and PE with oxo-degradable additive, and reusable bags, also known as "eco-bags," made of different materials (paper, nonwoven fabric, traditional polyethylene, fabric, and raffia cloth).

This partnership also delivered a research on pallets, storage-packaging structures used in distribution logistics, in which we compared pallets made of plastic resins (packless) and wood.

Moreover, we conducted an important study (2010-2012) on the eco-efficiency of polyethylene, aiming to compare, with environmental, social, and economic criteria, the performance of resins made from petroleum (naphtha) and sugarcane ethanol, both developed by Braskem.

Challenge

To analyze the life cycle of three groups of products – plastic and reusable bags, pallets (packless and wooden pallets), and polyethylene (from petroleum and renewable resource) -, aiming to assess impacts of their production and use. Such assessment is used to inform the company regarding its business decisions and support consumers toward better choices in terms of sustainable use of materials.

Solution & tools

The Espaço ECO® Foundation conducted a thorough polyethylene (PE) life cycle assessment for each of its use in plastic bags and pallets for packaging.

Our green PE study considered impacts from cradle – consumptions for sugarcane crops – to the industrial process of turning it into resin to final manufacture of the product (PE pellet). As for naphtha-based PE, the analysis considered data from extraction of petroleum to the industrial phase.

As what regards to plastic bag, its assessment was based on different aspects of production and consumers' use, such as materials used to manufacture the bags, its production costs, reusability and recyclability, and weight-holding capacity.

Based on this overview, Espaço ECO® Foundation proposed scenarios in which one would be able to identify which bags have the least impact according to

¹ | Petrochemical company Braskem has 36 industrial facilities (29 in Brazil, 5 in the United States, and 2 in Germany) and offices and commercial centers across the Americas, Europe, and Asia. It produces thermoplastic resins, such as polypropylene (PP), polyethylene (PE), and polyvinyl chloride (PVC), as well as basic chemical inputs, such as ethylene, propene, butadiene, chlorine/soda, and solvents. Additionally, it has a sugarcane-based product portfolio, including ethylene and green polyethylene.

different elements, i.e. trips to the supermarket, volume of items carried, and frequency of household waste disposal, as non-renewable bags are widely used for waste disposal.

On the subject of pallets, the analysis compared the eco-efficiency of using packless structures (made from PP fabric and sheets) and wooden pallets manufactured according to the Brazil standard (PBR). Our surveys focused on 3-kg packless structures with load capacity of up to 1,500-kg and 35-kg wooden pallets with load capacity up to 1,400-kg, considering aspects such as transportation, raw material production, and recycling. On average, the service life of both packless packaging and wooden pallets is 12 months, supporting up to five trips in this period. Nevertheless, we noticed each product performed differently in terms of environmental criteria, such as carbon emissions, as we describe below.

Results

Polyethylene (PE)

The Eco-Efficiency Analysis shows green PE as a better option since its environmental performance, especially regarding greenhouse gas emissions. This is due to CO₂ captured from the atmosphere during the sugarcane crop phase. While green PE reduces CO_{2eq} emissions, naphtha products, on the other hand, its production emit CO_{2eq}.

Compared with the naphtha PE supply chain, the renewable PE chain also proved more efficient in terms of toxicity, as it is 85% less toxic. Moreover, the study showed green resin energy consumption is approximately half the consumption of petroleum-based PE.

Notwithstanding, manufacturing the same amount of green PE generates nearly 10 times more solid waste than using naphtha PE.

In terms of land use, green PE production requires arable land for growing sugarcane, and there is the additional social issue of hand-harvest labor-related accidents. Therefore, this is an important aspect to consider in improvement processes. Another analysis' outcome was that Braskem could reassure the important decision to go into the green PE production and marketing business, investing in its Triunfo industrial plant (Rio Grande do Sul State). This way, the company could come up with a conduct code to be adopted by all ethanol suppliers; and also marketing the "I'm Green" badge, conceived to help consumers identify packages made from renewable resins.

Plastic bags

Our plastic bag eco-efficiency study concluded each bag's environmental performance depends on different consumer habits. Espaço ECO® Foundation researchers analyzed the life cycle of eight bag options available in the Brazilian market, considering a one-year period of use. The number of trips consumers make to the supermarket, how many times they dispose their garbage in plastic bags, and how many items they buy will define which bag is more efficient for them from an environmental point of view.

According to these criteria, bags having the least impact are reusable polyethylene bags – considering a one-month base scenario encompassing 160-kg worth of shopping items with four trips to the supermarket and four waste disposals. It is the most eco-efficient option in terms of photochemical formation of ozone and solid waste. However, disposable green polyethylene bags had the best results when it

comes to energy consumption, therefore having less impact on natural resources.

To simulate consumer behavior and carry out a sustainability assessment for each bag, we designed different scenarios, varying the number of trips to the store and the number of bags used to dispose waste in one month.

In short, consumers' shopping and disposal habits determine bag performance. When few bags are used (for example, when consumers make few trips to the store), the best option is using disposable bags, of which green PE bags have the least impact. When consumption habits are more intense, reusable plastic bags will be better alternatives, as they are more durable.

Pallets

Our research found reusing pallets improves eco-efficiency performance in all environmental indicators. The wooden alternative's environmental performance was worse according to our analysis. Regarding CO₂_{eq} emissions, using wooden pallets may have nearly 10 times more impact than plastic. We notice a similar situation for emissions that can potentially cause acid rain, in which the latter represents just an eighth of the former's emissions. This is also the case when we look at life-cycle energy demands, an indicator three times higher for wooden pallets.

Therefore, according to our life cycle analysis, the only pro of using wooden pallets is the money saving aspect, as it is a little less expensive than the packless alternative.

Article by Rafael Viñas, Socio-Eco-Efficiency analyst at FEE®



We have been conducting life cycle assessment since 2005 to better understand the many different impacts within our supply chain. This way we are able to see which of them are good for society and to which we should pay closer attention.

Testimonial

We have carried out 12 different studies with the Espaço ECO® Foundation so far, addressing, among others, the eco-efficiency of plastic bags, packless pallets (made from plastic resin), and green polyethylene. They made us think about how relevant a life cycle assessment is to manufacture our products. Then we started to think about which of them could better meet society's needs, so we started a survey on the impact of consumer habits.

This work helped us exercise an advocacy strategy for plastic, especially products such as plastic bags and paint cans. Our studies have helped us define a message to the market regarding the environmental benefits of using plastic – a way to make it clear and expand public knowledge on the topic.

When people who are critical about plastic read these researches, their response became less intransigent, and they minimized their attacks and started to look at these products with more friendly eyes.



With what we have learned from these studies, Braskem has decided to put effort into 10 topics with long-term goals to achieve by 2020. They are: Safety; Financial & economic results; Post-consumption; Renewable resources; Water efficiency; Climate change; Energy efficiency; Local development; Solution development; and Reinforcing practices. Our main goal? To make sustainability a decision driver. It is undoubtedly a big challenge, as the market sometimes will not acknowledge this effort.

BASF and Braskem are very committed and want to have an influence in public policy. As companies, they know there is always room to move forward in social-environmental matters. However, our great challenge today is how to expand this movement. There must be government incentives. For instance, by the Brazilian federal sustainable procurement policy, the government should procure suppliers with social-environmental concerns and solutions, but that is not enough when you think of Brazilian potential to innovate toward sustainability. This policy should have a more scientific approach to life cycle, following suit of the Espaço ECO® Foundation and the Brazilian Life Cycle Association, linked with the University of Sao Paulo. As a new ISO standard for sustainable procurement is being discussed (ISO 20400, now being developed, in which I am co-chair) to support businesses in incorporating social-environmental

matters to their purchasing processes, life cycle should be considered when procuring products.

Overall, now a days, consumers are making their buying decisions based on product quality and price. The perfect scenario would be if they had access to sustainability indicators for each item as they shop. In the future, hopefully, they will be able to access these data via barcode-based information systems, helping them make more informed, conscious decisions. Today this may seem like a scene from a perfect world, but with technological development, it won't be hard to get there. ”

Jorge Soto
Sustainable
Development
Director at
Braskem



BRASKEM ARCHIVE

Sustainability in the coffee supply chain: from cradle to the Port of Santos



COOXUPÉ ARCHIVE

“ Our partnership with Espaço ECO® Foundation brings out our values and philosophy, to be a responsible cooperative where we operate and with the communities with which we have a relationship. ”

Carlos Paulino

*Cooxupé
President*



Presentation

Not only does Minas Gerais State have some of the best coffees in Brazil, it is also home of Cooxupé¹, the world's biggest coffee farmers cooperative, with more than 11,000 members. Based in the Southern part of the state, the co-op exports to over 40 countries, and since 2009, carries out the Mata Viva[®] Environmental Education and Conservancy Program in partnership with the Espaço ECO[®] Foundation. In 2013, it also undertook a sustainability study on the coffee supply chain, aiming to measure and assess its product's socio-eco-efficiency throughout its life cycle, looking at each step from extraction of natural resources and production of inputs to coffee exports from the Port of Santos.

Challenge

To assess the environmental, social, and economic impacts of coffee production during the 2012/2013 crop in two areas of the state – Cerrado and South Minas –, encompassing three production settings: non-mechanized, mechanized, and mechanized irrigation. Also, to compare the sustainable evolution of industrial processing in four years (2008, 2010, 2012, 2013).

Solution & tools

We used the AgBalance[™] tool to assess socio-eco-efficiency from cradle (extraction of natural resources) to the Port of Santos. For each area analyzed, we gathered production data from farms according to their dimensions: small (3-20 ha ≈ 7.4-49 acres), medium (21-50 ha ≈ 50-120 acres), and large (+50 ha ≈ +121 acres). We divided this Life Cycle Assessment-based study in two parts: on-farm and post-

farm phases. The former looked into the production process of one 60-kg coffee bag from extraction of natural resources (for crop inputs) to farming practices and picking in the 2012/2013 crop year. The second part analyzed coffee transport from the farms to Cooxupé's industrial facilities, product processing, and transportation (for export shipments) to the Port of Santos.

This work was based on a production system sample from 15 farms in the cities of Guaxupe, Rio Paranaíba and Monte Santo de Minas. Of all coffee Cooxupé received from its members during the 2012/2013 crop, 56% came from mechanized farms in the South; 10% from the non-mechanized farms in the South; and 34% from irrigation farms in the Cerrado. It is noteworthy that over 96.8% of Cooxupé's members are micro or small producers.

Results

1) On-farm phase

One of the most important things the study pointed out is that around 90% of environmental impacts happen during the on-farm phase when we consider the entire scope of analysis (from cradle to the Port of Santos). Results point to a direct correlation between coffee crop productivity gains and sustainability performance improvements (a concept defined, in this case, as being able to produce more coffee by hectare using less resources/inputs per bag).

