Ecosystem Services related to Business

Cases of Trends in Ecosystem Services (TeSE) Initiative Member Companies

2017 Cycle
GVces and the Business Initiatives

The Center for Sustainability Studies (GVces) of the Business Administration School at Getulio Vargas Foundation (FGV-EAESP) is an open arena for study, learning, insights, innovation, and knowledge production, formed by people with a multidisciplinary background, engaged and committed, with an authentic desire to transform society. GVces activities are based on the development of public and private management strategies, policies and tools to promote sustainability for local, national and international scenarios, driven by four major pillars: (i) training activities; (ii) research and knowledge production; (iii) debates and exchange of information; and (iv) mobilization and communication. Under this context, GVces Business Initiatives make up a network with the purpose of transforming the sustainability challenges into an opportunity to create value for the business and its stakeholders. This purpose has been achieved through the co-creation of strategies, tools and proposals for public and business policies; support for implementation through pilot projects; knowledge systematization and dissemination through publications and events; and articulation with various government and civil society actors.

There are five Business Initiatives: Business for the Climate Platform (EPC), Innovation and Sustainability in the Value Chain (ISCV), Local Development and Large Projects (Local ID), Trends in Ecosystem Services (TeSE) and Applied Life Cycle (CiViA). In addition to working on the agendas of local development, ecosystem services, climate, value chain and product life cycle, the Business Initiatives have worked together, bringing knowledge and content, on the integrated agenda of water resources in 2016 and 2017.

- **The Business for the Climate Platform** aims to contribute to the advancement in the corporate management of greenhouse gas emissions (GHG) and the risks and impacts derived from climate change. Since 2009, the initiative has been working on the co-creation of guidelines and tools for business management – such as the tool for the elaboration of climate change adaptation plans and the Business Guidelines for Internal Carbon Pricing –, public policies proposals and support of pilot projects implementation of the tools and guidelines.

- **The Innovation and Sustainability in the Value Chain** initiative develops methods and tools, such as protocols for the supply chain management, for integrating sustainability into the processes and policies of companies’ purchases. In 2015 and 2016, the initiative developed Risk Matrix and Materiality Analysis Protocols in the Supplier Chain, in order to assist companies in mapping risks and opportunities in their chains.

- **The Local Development and Large Projects initiative** aims to articulate the business sector for reflection, experiences exchange and construction of proposals and business guidelines for local development, through dialogue, study and co-creation of methodologies and tools. Since 2013, the themes already covered are: Comprehensive Protection of Children and Adolescents, Innovation in Local Development, Impact Monitoring and Evaluation, and Local Institutional Capabilities.

- **The Trends in Ecosystem Services initiative** develops strategies and tools for corporate management of impacts, dependencies, risks and opportunities related to ecosystem services. In the previous cycles, guidelines and tools were developed for valuing vulnerabilities and impacts of the business activity on natural capital. The initiative has been applying training in valuation and management of ecosystem services and developing business cases with its member companies.

- **The Applied Life Cycle initiative** seeks to incorporate life cycle thinking into the strategic management of companies based on Life Cycle Assessment (LCA) of products - goods and services. In addition, it is discussed, in workshops and working groups, subjects such as product communication and labeling, as well as competitiveness issues. Since 2015, companies have been trained in the methods and tools of two categories of environmental impact: climate change and water use. From this, they have been developing pilot projects of carbon footprint and water footprint of their products.
Ecosystem services related to business. Cases of Trends in Ecosystem Services (TeSE) Initiative Member Companies - 2017 Cycle

An initiative of
Getulio Vargas Foundation
Center for Sustainability Studies (FGVces)
Trends in Ecosystem Services (TeSE)

Masthead

General Coordination
Mario Monzoni

Vice Coordination
Paulo Branco

Executive Coordination
Annelise Vendramini

Technical Coordination
Natalia Lutti Hummel

Team
GVces: Thais Camolesi Guimarães
GIZ: Luciana Mara Alves and Raquel Agra
MMA: Ana Paula Prates, Rodrigo Martins Vieira, Luana Magalhães Duarte de Araujo and Otávio Gadiani Ferrarini
CNI: Elisa Romano Dezolt and Renata Medeiros dos Santos
Consultor Projeto TEEB R-L: Philippe Lisbona (Verdesa)