From the information collected at the farms, we were able to establish an initial database to keep assessing crop sustainability for the next crop years and to pursue continuous improvement; for instance, optimizing the consumption of material

¹ | Cooxupé (Cooperativa Regional de Cafeicultores em Guaxupé Ltda. – the Regional Coffee Growers Cooperative in Guaxupe Ltd.) was Brazil's top coffee exporter in 2014, recording R\$ 3.2 million bags (11% of Brazil's total coffee export records that year). In 2013, it invested R\$18 million in coffee roasting and preparation and managed to go from 300 t to 500 t by shift.

inputs, such as fertilizers, agrochemicals, limestone, water, and energy (diesel and electricity).

When we compare the three production settings (non-mechanized, mechanized, and irrigated farming), some specificities become clear, such as higher water use in irrigated crops. Rain fed production settings use no more than 200 liters per bag (water use from rainfall not included), while irrigated crops used over 600 liters. On the other hand, we noticed that non-irrigated areas are less productive and need more land area to produce one coffee bag.

2) Post-farm phase (Japy Complex included)

This phase consists of bean transportation from farm to industrial plant, processing, and later shipment to the Port of Santos. “Bulk” logistics – in which jute bags are replaced with big bags, made from polypropylene, a recyclable polymer –, already a reality for commodities such as corn and soybean, were recently implemented by Cooxupe, bringing economic, social, and environmental benefits to the coffee supply chain.

We were able to measure these sustainability improvements in the post-farm phase with the AgBalance™ management tool, in which we highlight the Guaxupe-based Japy Complex implementation, and identified opportunities for future improvements. Japy facilities are ready to receive coffee in bulks since 2011, where it is piled up in bags, thus contributing to expand their storage capacity and “gate-out” logistics.

In terms of environmental impacts, the most substantial contribution was related

to jute bag production and use. Replacing them with big bags and selling in bulks instead led to significantly lower indicators, and consequently performance improvements. In 2013 over 2008, we highlight reduced energy consumption (down 48 megajoules/bag) and global warming potential (down 0.4 kg CO_{2eq}/bag).

Our study also made it clear that there is a trend in reducing impacts per processed bag, supporting improvement actions taken over the past few years, in which bulk logistics optimization stands out.

To grasp the importance of these results, when we consider all coffee prepared in 2013 (approximately 4.8 million bags), the industry’s electric energy-saving improvements over 2008 are equal to one year’s energy consumption of 34,500 households. In terms of CO₂ emissions, these saving efforts are like saving 1,850 14-t trucks the trip from Guaxupe to the Port of Santos and back.

With respect to social impacts, more automation in coffee processing and bulk transportation processes have been contributing to improve workforce qualification and reduce risks associated with handling 60-kg coffee bags, such as ergonomic injuries and accidents when manufacturing traditional jute bags.

There are coffee tastings for all their production, which is then classified by size, weight, color, and other parameters. Cooxupe’s tasting team at their classification lab tastes 4,000 cups of coffee a day, a performance that allows them to ensure excellent quality control and more accurate adjustments to their blend² catalogue, which is very diversified, both in terms of flavors and prices. Therefore, building the Japy Complex proved an excellent decision by Cooxupe, because it is a more automated, eco-efficient processing system.

² | According to the Brazilian Coffee Industry Association, the perfect “blend” is just the exact combination of Robusta and Arabica beans, as to get a coffee powder with color and flavor patterns generally accepted by the market. Additionally, as Robusta and Arabica varieties have different prices, this will also influence end-product costs.

Recommendations

As we realize sustainability is a never-ending journey, sustainability management tools will help managers sort out priorities and make better decisions. AgBalance™ is one of these tools, so we summarized improvement recommendations, both for the on-farm and post-farm phases, as follows.

1) On-farm phase:

- *Collect information from more farms (focused on major sustainability indicators), for instance, using a field notebook, aiming to expand a database and have more sustainable farming practices replicated faster by offering producers technical support;*
- *Optimize fertilizer use, use denitrification, slow-release fertilizers, and organo-mineral fertilizers;*
- *Promote precision agriculture (technology and innovation to produce more using fewer resources);*
- *Replace traditional irrigation systems with drip irrigation system and rainwater harvesting;*
- *Use renewable energy sources (biodiesel, wind, or solar sources);*
- *Keep encouraging members to fill the Rural Environmental Register (Portuguese acronym CAR) to determine Areas of Permanent Forest Preservation (APPs) and Legal Forest Reserves (LR) within the area where Cooxupe operates, and also support the Environmental Regularization Program (Portuguese acronym PRA) for properties requiring it.*

2) Post-farm phase:

- *Japy Complex: collect data from 2014 and following years to continuously assess the evolution of sustainability indicators and lead to more improvements;*
- *Expand the bulk coffee logistic system, eliminating as much as possible the traditional 60-kg capacity jute bag system;*
- *Consider the possibility of expanding the study to survey coffee consumption, including roasting phase and partnerships with coffee distributors and traders who work with the coffees produced by the co-op;*
- *Optimize the industrial wastewater treatment process in coffee processing (more efficient chemicals).*

Study results encourage Cooxupe to keep working to improve its own processes, aiming at operational excellence and an increasingly more sustainable production. This way, it allows its co-op members to keep adopting best farming practices and certification programs, bolstering Cooxupe's commitment to sustainable agricultural development, not only for its co-op members, but also for local communities where it operates, employees and stakeholders.

Environmental education & conservancy

Regarding our socio-environmental education initiatives, the Mata Viva® Program has moved forward, building the Environmental Education Center (NEA) in 2012 in the Japy Complex surroundings. The construction used sustainable materials, such as certified bricks and wood, solar panels, and polyurethane roof tiles, which reduce energy consumption.

At the NEA, the Espaço ECO® Foundation offered training courses to educational coordinators and engaged over 100 public and private school teachers in the topic of sustainability. In addition to acquiring qualification, they received support materials with content on the topic and examples of practical activities to carry out in the classroom before and after visiting our center. By December, 2014, more than 4,500 fourth- and fifth-year students from Guaxupe and 19 neighboring cities had visited our center and been moved with experiential activities for nature. Two of them stand out: the eco-hike they did inside the NEA, in a recovered Atlantic Forest area with over 80 native species, and a tour of a nursery with over 30,000 seedlings planted with seeds collected in local woods. NEA tours are made in half a shift.

The environmental conservation initiatives undertaken within the Mata Viva® Program in Cooxupe's line of business encompass environmental diagnosis of over 1,400 hectares (3,460 acres) and planting approximately 25,000 native seedlings in a 15-hectare (37-acre) restored area in 3 Minas Gerais cities (Guaxupe, Rio Paranaíba, Monte Santo de Minas).

Article by Eduardo Toshio, Socio-Eco-Efficiency analyst, Luiza Bruscato, Education for Sustainability analyst, Bruno Frizzarin, Environmental Conservation analyst, and Tiago Egydio, Environmental Conservation consultant at FEE®

“ Sustainability is a key demand both from businesses and society. Encouraging and supporting research on the sustainable practices we adopt important initiatives to spread information about what we do, how we do it, and what takes priority.

Testimonial

Farmers are sustainable beings by nature, and carrying out this activity focused on economic progress, making social and environmental commitments, is a pillar for our Cooxupe management. Our partnership with the Espaço ECO® Foundation brings out our values and philosophy, to be a responsible cooperative where we operate and with the communities with which we have a relationship.

The AgBalance™ analysis bolstered precision agriculture in our members' coffee crops. And the energy saving aspect generated by the Japy Industrial Complex, which is also highlighted in the study, proved our efforts and investments to build the compound very beneficial for coffee production and the environment as well. Another relevant aspect we must highlight is regarding the rational use of fertilizers and agrochem-



icals. It is an aspect we have always worked on with our co-op members, supported by the technical support team.

Our projects with the FEE® add value to our products, and especially our work. One of them is the Environmental Education Center (NEA), established in December, 2013. In one year, it had trained 106 teachers to address environmental topics in the classroom, and welcomed 4,532 students from 27 cities from Southern Minas Gerais, raising awareness of the importance of environmental conservation with educational, interactive activities in nature. The NEA also runs a tree nursery with capacity to house 60,000 native seedlings, and half its capacity is being used right now. This way we are also able to serve our members, who need plants to reforest and restore areas in their properties.

Cooxupe is over 80 years old and has a long history of important fights, accomplishments, and progresses made for coffee production in Brazil. Today our brand is one of the biggest references for the national coffee industry and abroad. And this is because our coffee is in the most important international markets.

The Espaço ECO® Foundation - Cooxupe partnership was formed in 2008. We certainly celebrate our work together, as it allows us to take new actions and proj-

ects which are good not only for the coffee industry, but also for all social actors directly or indirectly connected with our activities.

You can't go back on sustainability. It must be increasingly strengthened and integrated with global demands from the market and society. Businesses that do not respect their local community or environment will not live on now that a sustainable attitude is vital.

Cooxupe counts on our partnership with the Espaço ECO® Foundation to keep developing projects that will be beneficial for society and the environment. We want to preserve, and most of all, contribute to education and respect for others, making sure we are building a better future for the generations to come. ”

Carlos Paulino
Cooxupé President



COOXUPÉ ARCHIVE

Sustainability of integrated systems (iCLF & iCL) to meet the world's growing demand for food and energy



SANTA BRIGIDA FARM ARCHIVE

FEE® ARCHIVE

“ At first, the exchange of information between Espaço ECO® Foundation and Embrapa was very positive for the sugarcane and livestock businesses; nevertheless, it was also absolutely strategic for Brazil's agribusiness in times of Climate Change and multilateral agreements on GHG emission reductions. ”

Celso Vainer Manzatto
 Researcher, Head of the
 Environment Division at Embrapa



Context

Espaço ECO® Foundation has an institutional partnership with Embrapa¹ to promote sustainable agricultural development on three different projects. These projects have in common the fact that they identify and use synergies among scientific methodologies – knowledge developed in the public and private sectors – to measure and assess sustainability in agriculture.

Our work has began with a regional Sugarcane Life Cycle Inventory, which aimed to offer to international databases accurate information on the impacts of sugarcane cultivation in Brazil – expected to be concluded until December, 2016. Subsequently, the AgBalance™ tool, developed by BASF to measure and assess socio-eco-efficiency in agriculture, was compared with Embrapa's tool, APOIA-Novo Rural (Sistema de Avaliação Ponderada de Impacto Ambiental de Atividades do Novo Rural), which assesses sustainability in the country's rural properties.