Design
Ricki Lustoza

Translation
Gisele da Silva Prata Garotti

Photos
Unsplash & Pexels

Partnership

This work was developed in partnership with the TEEB R-L Project. The TEEB Regional-Local: Biodiversity Conservation by Integrating Ecosystem Services in Public Policies and Business Operation project is an initiative of the Brazilian government, coordinated by the Brazilian Ministry of Environment (MMA), along with the Brazilian National Confederation of Industries (CNI), in the context of Brazil-Germany Cooperation for Sustainable Development. The German Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety (BMU) supports, as an integral part of the International Climate Initiative (IKI), the Project execution through the technical support of Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.
To refer to this publication:
# Summary

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>7</td>
</tr>
<tr>
<td>Cases of ecosystem services valuation</td>
<td>8</td>
</tr>
<tr>
<td>BASF – Case 1</td>
<td>9</td>
</tr>
<tr>
<td>BASF – Case 2</td>
<td>12</td>
</tr>
<tr>
<td>Braskem</td>
<td>16</td>
</tr>
<tr>
<td>Concepta Ingredients</td>
<td>19</td>
</tr>
<tr>
<td>Copel</td>
<td>22</td>
</tr>
<tr>
<td>EcoRodovias Group - Ecocataratas and Ecovia Caminhos do mar</td>
<td>26</td>
</tr>
<tr>
<td>EcoRodovias Group - Ecosul</td>
<td>32</td>
</tr>
<tr>
<td>Toctao Group</td>
<td>36</td>
</tr>
<tr>
<td>Suzano Pulp and Paper</td>
<td>39</td>
</tr>
</tbody>
</table>
Introduction

The Trends in Ecosystem Services (TeSE) business initiative was launched in 2013 by the Center for Sustainability Studies of Sao Paulo Business Administration School at Getulio Vargas Foundation (GVces/EAESP-FGV), with the mission of supporting the Brazilian business sector in the incorporation of natural capital into business decision-making. Since then, TeSE has been developing, through a process of joint construction with its member companies, tools aimed at quantification, economic and non-economic valuation, and reporting dependencies, impacts and externalities with regard to ecosystem services.

From 2014 to 2016, the initiative published 28 business cases from the implementation of the Corporate Guidelines for the Economic Valuation of Ecosystem Services (DEVESE 2.0) and its respective calculation tool; and two pilot-cases of ecosystem services business management. In 2017, nine new business cases of economic valuation of ecosystem services were developed and are described in this publication. This cycle also included the development of the first pilot-project for noneconomic valuation of cultural ecosystem services, based on the Corporate Guidelines for noneconomic valuation of Cultural Ecosystem Services (DESEC 1.0).

These cases contribute to creating a set of references to the application of ecosystem services valuation in the business environment and for the diagnosis of opportunities for improvement of DEVESE and its calculation tool, both TeSE commitments. Motivated by the challenges and learnings of the cases developed by the companies participating in the initiative, in 2017, two Technical Note were produced, addressing the implementation of DEVESE and its calculation tool for the ecosystem service of global climate regulation and the application of DEVESE and DESEC for hydroelectric plants.

The report on the results of business cases has been made, since 2015, through the "form for reporting dependencies, impacts and environmental externalities", inspired by the Corporate Guidelines for Environmental Externalities Report (DEREA). It has been enhanced to be in accordance with the Natural Capital Protocol, a framework designed to assist the business sector in measuring and assessing their dependencies and impacts on natural capital. This form serves as a guideline for organizations to develop a clear an objective report of its estimates of economic value of dependencies, impacts and environmental externalities. The content on the form is self-declared by the companies, each case indicating the person responsible for the information reported.