The third experience consists on a sustainability analysis of integrated (iCLFS and iCLS) and non-integrated systems of crop, livestock and forestry. To develop the analysis, data from integrated systems were collected at Santa Brígida Farm (SBF) in the city of Ipameri, in the state of Goiás and data for traditional systems (non-integrated) were collected from the neighboring farm areas. Besides being one Embrapa's Technological Reference Unit, the SBF was a pioneer in obtaining funds from Brazil's Federal Low Carbon Emissions Agriculture program (ABC).

This study is an FEE® partnership with the environmental engineer and

UNESP master's student Marcela Porto Costa and it was conducted using the AgBalance™ tool. It was also supported by Embrapa, Santa Brígida Farm, BASF, and the Fostering Network for Crop-Livestock-Forest Systems.

The Challenge

In the 1970s, the occupation of the Cerrado region through the expansion of agricultural frontiers and the increasing productivity led to pasture degradation, as well as environmental and economic damage. In this context, sustainable management techniques, in addition to soil and crop management have been developed for the recovery or pasture formation. Some of these techniques are already addressed by the Brazil's Federal Program ABC (Low Carbon Emissions Agriculture), such as the Integrated Crop-Livestock System (iCLS) and the Integrated Crop-Livestock-Forestry System (iCLFS), developed by Embrapa.

One of the challenges faced today by the current agricultural production model is the world's growing demand for food, fibers, and energy. Intensification of food production by traditional methods in Brazil to supply this demand may be associated with negative environmental effects, such as environmental impacts generated by new agricultural frontier openings, overuse of fertilizers, high degree of pasture degradation, among others. Nevertheless, good climate conditions, social and economic incentives, and degraded areas to be recovered are elements that contribute for optimizing Brazilian production models. The integrated systems (iCLS and iCLFS), besides recovering degraded pastures and increasing productivity, also represent an opportunity to contribute to achieve the growing demand for food and energy, without having to open new arable areas.

¹ | Established in 1973, the Brazilian Agricultural Research Corporation (Embrapa) is a world-renowned company providing knowledge and technological solutions for tropical agriculture. With special units located across Brazil and abroad, it operates the many different sectors of agribusiness.

The challenge of the study was to assess and analyze the socio-eco-efficiency in different production models (integrated and non-integrated systems), aimed to produce soya, corn, sorghum, meat and wood enough to achieve the average needs of 500 people in Brazil during seven years.

Solutions & tools

Prior to mid-2005, the main activity at Santa Brígida Farm (SBF), located in the city of Ipameri, at Goiás state, was traditional livestock. In 2006, the farm became a Technological Reference Unit (TRU) of Embrapa and gradually began to recover its degraded pasture by implementing integrated systems. Today, the total degraded area of SBF has already been recovered. In addition to the recovery efforts, the integrated farming systems emerged as an alternative to increase production potential and optimize the use of some natural resources, such as soil. Over a seven-year production cycle, the iCLF system implemented at SBF could produce soybean, corn, meat and wood enough to satisfy both food (animal and human) and energy demands from the market. Another positive aspect is the offer of seasonal and non-seasonal products for the society.

The integration consists of planting forage concurrently with a grain crop (sorghum or corn) through rotation and succession (iCLS) and there is the possibility of planting tree species in spaced lines (iCLFS). The forage and crop residue creates fresh pasture (Figure 1), so farmers can use the land for livestock grazing in the dry season (Figure 3). The forest component provides ther-

mal comfort for the animals improving the weight gain. Also, farmers can supplement their income with forest harvesting (Figure 2).

Figure 1: iCL System (harvesting)

Figure 2: iCLFS (pasture after harvesting + forest)



The AgBalance™ tool, developed by BASF and applied by FEE®, was used to evaluate the most socio-eco-efficient way to produce soybean, corn, sorghum, meat, and wood (biomass for energy) enough to supply the average needs of 500 people in Brazil over 7 years, between 2007 to 2014. The study compared 5 different combinations of systems (integrated and non-integrated) for crop, livestock and forestry production. For each combination, there is a protagonist system, in other words, a system which stood out as the mainstay, due to its substantial contribution to the final product ratio offered to the market.

The main reason for the development of this study was to offer decision making criteria for farmers, who can be able to recover their lands and produce in a better socio-eco-efficient way; policy makers engaged in helping create laws providing incentives for the adoption of those systems; legislators acting on regulations of products available in the market; stakeholders of downstream and upstream processes and researchers who can improve and disseminate the most sustainable techniques around the world. Therefore, the results of this study were strictly conditioned to the economic, social, and environmental aspects of farming production in the Brazilian Cerrado biome context. The results also depended on the physical and chemical conditions of the soils of SBF and traditional farms.

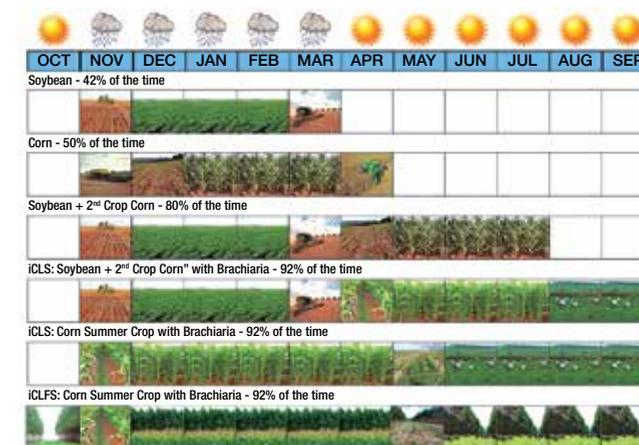


Figure 3: Different kinds of land use under different managements in the city of Ipameri (GO)

Results

The study was conducted from January 2014 until June 2015. Results showed better socio-eco-efficiency when iCLFS followed by iCLS were prioritized in the combinations, regarding achieving the established proportion of food and energy in the period and scope defined.

Compared to the traditional production model, the combination that prioritizes iCLFS followed by iCLS demonstrated better performance for different impact categories, as seen in Table 1.

Category	Benefits
Biodiversity impact due to land use	The most integrated combination satisfies the proposed demand with a direct production area of 69.6 hectares, while the traditional combination requires 419 hectares. Besides the difference of six times less area required, the reduction on biodiversity impact due to land use is 84% throughout the 7-years production cycle.
Atmospheric emissions	The most relevant emission analyzed was CO _{2eq} , a contributor gas to global warming potential. The main sources of emissions come from the fertilizer pre-chain (MgO, CaO, N, K ₂ O), from fertilizer use and enteric emissions from livestock (including emissions from the cow's life cycle, attributed to calves generation). The potential reduction in the comparison is of 55%* (regarding the "cradle-to-gate" approach). * Value for total emissions only, carbon sequestration was not included.
Solid waste emissions	Most solid waste comes from the fertilizers pre-chain (industrial/chemical waste from CaO production, and municipal waste equivalent from P ₂ O ₅). The reduction potential is of 58%.
Cumulative energy demand	The reduction potential is of 59%, mostly related to natural gas and oil used in MgO and CaO pre-chains.

The accumulation of organic matter in the soil has a positive influence on soil and pasture quality, contributing to reduce the average time for the cattle slaughtering, from four to two and a half years (the farm's goal is to achieve two years). Thus, there is less methane emissions from livestock activities – methane is a contributor for global warming potential. In addition to incorporation of organic matter, brachiaria roots reach more than one meter depth, favoring the nutrient cycling process and preventing soil erosion and compaction.



Figure 4: Trenching for analyzing the depth reached by brachiaria roots

The study also points for productivity gains over the years for all crops (soy, corn, sorghum, eucalyptus) and livestock. Corn yield improved from 4,800 kg per hectare to 10,800 kg per hectare. Eucalyptus productivity (increment per individual) is also higher in the iCLF system. Stocking rate and productivity to livestock system at traditional farms are of 0.5 Animal Unit (Animal Unit = 450 kg of Live Weight) per hectare and 2@ (@=15 kg of meat) per hectare; while at Santa Brígida Farm, the values are 3 Animal Unit per hectare and 16@ per hectare respectively. Average daily weight gain for cattle in the iCL system represents 1.2 kg per day.

The social dimension also improves when integrated systems are prioritized. At the farm level, more jobs per hectare are demanded, with higher qualification - since these systems are complex and activities are carried out in the farm during the whole year. Therefore, there is a necessity of investments on family support and professional training insofar as the employees work with different kinds of crop, livestock, and forest activities. The integration systems have flexibility for choosing different combinations among grain, forages and tree species. For this reason, there are always research & development investments in iCLFS and iCLS.

All these aspects increase the attractiveness for internship and trainee programs in

these systems. At Santa Brígida Farm Technological Reference Unit, more than 60 students have been trained so far.

In the context of world's increasing demand for food, fibers, and energy, the iCLFS feasibility is directly associated with the fact that it promotes better land use without requiring the opening of new arable lands, reaching higher productivity and reducing impacts on climate change.

Presently Santa Brígida Farm has implemented integrated systems in all its previous degraded arable land. This study will assist mainly in the promotion of the production model of Santa Brígida Farm, enabling the dissemination of the benefits of integrated systems.

Text elaborated by Sueli Aparecida de Oliveira, Socio-Eco-Efficiency consultant at the FEE®, and Marcela Porto Costa, Master in Environmental Sciences - UNESP-Sorocaba

“ We were firstly engaged in activities with Espaço ECO® Foundation partnership in early 2011, after BASF brought the AgBalance™ to Brazil and began to adapt it to our local reality.

Testimonial

We started a technical cooperation to compare AgBalance™ and the Embrapa-developed sustainability assessment software APOIA-Novo Rural.

Then, we expanded this public-private partnership with the iCLF system (integrated Crop-Livestock-Forestry system). This work has enabled us to have access to BASF's accumulated experience in life cycle analysis, which was very helpful in our efforts to adapt sustainable agriculture indicators for a tropical country, with a production system that is very different from temperate regions, such as the USA and Europe.

Another project that resulted from this cooperation, the sugarcane life cycle assessment aims to establish an accurate database on ethanol production, emissions, and other environmental impacts. The study should be ready by the end of 2016 and it will allow us to compare sugarcane with corn biofuel, for instance. We will go further with this analysis to understand how competitive ethanol is as a renewable source.

We are in the final phase of the project, identifying the many different sugarcane production environments based on 1993-2013 data. The more accurate this information, the better the estimates will be to assess the sustainability of Brazilian ethanol compared with other energy alternatives.

Not long ago, both in Brazil and abroad there were concerns about whether the sugarcane ethanol production expansion in the country could potentially increase deforestation in the Amazon and compete with food production and offer.