This publication does not provide details of the data and calculation used, given the complexity and strategic nature of some of the information used by the companies, but it fulfills its objective of disseminating the theme, exemplifying some of the risks and opportunities derived from ecosystem services related to business. Details on the type of data and methodological procedures required for these analyzes can be obtained directly from DEVESE and its calculation tool, both available on the TeSE website (www.fgv.br/ces/tese).
Cases of ecosystem services valuation
Valuation of the externality of carbon sequestration promoted by the restoration activities in Brazil Mata Viva®, in Guaratingueta, Sao Paulo

EXECUTIVE SUMMARY

BASF is a German company operating in five segments: chemicals, performance products, materials and functional solutions, solutions for agriculture, oil and gas. In Brazil, the company operates in the states of Sao Paulo, Parana, Rio Grande do Sul, Bahia and Pernambuco and, with activities to promote the reduction of greenhouse gas emissions (GHG), BASF started, in 1984, a forest restoration project at its plant in Guaratingueta, Sao Paulo. In this process, 135 hectares were restored, transforming old pastures into a forest called Mata Viva® – the largest forest in an urban route of the municipality in which it is located.

More than 30 years after the beginning of the restoration activities that resulted in Brazil Mata Viva®, this case study seeks to assess the benefits brought in terms of global climate regulation by the investments made in the recovery of the area, with focus on the carbon sequestration promoted by the area restoration.

This externality was valued using the Replacement Cost Method (RCM), considering the Social Cost of Carbon (SCC), which represents the estimated cost of eventual impacts – due to the addition of one ton of carbon in the atmosphere – in agricultural productivity, human health and infrastructure. The valuation was conducted for the period of existence of the project, based on primary data collected locally by the company.

The study of the biomass stored by Brazil Mata Viva® was carried out in 2011, calculating the amount of carbon in the aerial part of the forest, in the litter, in the soil and in the area equivalent to use and to occupation of the soil prior to the restoration activities to serve as base line of the study. By collecting primary data on the existing carbon stock in the Forest, and of pastures existing in its surroundings (situation of use and occupation of the soil previous to the restoration activities undertaken, which served as base line), it was possible to quantify the Brazil Mata Viva® contribution to the atmosphere carbon sequestration, representing the amount of 33.5 thousand tons. This net carbon removal was, then, valued at US$ 1.28 million.

The results of the study support the company’s strategy to develop with sustainability-oriented management and, consequently, makes tangible the results of effort and dedication, encouraging the development of new initiatives. This case contemplates only one of the ecosystem services provided by the restoration of degraded areas, making possible, in the future, to expand its analysis.
Project drivers

**Goals:** Understand the business relationship with ecosystem services.

**Description:** In 1984, BASF began restoration activities in the Permanent Preservation Areas (PPA) of the Paraíba do Sul River, which are located within the premises of BASF in the municipality of Guaratinguetá/SP. Since then, maintenance activities are developed to maintain the forest for its preservation, and, from this perspective and on its own initiative, there was an effort to know what was the biomass stocked by the forest from the beginning of the restoration activities started in 1984, and if the forest was on an environmental trajectory comparable to others native forests.

To do so, an on-site study was developed to quantify the CO$_2$ stock of the forest, by studying the biomass of the most abundant trees in the forest, which allowed us to arrive at an equation with a high level of precision for this estimate, and to understand the successional trajectory of the forest, evaluating if new interventions were necessary to guarantee its conservation.

With these data in hand, seeking to understand the consequences of forest development in relation to the carbon stocks, we evaluated the generated externalities, which reflect the potential costs that would be caused to society in public health, maintenance works and damages generated by climate events and agricultural losses an others, if this carbon were in the atmosphere.

Project scope

**Object of the project analysis:** Project.

**Description:** Thirty three years after the beginning of the restoration activities, that resulted in Brazil Mata Viva®, we seek to better understand the benefits of the investments made in the area recovery, focusing on the valuation of the ecosystem service restricted to the externality of CO$_2$ sequestration promoted by Brazil Mata Viva®, based on the Social Cost of Carbon (SCC).

**Geographic Area:** municipality of Guaratinguetá, Sao Paulo state, Hydrographic Basin of the Paraíba do Sul River.

**Step(s) of the value chain included:** Own operations.

**Type of approach:** Retroactive.

**Time horizon:** 32 years (1984 – 2016).

**Ecosystem Services:** Global climate regulation.

Global climate regulation

**Role played by ecosystems in carbon and nitrogen biogeochemical cycles, thus influencing emissions of important greenhouse gases, such as CO$_2$, CH$_4$, and N$_2$O.**

**Method(s) used:** Replacement Cost Method (RCM).

**Results**

**Externality:** US$ 1.28 million
Analysis of the results

For the internal public, the result brings a positive perspective to the generation of awareness of the return on investments in the environmental area and for planning new actions in other facilities; consolidates its reputation and image with several stakeholders of the company; and enables actions of infrastructure that are related to commitments assumed by the company, such as: Global Pact, Sustainable Development Goals (SDGs), Biodiversity pledge and others.

For the municipality of Guaratinguetá and its population, the planted forest is the largest green area in urban area of the municipality. This area contributes in a decisive way so that the municipality has the amount of green area recommended by the World Health Organization (WHO), improves the environmental quality of the municipality, stocks a significant amount of carbon and helps to protect the Paraíba do Sul River, of extreme importance for the urban supply, industries and agricultural activities, of several municipalities and of two Brazilian states.

Management of ecosystem services

Use of ecosystem services valuation results: Cost-benefit analysis; Definition of strategic goals and progress monitoring; Reporting.

Description: In addition to the 135 hectares restoration activities that resulted in the Mata Viva®, which generated the positive externalities mentioned, BASF is currently developing a management plan for the Forest, enabling a better development of its structure and, consequently, the increase of forest biomass and biodiversity.
Valuating the externality promoted by natural pollinators in agricultural crops of Permanent Preservation Areas (PPA) restored by Brazil Mata Viva® Program

EXECUTIVE SUMMARY

BASF is a German chemical company operating in Brazil, in the following states: Sao Paulo, Paraná, Rio Grande do Sul, Bahia and Pernambuco. Since 2008, BASF, with the support of Espaço Eco Foundation, is implementing the Mata Viva® program for Education and Environmental Conservation. One of its fronts is the support to rural producers for the environmental compliance of its proprieties, through studies that quantify and shows, technically, how to solve these liabilities for the restoration of Permanent Preservation Areas (PPA) and Legal Reserve (LR). Since the beginning of the program, studies have been carried out on the environmental compliance of rural properties in more than 30 thousand hectares; and about 710 hectares were restored with the planting of more than 1,1 million seedlings of native species.

In order to understand the consequences of the restoration activities, in 2014, an inventory was carried out to evaluate the biodiversity and the abundance of bees in three properties that had its areas restored by the program for, at least, five years, located in the municipalities of Bebedouro, Tanabi e Araraquara, all in the state of Sao Paulo. In this case study, the importance of ecological restoration for recovery of bee biodiversity seeks to be understood by the evaluation of the ecosystem service of pollination regulation.

The three restored areas are located in municipalities with low percentage of native vegetation cover and with agricultural development, technified for a long time. In this way, it was emphasized the relevance of ecological restoration to increase agricultural productivity in properties owned by third parties – externality aspect – due to increase of the number of native bees. Considering that the crops cultivated in the three properties is the sugarcane, which does not depend on pollination, scenarios were assumed regarding the contribution of the increase of bees and consequent increase of agricultural productivity in coffee and orange cultivation, because they are agricultural crops practiced on a large scale in the region.

For the valuation of the externality generated by the pollination ecosystem service, the Marginal Productivity Method (MPM) was used, estimating the economic value associated to the portion of third-party production, which varies according to the availability of pollinators from the restored areas. The valuation was carried out for the year 2016.

The study identified that the investment made by the company, for the forest restoration in the PPA of agricultural properties of these partner rural producers, contributed to generate a positive externality, respectively, for each of the properties, in the order of R$ 20,8 thousand, R$ 19,5 thousand and R$ 55,9 thousand per year (considering the orange cultivation); and of R$ 36,6 thousand, R$ 32,5 thousand and R$ 98,5 thousand per year (considering the coffee cultivation).