So the country's Ministry of Agriculture, Livestock, and Supply commissioned Embrapa to write the sugarcane Agro-ecological Zoning for ethanol and sugar production in Brazil (Portuguese acronym ZAE Cana), which showed there were approximately 64 million hectares (158 million acres) of anthropized area available and potentially suitable for sugarcane production, of which around 37 million hectares were used for grazing.

The ZAE Cana showed the country does not need to incorporate new areas with native coverage into the production process, as it still has place to expand sugarcane crops without directly affecting the lands used for food production. Nevertheless, we still ne-

eded knowledge and information – to confront attacks with scientific arguments – on radiative balance, Greenhouse Gas (GHG) emissions associated with land use change, and a Life Cycle Assessment on sugarcane production in the Center-South of Brazil during its expansion phase (1993-2013). So at first, the exchange of information between Espaço ECO® Foundation and Embrapa was very positive for the sugarcane and livestock businesses; nevertheless, it was also absolutely strategic for Brazilian agribusiness, because we live in times of Climate Change and multilateral agreements on GHG emission reductions.

The BASF-Espaço ECO® Foundation public-private partnership is of strategic importance for Embrapa and the Brazilian agribusiness, conducting Life Cycle Assessments of production systems and providing studies on the sustainability of the country's supply chain.

This successful story represents BASF, the FEE®, and Embrapa's commitment to the sustainability of other Brazilian agribusiness supply chains. ”

**Celso Vainer
Manzatto**

*Researcher,
Head of the
Environment
Division at
Embrapa*



Eco-Efficiency as a management tool in cellulose production



FIBRIA ARCHIVE

FIBRIA ARCHIVE

“ I’m an enthusiast of Espaço ECO® Foundation’s style: they do a consistent, thorough work. I see them as disseminators of innovation and improvement proposals while offering us different paths to follow. ”

Umberto Cinque

General Manager for Industrial Environment at Fibria



Presentation

Espaço ECO® Foundation has been working in partnership with the Votorantim Group¹ since 2005. Eco-efficiency analyses were conducted for different industrial units, Votorantim Papel e Celulose (VCP)², the paper & pulp unit. In 2009, we began conducting eco-efficiency studies for Fibria³ (life cycle analysis of toilet paper made in Germany with cellulose produced by Fibria in Brazil) and Socio-Environmental Education Programs.

Challenge

To assess the environmental and economic performance of cellulose production for later manufacture of toilet paper at Fibria plants in Tres Lagoas, Mato Grosso do Sul; Jacarei, São Paulo; and Aracruz, Espírito Santo. The study intended to follow the process from extraction of natural resources to the manufacture of one tonne of cellulose, the industrial production equivalent to 0.98 tonnes of toilet paper, and finally, product use and final disposal.

Besides the analysis conducted, we also faced the challenge of preventing and mitigating impacts surrounding the plants by means of socio-environmental education programs, with which sustainability-related activities and actions for local development were promoted.

Solutions & tools

Espaço ECO® Foundation used Life Cycle Assessment (LCA) and Eco-Efficiency Analysis to survey each step of the toilet paper life cycle – based on Fibria's 2010 wood and cellulose production data –, compiling an inventory of

consumptions and emissions, assessing potential impacts associated with them, and analyzing improvement opportunities for three production plants: Três Lagoas (MS), Jacarei (SP), and Aracruz (ES).

Based on the results obtained in the analysis, Fibria decided to use the Manager⁴ tool.

The analysis and management tools applied by Espaço ECO® Foundation helped the company being recognized at the Dow Jones Sustainability Index⁵, after evidence that it is continuously improving its social and environmental performance, expanding the value chain analysis.

Regarding the socio-environmental education part of the project, firstly were started the actions at the Tres Lagoas and Jacarei plants, carrying out social and environmental diagnosis studies in the local communities. In 2011, it was established the Partners in Transformation Program in partnership with the Jacarei local government (SP), aiming to promote local development by training leaderships in sustainability-focused shared management. Jacarei neighborhoods Jardim Colonia, Parque Imperial, Bandeira Branca, and Parque Meia Lua were selected based on their proximity to Fibria's plant. The initiative had three steps and involved all the company's stakeholders, i.e. employees, value chain (clients and suppliers), and local residents. At first, interviews with organizations (schools, NGOs, churches, companies) from local neighborhoods were conducted. These talks brought out issues the population identifies as high priority, such as the situation of green areas, education, safety and security, employment, and real estate developments.



FIBRIA ARCHIVE

¹ | The Votorantim Group is a 100% Brazilian company doing business in more than 20 countries in the cement, metals, steel, energy, cellulose, and agro industries. ² | In 2009, Votorantim Celulose e Papel S.A. (VCP) incorporated Aracruz Celulose S.A., creating Fibria. ³ | A world leader in eucalyptus cellulose production, Fibria has installed capacity of 5.25 million tonnes of cellulose per year, with plants in Tres Lagoas, Mato Grosso do Sul; Aracruz, Espírito Santo; Jacarei, São Paulo; and Eunapolis, Bahia, where it runs Veracel in joint venture with Finnish company Stora Enso. In association with Cenibra, it runs the only port specialized in cellulose shipments, the Barra do Riacho Port Terminal, in Espírito Santo State. Operating entirely with forest plantation in the states of Rio Grande do Sul, São Paulo, Minas Gerais, Rio de Janeiro, Espírito Santo, Mato Grosso do Sul, and Bahia, Fibria works with a total forest base of 1.076 million hectares (2.658 million acres), of which 403,000 hectares (995,835 acres) are areas of permanent forest preservation.

⁴ | An online management tool that allows updating process input and output data and viewing eco-efficiency results. It also allows carrying out scenario simulations. ⁵ | The Dow Jones Sustainability Index looks into practices adopted by companies listed on the New York Stock Exchange. Its goal is to provide input to investors who are interested in prioritizing shares from companies with social and environmental responsibility and corporate governance principles.

Working groups were consolidated in the second phase. The 86 people who were initially discussing the program's strategic lines were joined by the 72 members of social innovation labs, setting up a group with more than 150 local leaders.

Finally, in phase three, the program developed practical actions in the neighborhoods, including interventions in public areas.

In Aracruz (ES), it was implemented the Environmental Education Program (EEP) in 2011. In partnership with the city Education and Environment offices, it also carried out actions with many local stakeholders, such as residents' associations, NGOs, fishermen's associations, and schools in the Barra do Riacho neighborhood, in order to strengthen leaderships' commitment to social and environmental matters, encouraging good practices while respecting and bringing back local habits and traditions.

Results

The LCA and Eco-Efficiency Analysis assessed wood production in Fibria's eucalyptus crop areas in Brazil and the manufacture of cellulose in three industrial plants. The following step was to consider a fictional plant in Germany, where toilet paper would be produced, using typical consumption and emissions data regarding this kind of process.

Afterwards, Espaço ECO® Foundation researchers made logistic distribution projections regarding toilet paper use within an average radius of 400-km, including disposal from households to the sewage treatment plant (STP) and sludge treatment by incineration or composting.

The analysis found that the transportation phase is responsible for the major CO₂eq emission within the toilet paper value chain, due to fossil-fuel burning. Regarding this aspect, it was recommended to Fibria the adoption of better practices for its production process, which would reduce CO₂eq emissions at its three plants: 73% in Jacarei, followed by Aracruz with 54%, and Três Lagoas with 52%.

Solid waste generated in the cellulose production process are the most representative ones; among them we can highlight barks, dregs and grits (inorganic solid waste) and sludge. Regarding the manufacture of toilet paper, the study considered the sludge of the plant's own STP which incineration allows energy generation and at the final disposal stage, it was considered sludge incineration or solid waste valorization through composting process.

As for the consumption of natural resources, the main negative impact was recorded at the manufacture of toilet paper, due to lignite consumption (brown coal), used for energy production in Germany.

Regarding economic aspects, the Três Lagoas plant obtained the best operational efficiency rates, while the Jacarei plant showed the highest total production costs, due to eucalyptus harvesting costs (1.5 times higher than the other mills) and road transportation costs, in addition to cellulose production.

Lastly, Partners in Transformation Program results are remarkable, in which 90 interviews were conducted to detect local communities' expectations, with a positive impact on 22,000 people. This action encouraged initiatives spearheaded by local community leaderships, such as the Guerreiros do Império ("Warriors of the Empire"), a group of local young residents from the Imperial

neighborhood dedicated to sports, which expanded during the program and became an association. At its final stage, the Program carried out practical actions, such as collective efforts, green revitalization, and civic engagement projects, with movie screenings, talks, courses, and a neighborhood newspaper conceived and published by local residents.

The Environmental Education Program in Aracruz engaged residents from the Barra do Riacho neighborhood, helped establish and consolidate a cross-functional neighborhood management group, and raised more awareness, encouraging critical thinking and improving community environment. Local leaderships conceived and developed many different initiatives, from organizing a soccer tournament and arts and crafts courses with recycled material to urban intervention (such as setting up waste containers at specific locations) and offering a Continuous Improvement Course in Environmental Education and Sustainability to local teachers who work in the municipal school system.

Article by Juliana Silva, Socio-Eco-Efficiency manager; Luiza Bruscato, Education for Sustainability analyst; and Nathaly Jo, Socio-Eco-Efficiency analyst at the FEE®



Our relationship with Espaço ECO® Foundation goes back a long way. We have a history of partnership, knowledge sharing, and joint effort to build solutions since our first eco-efficiency analysis in 2005.

Testimonial

One of our challenges was to deal with the odors at our plants so we wouldn't disturb the local population. Our response to this issue is to invest continuously in technologies and corrective measures. Another strategy suggested by the FEE® was to find, through the Environmental Education Program, people in local communities who were familiar with how the company works and how we handle the issue.



These opinion formers could more effectively convey, using their own words, what goes on at our plant to people from their local communities. The mission assigned to these agents was to explain what they would see at the plants to their fellow neighbors and propose suggestions and recommendations to Fibria. Having this in mind, we conceived the eco-agent.

It is a dynamic process: in the rainy season, when we face the worst atmospheric dispersion conditions, eco-agents prepare themselves to talk to local families and help us with the prevention work.

“I’m an enthusiast of Espaço ECO® Foundation’s style: they do a consistent, thorough work. I see them as disseminators of innovation and improvement proposals while offering us different paths to follow.” One alternative Fibria is considering, for instance, is the socio-eco-effi-



FIBRIA ARCHIVE

ciency assessment, SEEBALANCE®. However, right now we are focused on working with the Manager indicator monitoring tool.

After our eco-efficiency analysis, we changed processes at our bleach plant in Aracruz, Espírito Santo, which helped reduce environmental impacts, including water use.