The result of the study supports the company’s strategy to develop with sustainability-oriented management and, consequently, makes tangible the results of effort and dedication, encouraging the development of new initiatives.
Project drivers

Objectives: Estimate total value and/or net impact; and understand the company’s relationship with the ecosystem services.

Description: In 2008, BASF, with the support of Espaço Eco Foundation, created and, since then, is implementing the Mata Viva® Program for Education and Environmental Conservation. An important area of action of the program is to support the rural producers to adapt their properties environmentally through studies that quantify and technically show how to solve their liabilities; and by restoration of Permanent Preservation Areas (PPA) and Legal Reserve (LR). The Mata Viva® program has already promoted studies for environmental compliance of rural properties in more than 30 thousand hectares and restored about 710 hectares by planting more the 1,1 million seedlings of native species. In order to understand the consequences of the restoration activities, in 2014, an inventory was carried out to assess the biodiversity and the abundance of bees in three properties restored five years ago by the Program.

Project scope

Object of the project analysis: Project.

Description: After nine years after the beginning of the Mata Viva® Program, which restored more than 710 hectares and with data on species diversity and abundance of bees of three restored areas, we intent to understand the importance of ecological restoration for biodiversity recovery of bees from the perspective of ecosystem services valuation, assessing the externality of pollination regulation. These three restored areas are located in municipalities with low percentage of native cover and “technified” agricultural development for a long time. We seek, with this study, to understand the relevance of ecological restoration to increase agricultural productivity, bringing to this the approach of ecosystem services economic valuation.

Geographic Area: municipalities of Bebedouro, Tanabi and Araraquara, in Sao Paulo state.

Step(s) of the value chain included: Own operations.

Type of approach: Retroactive.

Time Horizon: One year (2016).

Ecosystem Services: Pollination Regulation.

Pollination regulation

Ability of ecosystems to regulate the populations of animal species that promote the pollination of various vegetal species, specially agricultural crops.

Method(s) used: Marginal Productivity Method (MPM).

Resultados

Dependency: not calculated

Impact: not calculated

Externality: between R$ 19,5 thousand and R$ 55,9 thousand per year (orange cultivation); and between R$ 32,5 thousand and R$ 98,5 thousand per year (coffee cultivation).
### Analysis of the results

The present study contributes to nurture important environmental and economic issues, highlighted below:

- The environmental law which falls on rural properties (Brazil’s Forest Code) considers mandatory the restoration of stretches classified as Permanent Preservation Areas (PPA) that are deprived of native vegetation. Rural producers have postponed the restoration of these stretches, either due to lack of definition of legal aspects, or economic reasons. This report reinforces that the recovery of degraded areas can, besides protecting the soil and the water resources, reestablish bees’ population that will bring economic benefits due the effective pollination and its consequences in the qualitative and quantitative improvement of the agricultural crops.

- Another important point is the reduction of pollinators that has been detected all over the world, triggered by several factors, such as global warming, overuse of pesticides, diseases and habitat reduction and destruction. Loss of bees can have economic and environmental negative impacts, either because the lack of agricultural crops pollination, or because the essential role that bees have in cross-pollination of native plant species. Emphasize solutions that contribute to restore bees population and with possibilities of economic gains is important to highlight natural capital as a strategic subject to be evaluated in business management.

---

## Data used

<table>
<thead>
<tr>
<th>Agricultural crops</th>
<th>Type of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>coffee and orange (both hypothetical)</td>
<td>Primary (bees inventory); and secondary (distance between the wings base).</td>
</tr>
</tbody>
</table>

### Dependency of pollination by bees: 33% (coffee) and 31% (orange).  

### Area of the agricultural crop considered in the analysis:  
- **Santa Julia Farm**, 535.25 hectares; **Sao Jose Farm**, 149.82 hectares; and **Ouro Verde Farm**, 190.96 hectares.