As a result we are reaping the good fruits, such as a high score in the Dow Jones Sustainability Index. This work boosted results in our voluntary commitment along with stakeholders and we were acknowledged for that. ”

Umberto Cinque
General Manager for
Industrial Environment
at Fibria



ARTHUR GALASANS

Eco-efficiency of the reverse logistics system for empty agrochemical containers in Brazil



INPEV ARCHIVE

DIEGO CURIY

“The life cycle studies carried out by Espaço ECO® Foundation can contribute both with information showing the benefits of responsible post-consumer waste management and the eco-efficiency assessment of products that use recycled raw material.”

João Cesar Rando
inpEV President

Introduction

According to ANDEF (the National Association for Vegetal Protection), before 1999 most empty agrochemical containers were improperly disposed of in Brazil. This practice exerted negative impact on the environment and posed risks to people's health. This scenario started to change in 2000, after Federal Law No. 9974/00 came into force, regulating the final disposal of empty agrochemical containers and defining shared responsibilities among farmers, industries, distribution channels, and the government.

Anticipating this movement and conducting researches to find better alternatives to create a reverse logistics program for empty containers since 1992, the crop protection industry entered into partnerships to support lawmakers in writing the bill containing regulations for the final disposal of empty crop protection containers in Brazil. This concerted work involving the many links of the agribusiness supply chain resulted in the establishment of the Campo Limpo System (SCL), run by the Brazilian National Institute for Processing Empty Containers¹ (inpEV).

Approximately 1,500 direct jobs were created as a result of the SCL. By the end of 2014, there were 415 container receiving units located across 25 states and the Federal District – 113 centers and 302 stations.

In 13 years of SCL operations, they collected over 320,000 tons of empty containers, putting Brazil at the top in this business, promoting the environmentally correct disposal of 94% of plastic primary packaging (in immediate contact with the product) and boasting a 91% recycling rate. Its work is regarded as a benchmark

¹ | The Brazilian National Institute for Processing Empty Containers (inpEV) is a nonprofit organization with over 100 member companies, and is dedicated to promoting proper post-consumer destination of empty crop protection containers throughout Brazil. inpEV was established in December, 2001, and is based in Sao Paulo.

for reverse logistics by acclaimed Getulio Vargas Foundation's Agroanalysis. Not only does inpEV handles most empty post-consumer containers in a major agribusiness industry, it stands out for how it manages the waste it collects as well.

Education & governance

According to the Brazilian Institute of Geography and Statistics (IBGE), Brazil has 5.1 million farms, 27% of which using crop protection products. One of the main works carried out at the SCL is educating farmers on empty container preparation (triple rinsing or pressure cleaning when preparing the spray mixture) before taking them to a receiving site. In addition to the fixed receiving sites, they have Mobile Receiving Units (MRUs), which improves the access for small and medium producers whose farms are located in areas where they don't have a structured supply chain. In 2014, the SCL promoted 4,800 MRUs. Also, aiming to optimize the process, they developed the Empty Container Return Scheduling (adEV), an online tool that provides the farmers with another option to schedule the return.

The Brazilian National Clean Countryside Day was created in 2005 to celebrate SCL's impressive results. Every year on August 18th, the day is cele-



brated throughout the country. From 2005 to 2014, more than 1 million people joined this initiative.

inpEV has also developed the Campo Limpo Environmental Education Program, which impacted 1,572 schools around the receiving centers and stations in 2014, reaching out to farmers' children and the general population about the life cycle of containers they find in their everyday lives. Educational kits were handed out to 157,000 fourth and fifth grade public school students in 21 Brazilian states.

In 2014, 91% of all containers were recycled – and the rest was incinerated –, summing up to 42,646 tonnes. They are processed at the receiving sites and then sent to licensed recycling centers, which make 17 different products out of them, all through controlled recycling process.

The Campo Limpo Reciclagem e Transformação de Plásticos S.A. (Clean Countryside Plastic Recycling and Transformation Co.) was established in 2008, and it makes post-consumer resins that will then be used in the manufacture of plastic containers for the industry, closing the loop in the crop protection container supply chain. The Campo Limpo is a unique experience in the world; it has integrated 30 stockholders manufacturing crop protection chemicals and was conceived based on eco-efficiency concepts to minimize environmental impacts, with rainwater reuse and solar energy systems.

The SCL is entirely funded by the manufacturing industry, distribution channels, and farmers, each part with their share of responsibility. In 2014, the System was able to cover around 30% of its own costs, thanks to initiatives for capturing value generated within the system, in which it set up partnerships with several

recycling companies. Also, it closed the loop of crop protection container management within the value chain, manufacturing containers for the industry itself.

Challenge

inpEV commissioned the Espaço ECO® Foundation to measure and assess the eco-efficiency of the Campo Limpo System, comparing scenarios of environmental impacts caused by a process “with” reverse logistics and “without” reverse logistics (called ‘non-mechanism’), by burning, burying, uncontrolled recycling, or using for other purposes.

We also compared the eco-efficiency of manufacturing the Ecoplástica Triex® – the world’s first crop protection container made from recycled resin to achieve UN certification (for transportation of hazardous products by land and sea) – with a traditional 20-liter virgin plastic container.

Solution & tools

Our work began in 2007, using the SEEBALANCE® tool to conduct the comparisons. Since then, the Espaço ECO® Foundation has been using the Eco-Efficiency Analysis tool to update data on the environmental and economic impacts of the entire container post-consumer destination process between 2002 and 2014².

Results

Investments in the Campo Limpo System between 2002-2014 were as high as R\$900 million, allocated among items such as infrastructure, receiving sites,

² | We updated data with the Manager system up to 2014.

logistics, final post-consumer destination, communication & education, legal counseling, technological development, and sustainability projects. Despite these costs – disregarding externalities –, the SCL's social and environmental benefits are remarkable.

For most indicators, the SCL had better performance than without the system. Besides CO_{2eq} emissions (carbon dioxide equivalent), we measured the impact on the ozone layer, energy and fuel consumption in transportation, work accidents, consumption of natural resources, land use, and other emissions.

The indicator that most clearly demonstrates how successful the System is was the volume of post-consumer containers properly managed and eventually disposed of, improving from 3,700 tons in 2002 to 42,600 tons in 2014.

The seventh eco-efficiency study conducted by the Espaço ECO® Foundation for inpEV proves how the SCL's environmental gains have been improving. Our survey shows that 447,000 tons of CO_{2eq} were prevented from being emitted in 2002-2014, which corresponds to preventing the extraction of 1 million barrels of petroleum.

Additionally, 1 million tons of solid waste were prevented from being generated, equivalent to what a city with 500,000 inhabitants disposes of in 7 years. In the same period, the System was able to save 18.4 million gigajoules, enough to supply energy to 1.7 million households for one year. Without the SCL, the extraction of natural resources would have been 3.8 times more intensive.

Using the Espaço ECO® Foundation's online tool Manager, inpEV will be able to monitor indicator developments with data generated in 2015-2017.

Ecoplástica Triex®

In 2009, the Campo Limpo Reciclagem e Transformação de Plásticos S.A. made its first container that would finally close the loop in the industry: the Ecoplástica Triex®. It is a remarkable example of "cradle-to-cradle" management feasibility.

Our eco-efficiency study compared the manufacture of the Ecoplástica Triex® with a traditional 20-liter virgin plastic container. When it comes to environmental benefits, the Ecoplástica production, which uses recycled resin, emits less greenhouse gas than the traditional container. Among other benefits, the manufacture of Ecoplástica uses 67% less energy and 80% less water than its traditional alternative.

Article by Guilherme Raucci, Socio-Eco-Efficiency analyst at FEE®

“ Established to represent the crop protection manufacturing industry in its post-consumer container management efforts, the Brazilian National Institute for Processing Empty Containers (inpEV) takes the concept of sustainability into account across all its processes. Our work starts with reaching out to farmers in the countryside, then getting the empty containers, dealing with transportation, and ensuring proper post-consumer destination, in which the waste is recycled

Testimonial

and turned into new products, closing the container loop.

The palpable values resulting from the eco-efficiency study conducted in this Espaço ECO® Foundation partnership are very significant, as they demonstrate the benefits of post-consumer container management in many different aspects: CO_{2eq} emission reduction, water and petroleum use reduction, waste generation reduction. Results prove inpEV's reputation is well-deserved, as well as Campo Limpo System's, and also prove that the work we have been doing over the past 13 years is positive for society and the environment.

The SCL is always relentlessly pursuing constant improvements for its processes. Because it is a system created to manage waste in a responsible manner, we all knew how important it is to use integrated management. The eco-efficiency study on the system, complying with the ISO 14040 standard, showed our feeling was right and translated the benefits into numbers, which can be comprehended both by the general public and our supporting members.

It is now clear there is a look toward sustainability for the container disposal process in the industry, which is putting in efforts to support and fund operations, even running deficits. This experience tends to beco-

me a reality in other industries as well, such as the ones mentioned in the Brazilian National Solid Waste Policy, signed into law in 2010.

The life cycle studies conducted by the Espaço ECO® Foundation can contribute both with information about the benefits of responsible post-consumer waste management and the eco-efficiency assessment of products that use recycled raw material. ”

João Cesar Rando
inpEV President



DECO CURY

PVC and aluminum windows performance throughout their life cycle



INSTITUTO DO PVC ARCHIVE

“The FEE® methodology is extremely efficient and user-friendly, and will make it possible for us to plan a consistent communication strategy, with scientific basis and technical information. It makes us a source of global scientific reference.”

Miguel Bahiense
Instituto do PVC
President



Presentation

Between June, 2012 and September, 2013, Espaço ECO® Foundation conducted a very relevant study for Instituto do PVC¹: the comparison of the performance of 1-square-meter PVC and aluminum windows in both commercial and domestic settings.

Both windows are white sliding shutters with three PVC or aluminum panels, one sliding shutter panel, one 5-mm-thick sliding glass panel, and one fixed solid panel. To perform this comparison, all the products' life cycle were detailed, from extraction of raw materials to final disposal, measuring the impacts from each step of their life cycle.

In the aluminum window case firstly bauxite extraction takes place in Serra dos Carajas, (Para State); then it is transported to plants such as CBA, Alcoa and Alunorte, where alumina is produced and aluminum suffers extrusion process. Afterwards, aluminum bars are shipped to the city of Indaiatuba, Sao Paulo state, where windows are assembled. Finally, assembled windows are shipped to retailers in the Greater São Paulo area.

The raw materials used to make PVC are mainly chlorine (57%) from brine (sodium chloride) and ethylene (43%) from naphtha (petroleum). For the purposes of this study Braskem's plants in Alagoas and Bahia were considered. From there, PVC is shipped to São Paulo State, where it is extruded and transformed into PVC bars. This part of the process takes place at Tigre's plant in the city of Rio Claro. The final step is carried out at Claris, in Indaiatuba, where windows are assembled and later shipped to retailers in the Greater São Paulo area.

PVC and aluminum trimmings are sent to recycling facilities in the cities where the windows are assembled – Rio Claro and Indaiatuba, respectively.

Challenge

The analysis aimed to identify which of the two products is the most eco-efficient, considering environmental and economic aspects, over a 40-year period maintaining a 24°C environment at Sao Paulo Metropolitan Area. To comprehend the country's climate diversity, scenarios were developed to assess the windows performances under temperatures of other cities, such as Curitiba (South) and Natal (Northeast), taking into account domestic and commercial settings.

Solution & tools

The Eco-Efficiency Analysis tool allows us to compare products and processes taking into account both environmental and economic aspects, according to NBR ISO 14040 standards – Life Cycle Assessment. The same service life estimation was considered for both windows, as well as each one's market price, and cost of air conditioner power consumption throughout the day, considering a 10-hour period in commercial settings and a 14-hour period in domestic settings.

Within the premise of quantifying the impacts generated “from cradle to grave,” we wanted to look into each step individually. The study focused on the production of sashes, utilities, window assembly, installation and maintenance, electric energy consumption to run the air conditioner, final disposal of the windows

¹ | Established in September, 1997, the “PVC Institute” gathers all industries in Brazil's PVC supply chain, with a unique concept of association management. It has members from the raw material, resin producers, additive and compounding, manufacturing, recycling, and distribution industries, among others.

and transportation involved in these operations. For this purpose, Espaço ECO® Foundation assessed the impacts related to energy consumption, emissions, land use, toxicity potential, risk potential and consumption of natural resources.

Results

The PVC window performed better than the aluminum window in 10 of the 11 environmental categories analyzed.

In the Energy Consumption category, which stands out as the most relevant in the study (31%), the PVC window performed better, because during its production process it uses 2.3 times less energy than the aluminum window. The PVC alternative was also better regarding its assembly process, because it is naturally white and does not require painting, unlike the aluminum product, which requires electrostatic coating, a process that consumes a lot of electric energy.

Moreover, based on the thermal transmittance study conducted at the Federal University of Santa Catarina, the PVC window has higher thermal insulation capacity and also enhanced economic performance, as it is less likely to require air conditioner use when external temperatures move away from the thermal comfort zone (24°C), consuming less electric energy.

Based on the study results, if PVC windows were installed instead of an aluminum window at homes with air conditioning units throughout Brazil, in one year energy savings would be equivalent to the energy consumption of 415,776 households in the same period. If six PVC windows were installed, savings would be equivalent to the energy consumption of 2,494,656 households in one year.

In the Resource Consumption category, bearing a 22% relevance in the study, PVC also performed better, especially during the sash production phase, in which resource consumption for the aluminum alternative is 4.9 times more intensive than for the PVC window.

Toxicity Potential is the third most relevant category (18%), and again the PVC window stands out, with a toxicity score twice as low as the aluminum window. In the Risk Potential category, which has a 14% relevance for the study, PVC also delivered best performance, especially in the production, assembly and installation phases.

PVC was also more eco-efficient for having less impact in the Solid Waste, Liquid Waste, Land Use, Global Warming Potential, Acidification and Photochemical Formation of Ozone Potential categories. Of all environmental categories, the aluminum alternative outperformed PVC only in the Ozone Depletion Potential, which has the least relevance for the study (0.3%).

For the economic impact assessment, it was considered the final consumer prices in the São Paulo Metropolitan Region. At first, the price difference between the PVC window and the aluminum window was over 40%. Throughout their service life, however, as the PVC alternative has presented a more efficient thermal performance, the initial market price difference drops to around 10%; to wit, in four decades, electricity costs associated with the PVC window represented 30% of its market price, while the aluminum alternative's rate was as high as 104%.

In a final analysis, we found that the higher is the difference between outside temperatures and the comfort temperature, the greater is the need for electricity

consumption to run air conditioner units, whether for heating or cooling purposes. Using PVC windows, which provide better thermal insulation, the air conditioner consumption is reduced, thus resulting in more eco-efficient performance.

Article by Nathaly Jo, Socio-Eco-Efficiency analyst at the FEE®

Testimonial

“ Between June, 2012 and September, 2013, Espaço ECO® Foundation conducted a fine work with us, comparing two one-square-meter window models – made of PVC and aluminum – applied both in domestic and commercial settings. At first, we had difficulties related to the processes, as the original proposal was to compare four types of materials (PVC, aluminum, steel and wood), but as we didn't have enough information available on the last two types, we had to reduce the scope of our study.

This research opened a communication channel with society about plastic products from a life-cycle-analysis perspective. It was an opportunity to learn how each material behaves, and to assess PVC windows' attributes from an environmental, social, and economic viewpoint. With this information, we will be able to show the real characteristics of the products we promote.

As the FEE® methodology is extremely efficient and user-friendly, it will be possible for us to plan a consistent communication strategy, with enough scientific basis and technical information to guide our conversation with opinion formers on the benefits of PVC windows.

We knew our product had environmental benefits, providing thermal and acoustic comfort and saving energy due to its thermal insulation properties. What is new here is that this is the first time a study of this kind was conducted in Brazil, supporting our perception and bringing Instituto do PVC to the forefront in the country. Before that, we used to use information gathered from surveys conducted abroad – for instance, in Spain, where PVC windows have a 70% market share – to promote its benefits.

Overall, we found the life cycle analysis extremely positive. In terms of environmental indicators, the PVC window performed much better than the aluminum alternative – a very promising piece of data that helps us in our goal to bring science into the conversation. This Espaço ECO® Foundation tool is vitally important and without doubt will be tremendously useful. Now we will engage in publicizing the outcomes of this work; our intention is to later conduct new life cycle analyses on products in the plastic supply chain. ”

Miguel Bahiense
Instituto do
PVC President



RAFAEL RIGOS

US Beef Value Chain Eco-Efficiency Analysis



NCBA ARCHIVE



“Ultimately, our partnership with the Espaço ECO® Foundation allows the beef industry to set a roadmap for the journey to a more sustainable beef while improving consumer confidence.”

Kim Stackhouse-Lawson, PhD

Executive Director of Global Sustainability, The National Cattlemen's Beef Association, A Contractor to the Beef Checkoff Program



**National Cattlemen's
Beef Association**

Introduction

BASF Corporation's Nutrition & Health Division in the United States collaborated with the Espaço ECO® Foundation to assess the social, economic, and environmental attributes of the U.S. beef industry and identify improvement opportunities. The first-ever beef industry life cycle assessment considered data from 2005-2011 and encompassed the entire beef production value chain.

Challenge

A sustainable beef industry is critically important as we work toward the goal of feeding more than 9 billion people by the year 2050. Experts estimate that this future global population will require 70 percent more food with fewer available resources.

Furthermore, in November 2006, a report from the Food and Agriculture Organization of the United Nations (FAO)² titled "Livestock's Long Shadow" was released. The report's primary publicized finding was livestock production accounts for 18 percent of global greenhouse gas (GHG) emissions.

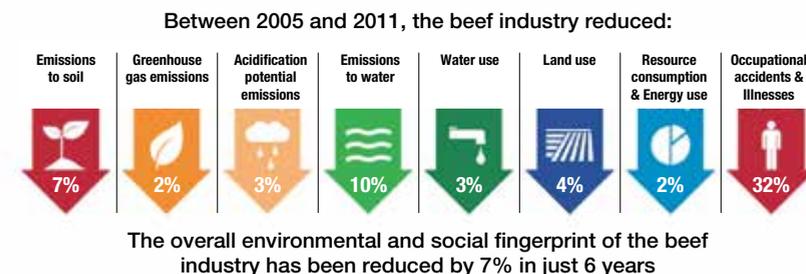
As a first step toward more responsible beef production, the National Cattlemen's Beef Association (NCBA), a contractor to the Beef Checkoff Program, commissioned the analysis from the Espaço ECO® Foundation in order to benchmark the eco-efficiency of the beef industry.

Solution & tools

The study consisted of an Eco-Efficiency Analysis with methodology based

on NBR ISO standards 14040, 14044, and 14045 – Life Cycle Assessment, externally validated by third party NSF International.

This analysis covered the entire value chain from the period of 2005 to 2011. The study considered all cattle production phases, including feeding, harvest, and distribution to the end-consumer. Inputs along the entire value chain were included, from the pre-chain production of fertilizer, packaging, chemicals and others; to primary inputs like feed and water, through consumption and disposal of packaging materials by the consumer. These impacts were quantified against a consumer benefit that equates to one pound of boneless, edible, consumed beef.



The German consultancy Schlange, conducted a concomitant HotSpot Analysis, intended to

provide a qualitative perception analysis of the sustainability attributes of the U.S. beef industry. The HSA consisted of an analysis of more than 150 literature sources and a survey reaching out to 39 stakeholders by means of an online questionnaire, telephone, or face-to-face interviews.

The survey covered six different groups that included industry, retailers/restaurants, NGOs/NPOs, government, capital markets, and academia.

A Socio-Eco-Efficiency Analysis was conducted using the SEEBALANCE® tool, an innovative tool that allows, for the first time, the assessment not only

of environmental impact and costs but also of the societal impacts of products and processes. The SEEBALANCE® analysis was intended to expand upon the Eco-Efficiency Analysis (EEA) and integrate the social impacts of the U.S. beef industry in order to assess a more complete sustainability framework that considers environmental, social, and economic issues. The study found slight socio-environmental progress in the U.S. beef industry between 2005 and 2011. Nevertheless, the analysis was inconclusive, as there were no data regarding the social impacts of the industry.

Results

The study pointed to a 5% improvement in overall sustainability of the U.S. beef industry between 2005 and 2011. This correlates to a 6% increase in cost and a 7% decrease in environmental and social impacts over that same timeframe.

Environmental impacts are assessed along every step in the value chain. For example, in the feed phase; nearly 95% of the consumptive water use was associated with the irrigation of crops. In this impact category, a 3 percent reduction in use was achieved, which was the most significant reduction overall. During the harvest phase, there was a reduction in solid waste generation by 28% and water use by 12%.

At the end of the project, representatives from every segment along the U.S. beef industry value chain gathered at a seminar where the results of the study were presented. During the event, experts reviewed advancements, discussed practical solutions to reduce impacts, and identified potential opportunities for

continued improvement to advance more sustainable beef.

Overall, the results of the sustainability assessment tell a very positive story for the beef industry. The study's most significant result shows that the value chain has improved over time. Advancements in areas such as improved crop yields, utilizing by-products as a feed source, more efficient packaging, and biogas capture and conversion into energy, have all led to improvements along the beef value chain, to date.

Article by Juliana Silva, Socio-Eco-Efficiency manager, and Rafael Viñas, Socio-Eco-Efficiency analyst at FEE®

Testimonial



To us, sustainability means balancing social diligence, environmental responsibility and economic opportunity with the global beef demand. We believe that it should be measured through the lens of continuous improvement. In other words, the beef industry has to become more and more sustainable over time.

In partnership with BASF Corporation, the Espaço ECO® Foundation has analyzed the life cycle of the beef industry in the United States. As a result of this work, we can better understand the impacts of the

management changes on beef sustainability and effectively chart a path to more sustainable beef.

The level of detail in the Life Cycle Analysis enables farmers, cattlemen and women, managers, retailers, and other chain players to better understand their impacts. This allows individuals to make management decisions so that the industry can become even more sustainable.

Ultimately, our partnership with the Espaço ECO® Foundation allows the beef industry to set a roadmap for more sustainable beef. We are committed to responsible production, and we hope this work can give consumers the opportunity to learn about beef in a more transparent way, building trust in our products. ”

Every beef farmer and rancher and every beef importer contributes to a fund called the beef checkoff, which is used to support the sustainability program

Kim Stackhouse-Lawson

*PhD Executive
Director Global
Sustainability, NCBA,
a Contractor to
the Beef Checkoff
Program*



NCBA ARCHIVE

Socio-Eco-Efficiency of Rio Grande do Sul irrigated rice production



“For their quality analysis, the Espaço ECO® Foundation - has made us feel sure we are on the right path. We have achieved financial results with less environmental impact and with social quality.”

Geraldo Azevedo
Condessa Farm Owner



Presentation

Irrigated rice farms in Rio Grande do Sul State are extremely infested with one variety of native rice, the Red Rice. Its incidence leads to reduced yields (kg/ha) of white rice, increased production costs, reduced milling yield, depreciation of the harvested product, and reduced nitrogen fertilization efficiency, which leads to devaluation of land.

The Clearfield® Production System allows farmers to optimize their resources and productivity by combining a crop technology for rice production (developed with traditional plant-breeding techniques genetically advanced seeds) with a selection of herbicides especially developed to control Red Rice, which other protection chemicals cannot control. After its successful performance at the Condessa Farm, a reference in best agricultural practices, the System is being seen as a vital enabler in sustainable rice production, an excellent method to assist Brazilian rice crops achieve their production potential, controlling effectively the Red Rice incidence. The Clearfield® technology has made it possible to increment rice productivity in areas that were practically abandoned due to red rice infestation.

Rice producers who use the Clearfield® System are advised to follow the Monitoring Program, which aims to raise awareness of safety and correct use of the products to ensure product's longevity. Major aspects of the program include the use of certified quality seeds, water management, crop rotation and/or cropping systems, and use of licensed herbicides specifically recommended for the Clearfield® Production System.

The Condessa Farm is an irrigated rice and seed producer located in the coastal

city of Mostardas, Northern Rio Grande do Sul. The farm belongs to the region that has received the first rice Brazilian certification - Protected Designation of Origin (PDO) - , designated for its proven grain quality – due to environmental factors – compared to other producing regions. The farm has approximately 2.000 hectares of rice crops and yielded 16.500 tons in 2013. It is constantly pursuing yield improvements with low environmental impact and high profitability. Compared with the State's average, for instance, its water and diesel consumption rates are 16% and 47% lower, respectively; and even with these environmental concerns, its profitability was 15% higher that year.

Over the years, the Condessa Farm has always worked to ensure production with more sustainable technology and agricultural practices. An example is land leveling, which directly reduces water and energy consumption of irrigation pumps and helps control weeds, in addition to improving nitrogen fertilization efficiency, for speeding up the irrigation process. Reduced tillage is another relevant technique deployed at Condessa farm, minimizing preparation operations and diesel fuel consumption. To prevent this work from being endangered by Red Rice, Condessa has been using the Clearfield® Production System since it first launched in 2004.

Condessa's technical and financial management over the years has made it possible to assess the sustainability impact of associating the Clearfield® System with the farm's practices in different crop years, comparing results with the overall scenario in the state. This data made it possible to conduct a trailblazing study in partnership with BASF about its impact on the environment, employees, and company results. For that purpose, it was applied the AgBalance™ methodology, which is based on the Life Cycle Assessment (LCA) concept, assessing not only

the direct impacts of rice production, but also the products used in the process.

Challenge

Rice is one of the most important grains for human nutrition, a staple food consumed by more than 3 billion people around the world and the second most cultivated cereal grain on Earth. The estimated global rice crop area exceeds 157 million hectares. According to the Brazilian National Supply Company (CONAB), the country's rice area in the years of 2012/2013 crop was 2.39 million hectares. Brazil's largest rice-producing states are Rio Grande do Sul, Santa Catarina, Tocantins, and Mato Grosso. Irrigated rice crops in Southern Brazil contribute an average 70% to total national production. Rio Grande do Sul state, Brazil's largest rice producer, contributes 65% to total national production.

The average global rice consumption is 60 kg/person/year. Asian countries, where 90% of all rice in the world is produced, have the highest averages, ranging from 100 to 150 kg/person/year. Latin America's rice consumption is on average 30 kg/person/year, in which Brazil stands out as great consumer (45 kg/person/year). Today, rice crops have the highest yield growth potential and supply 20% of the global population's calories consumption. Thereupon, it has a strategic role in solutions for food safety issues. However, despite impressive production rates, the international rice trade is not very significant. Brazil's rice production was slightly above consumption in 2012/2013, so carryout levels could supply the country's demand for rice for two months.

The Espaço ECO® Foundation's study proposal was to compare the Condessa Farm's rice production with Rio Grande do Sul State's average production in two different crop years (2004/2005 and 2012/2013), based on a 50-kg rice bag. The

decision of evaluating the state average production was chosen since this state has different irrigated rice crop systems.

The FEE® work consists in two phases. One phase of evaluation used the AgBalance™ tool to analyze social, economic, and environmental impacts of rice production by the Condessa Farm compared with other Rio Grande do Sul producers' average results. Concurrently, it was applied the HotSpot Analysis methodology, involving rice value chain stakeholders in order to investigate sustainability-related priority topics, considering each one's relevance and materiality.

Results

The Condessa HotSpot Analysis involved 29 stakeholders – including producers, cooperatives, distributors, production plants, processing industry players, research institutions, NGOs, financial supporters, and investors – in order to pinpoint priority sustainability topics in the rice value chain.

Overall, interviewees consider the value chain's sustainability level low – it scored 6.5 on a 0-10 scale. The most sensitive issue pointed out by stakeholders was regarding water management, with a 9.7 score.

Other relevant topics pointed out by the stakeholders were: the proper use of seeds and certified inputs; research and development; profitability; productivity; production costs; governance; management and administration; training; qualification and work conditions. Low-interest topics include climate change and emissions, recycling, and certification.

On the social-environmental and financial balance analysis, the Condessa Farm

outperformed State of Rio Grande do Sul farms per 50-kg rice bag, starting with 15% lower production cost and 6% higher productivity rates in the 2012/2013 crop.

Our environmental impact analysis found a 13% greenhouse gas emission reduction and 21% CFC-11 reduction (CFC-11 leads to ozone depletion). Energy efficiency is 14%; Land Use efficiency is 7%; Consumptive Water Use efficiency is 6%.

To demonstrate the representativeness of the amount of energy, land, and water, the Espaço ECO® Foundation designed hypothetical scenarios considering the environmental benefits that could be achieved if all Rio Grande do Sul state were as efficient as the Condessa Farm. The State would save up to 412 billion liters of water, which is equivalent to its capital city, Porto Alegre, would use in two years. In terms of land use, producers would use 60,000 less hectares than they do now a days. When it comes to energy consumption, estimated reductions would be around 990 million kWh (which corresponds to energy consumption of 330,000 households in one year).

Regarding the social aspects, the study demonstrated that Condessa farm outperformed the average of Rio Grande do Sul State. For instance, in 8 years of production, there was no accidents at the farm (considering all its pre-chain, the number of accidents was 95% smaller in the 2012/2013 crop). Moreover, the wages and salaries of its employees was 20% higher if compared to the average of the state in the same period.

The AgBalance™ results for the Clearfield® and Condessa systems provided a systemic view, demonstrating that sustainability of irrigated rice in Rio Grande do

Sul has been improving over the years, and it can continue to improve through the adoption of best agricultural practices and technology. In addition, it is important to note the environmental, social, and economic improvements resulted from innovation and scientific research on irrigated rice production market segment.

Article by Daniel Falchetti, Socio-Eco-Efficiency analyst at the FEE®

“ *Our company has always worked through technical and financial analyses, quantifying productivity per crop and measuring all costs involved in the production of each rice bag. With that, we knew we were doing a good job. Consequently, we are constantly increasing productivity and area, without increasing the consumption of important resources, such as diesel fuel. For the quality presented in the analysis conducted by Espaço ECO® Foundation made us sure we are on the right path, achieving financial results with less environmental impact and more social quality.* **Testimonial**

Environmental and social issues are ever-growing concerns in our society And we are always looking to produce food in harmony with our local environment. Additionally, it is vital that our employees are committed to our company and feel happy and proud to be part of our team. This is what we get with our long-term work.

The Clearfield® System has helped us control our main technical problem: Red Rice. This technology also helped us better manage water and light (seeding at the right time), which are rice's primary inputs. Also, now we use other inputs more rationally and we reduced soil preparation.

Surprisingly for us, the study showed rice value chain stakeholders' main concern is regarding responsible use of resources. The HotSpot Analysis also pointed to water consumption reduction as a more valuable aspect for these interested parties than climate change effects. The FEE® also highlighted the challenge of producing more without expanding crop areas.

I believe the fact that we stand out among average Rio Grande do Sul producers is due to the investments we have been making over the past 10 years and our well-thought-out strategic decision. This scenario may encourage other producers who want to boost their productivity and improve their social and environmental indicators.

The FEE® helped us to identify where we are and what still needs improvement. Two findings stand out from AgBalance™ results: Condessa Farm productivity has been improving over time (the study compared 2004/2005 and 2012/2013 crops) and our diesel

consumption is low, which is good in terms of carbon emissions into the atmosphere.

With the data we collected, we can make projections for the years to come in order to become even more sustainable. Our partnership with BASF and the FEE® was and will continue to be fundamental for our business evolution. ”

*On the left,
Airton M. da Silva,
employee, and
Geraldo Azevedo,
Condessa Farm
owner*



AgBalance™: in pursuit of excellence in soybean, corn, and cotton production



BASF ARCHIVE



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“ Our partnership with the Espaço ECO® Foundation has also taught us that the more you work on the soil, the more fertile it will be and the less nutrients it will need. This translates into less impact on the environment, society, the operation, and our costs. ”

Álvaro Luiz Dilli Gonçalves
*Sustainability and Human Resources
 Director at SLC Agrícola*

SLC *Agrícola*

Presentation

SLC Agrícola¹, an agricultural commodity producer working especially with cotton, soybean and corn, is the world's first-ever publicly traded grain grower and one of Brazil's biggest grain exporters. Another SLC unprecedented accomplishment is being the owner of the world's first farm – Planalto, in Mato Grosso do Sul State – to receive three Integrated Management System (IMS) certifications: ISO 14001, ISO 16001, ISO 18001.

SLC reached out to the Espaço ECO® Foundation because it was seeking to assess the agricultural socio-eco-efficiency of two farms at different stages of development. Upon diagnosis, the study pointed to management improvement opportunities for each enterprise and identified potential synergies.

Challenge

To analyze the major environmental, economic, and social impacts of soybean, cotton, and corn production in the 2009/2010 crop, identifying good sustainability practices already in place and improvement opportunities, aiming at operational excellence.

The Espaço ECO® Foundation analyzed two production facilities: the Planalto Farm in the city of Costa Rica, Mato Grosso, and the Panorama Farm in Correntina, Bahia, each one with very different background and performance. The former has been producing grains for over 30 years and has a well-established management model, while the latter was only four years under SLC Agrícola's management.

Solution & tools

Our study conducted four analyses with the AgBalance™ tool: (1) an average 1-hectare (2.47 acres) crop at both farms and the production of 1 Mg of (2) soybean, (3) corn, and (4) cotton. The aim was to understand the real sustainability challenges facing the grain and fiber supply chain, identifying best sustainability practices already in place and synergy opportunities for SLC's 16 farms.

Each farm's life cycle was investigated from cradle to farm gate; in other words, from natural resource extraction and processing to intermediate products and the manufacture of finished goods.

Our study looked into soybean and corn production up to the drying process. For the cotton assessment, we also included the processing stage, when cotton fibers are separated from the seeds.

The Espaço ECO® Foundation gathered data on agricultural input consumption (crop protection chemicals, fertilizers, seeds, diesel fuel, water, limestone, power, wood), each farm's characteristics (soil, sloping lands, rainfall regime, productivity), social data (number of employees, wages, accidents, social security, female employees, employees with disabilities, interns), and financial data (variable and fixed costs, sales revenue). Additionally, we gathered agronomic data and soil characteristics that reflect those of the Brazilian Cerrado. Secondary information was based on statistics and inventory data and supports the impact assessment of the pre-agricultural chain, i.e. input production, raw material extraction, and transportation logistics, among other phases.

¹ | Established in 1977, SLC Agrícola went public in 2007. A leader in grain production, SLC mainly grows cotton, soybean, and corn across 248,000 hectares (≈ 613,000 acres), of which it owns 133,000 hectares (≈ 329,000 acres). It works with 14 farms across the South, Southeast, Northeast, and Center-West of Brazil – mostly in the Cerrado region.

Results

Our analysis showed the company already adopts sophisticated sustainability management practices for its production process, so the Espaço ECO® Foundation suggested improvement opportunities. One of them regards fertilizer use optimization, inputs that use a lot of energy and emit CO₂ from production to transport to farms. If SCL reaches its fertilizer use/year 10% reduction goal in both farms, it will be saving approximately 14.9 million kWh, and nearly 8,000 Mg CO_{2eq} will not be emitted, which corresponds to a 14 Mg truck driving around the Earth 150 times. **It bears pointing out this is theoretically what results could be like over time, as a 10% fertilizer reduction is expected when applying precision agriculture techniques.**

All indicators show that the Planalto Farm, Mato Grosso do Sul performed better. It has better soil and climate conditions, so its production costs are lower, as well as its environmental impact. Before the Espaço ECO® Foundation conducted this survey, SLC data already showed the Planalto Farm used 36% less fertilizers than the Panorama Farm. Moreover, it has been under SLC Agrícola's management for three decades and has well-established agricultural practices. Over 30 years, it has introduced good agronomic practices, which led to continuous soil improvement, for instance, adopting direct planting and crop rotation, in which the soil is not disturbed through tillage and is constantly covered with crop residue, so it is protected from Cerrado's heavy rains and erosion.

The Espaço ECO® Foundation survey showed that, because the Panorama Farm is located in an area with more sandy soils, erosion risks are higher there. Therefore we recommended the company should continue with and enhance

its soil conservation practices, such as reduced tillage, direct planting, contour farming, and crop rotation.

Regarding the Ecotoxicity category, which measures the effects of using crop protection agro-chemicals on soil organisms and its spread across the environment, we highlight the fact that some molecules are responsible for most of the impact, such as organophosphorus insecticides, which represent around 70% of the ecotoxicity potential and only 2% of total crop protection products applied.

In terms of protected areas, the two farms' natural forest areas are larger than what is legally required, which is a positive aspect in the Biodiversity category. Panorama is 25.3% native woods and Planalto is 22.8%.

As for the environmental aspect, our survey showed that, by reducing their current fertilizer use by 10%, greenhouse gas emissions would drop in both farms – around 8,000 Mg CO_{2eq} – as well as their electricity consumption (down approximately 14,900 kWh). Fertilizers represent 53% of the entire chain's energy expenses and 77% of its greenhouse gas emissions (29% from pre-supply chain and 48% from its actual use, especially through the denitrification process, converting to N₂O). According to our analysis, changing modes of transportation would mean more efficiency in mitigating environmental impacts.

If grain logistics used trains instead of the current truck alternative, greenhouse gas emissions would drop around 2,800 Mg CO_{2eq} per crop, and work accidents would reduce by 26%, also creating significant social impact. Nonetheless, changes in load shipping depend on public infrastructure investments.

Regarding social performance, the Panorama Farm stands out in the Future Generations category, as it has a larger number of trainees working there. Workplace safety programs are efficient at both farms; however, Planalto's staff has a higher level of maturity – they seem to be better prepared according to SLC's management model – and had better accident, occupational disease, and toxicity potential rates, plus higher salaries. The Espaço ECO® Foundation recommends the company should keep investing in professional qualification.

Finally, we found the Planalto Farm has less production costs in its soybean, cotton, and corn crops, especially due to lower depreciation and fertilizer costs. This is also due to better soil quality and geographic location in terms of production flow.

AgBalance™ results provide a systemic view, thus making it clear that even with intensive production, soil degradation and environmental impacts can be reduced with the good agricultural practices SLC farms already adopt, demonstrating there is no contradiction between intensive production and sustainability.

Article by Fábio Cirilo, Socio-Eco-Efficiency consultant at the FEE®



SLC Agrícola believes sustainability is an opportunity to manage risks in our value chain in a more effective fashion, and also a possibility to reach more sophisticated niche markets. It builds up our reputation and image and makes us value team work even more, since it is a transversal theme, and therefore, everyone has to do their part.

Testimonial



Panorama Farm

FERNANDO BUENO

The AgBalance™ tool proved what we already felt – 70% of greenhouse gas emissions are generated outside our farms, and come from the logistics and life cycle of the inputs we buy. Raw materials such as fertilizers and crop protection chemicals, which are vital for our operation, come from other countries and consume a lot of fossil fuel to get to us.

Our partnership with the Espaço ECO® Foundation has also taught us that the more you work on the soil, the more fertile it will be and the less nutrients it will need. This translates into less impact on the environment, society, the operation, and our costs.

The eco-efficiency study showed us we are at a high level of management, and offered recommendations as well. One of them is that we should continue working with precision agriculture, because it reduces the need for new lime and calcium applications. Another guideline is regarding the nitrogen cycle in corn and soybean crops, as it is a significant greenhouse gas emitter. Strengthening the direct planting and crop rotation systems, using cover crops, and reducing nitrogen fertilizer use are tools we will surely adopt to reduce our footprint.

So our partnership with the Espaço ECO® Foundation has proven to be an asset right now, a time when the agribusiness must get involved and manage its impacts. It is not a coincidence that Brazil's Federal Government has been supporting low-carbon agriculture projects, because there are 100 million hectares of degraded area in the country that can be recovered with good agricultural practices.

We're the primary sector of the economy, in which

concerns with social and environmental issues is still taking its first steps. The future is certified agriculture, because the market is demanding more and more healthy, organic, socially responsible products. Consumers do not want food produced in properties with slave-like, illegal deforestation, and land grabbing practices. This alliance in pursuit of best practices and continuous evolution will guide us in the years to come. Businesses that want longevity and economic prosperity cannot go back on sustainability, which is built on the balance between the three pillars. ”

**Álvaro Luiz Dilli
Gonçalves**
*Sustainability and
Human Resources
Director at SLC Agrícola*



SLC AGRÍCOLA ARCHIVE

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Espaço ECO® Foundation

Development

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Over the next 10 years, we will meet great new challenges to strengthening sustainable development in society and the corporate environment. Facing this scenario, we know we can count on the FEE® for their innovative, efficient solutions that bring sustainability and science together, using renowned scientific methodologies. Some of their current solutions are the SEEBALANCE® and AgBalance™ tools, which are constantly evolving and improving.

The FEE® contributes to push the conversation forward and promote a more widespread debate over sustainability, based on social, environmental, and economic indicators.

Marina Grossi,
CEBDS Chairwoman





Nine in ten executives are used to saying one of their biggest barriers to get sustainability more into their corporate strategy is how hard it is to measure their business results. There are even the ones who really think it's an almost impossible task to accurately measure advantages and benefits, as if in an area with such complex, interdependent variables, there were a lot of speculation and not a lot of science. To them I strongly recommend reading this book.

In it, the Espaço ECO® Foundation gathered ten stories from clients and partners who were offered the opportunity to use their life cycle assessment, eco-efficiency, and socio-eco-efficiency analyses.

Study goals are many – from coffee production settings and integrated crop-livestock-forest systems to production of green plastic, US beef, and pulp for toilet paper.

What all studies have in common, as they assess environmental, social, and economic impacts, is that they offer evidence that allows companies to make comparisons and better decisions for their businesses, society, and the planet.

After reading these stories, readers will have no doubt that sustainability generates value.

Ricardo Voltolini,
president at Ideia Sustentável
Consulting Firm: Strategy &
Intelligence in Sustainability