### Wild pollination (method 2)

#### Number of areas considered as suppliers of pollinators and size:  
Permanent Protection Area (PPA) of each of the three properties evaluated (68.05 hectares of PPA, **Santa Julia Farm** – 11.2% of the property total area; 12.40 hectares of PPA, **Sao Jose Farm** – 7.6% of the property total area; 15.16 hectares of PPA, **Ouro Verde Farm** – 7.35% of the property total area).

#### Areas in which the field diagnosis of bee diversity was carried out, and the percentage they represent in relation to the total area considered as pollinators suppliers:  
Transects that covered one hectare in each property.

---

### Further information

#### Results of the physical indicators:  
The externality generated in the pollination for the orange cultivation was 1.67% to 5.63% per year and 0.89% to 6% per year for the coffee cultivation.

#### Assumptions adopted in the valuation estimates:  
Considering the agricultural crop cultivated in the three properties is sugarcane, which does not require pollination to obtain the product generator of economic value, we assume fictional scenarios and adopted coffee cultivation and citrus production for the study.

#### Adjustments or derivations applied to methods and tools used:  
N/A.

#### Others:  
The study carried out to inventory the bees’ diversity did not intent to produce a study of ecosystem services valuation. Because of this, no information was collected about the flight distance and the distance between the wings base. That’s why we turned to literature for this information. When no specific information was found about the existing species in the inventory, we adopted data from other species, if they were of the same gender or family.

#### Explanatory Notes:  
N/A.
Management of ecosystem services

**Use of ecosystem service valuation results:** Definition of strategic goals and progress monitoring; environmental management; social and environmental impact assessment; and reporting.

**Description:** Studies like this, that demonstrate positive externalities results through investments in natural capital, specifically pollinators, are seen as of great value to the company’s business. The valuation of this ecosystem service in forest restoration projects that BASF promoted through Mata Viva® Program is extremely important for the company’s internal management system because of its certifications, besides bringing positive results of investments made that can boost new initiatives for projects with similar focus.

The support that these results bring to other areas in the company (i.e. the environmental stewardship team) is also important, as these areas have been undertaking several initiatives related to pollinators.
Valuing scenarios of water scarcity to enable actions to reduce water and climate risks

EXECUTIVE SUMMARY

Braskem is a Brazilian company of the chemical and petrochemical sector that works in the production of thermoplastic resins in the Americas, with industrial units in Brazil, United States, Germany and Mexico. Assuming the management of risks and opportunities related to climate change as a component to be inserted in its sustainability strategy in order to maintain and strengthen the business competitiveness, Braskem started, in 2014, the preparation of an adaptation plan, considering its 40 plants.

During this process and subsequently reiterated by a study organized by the company, it was identified, for the Duque de Caxias unit, in Rio de Janeiro state, the scenario of high risk of water scarcity in the Hydrographic Basin of the Guandu River, which supplies the region. In this context, this study seeks to use the valuation of the water provision ecosystem services to elaborate simplified analyzes of some water scarcity scenarios with a focus of viability actions for water and climate risks reduction. Due to this objective, the analysis considered only the impact aspect, considering the year of 2022.

Four scenarios of water scarcity were evaluated: (i) reduction of water authorization by legislative measure and production loss; (ii) increased water use charges; (iii) reduction of water authorization due to hydrological risk and production loss; and (iv) reduction of water authorization and implementation of a project for water reuse to supply 100% of Braskem’s operations. All the scenarios were evaluated by the Marginal Productivity Method (MPM), which considers the company’s productivity variation due to the variation in the quantity of water available for consumption.

The results obtained demonstrate that a reduction of water grant as a result of a legislative measure in the Duque de Caxias region (considering the historical example of The Piracicaba, Capivari and Jundiaí River Basins) could lead to an economic impact of over R$120 million in 2022, due to the load reduction of the industrial plant. This impact is higher when compared to the one caused by the increase in the price paid for the acquisition of reused water in the region (assuming the implementation of a project with conditions similar to Aquapolo).

The results of this study will be used to subsidize the choice of risk management actions associated with water availability in a relevant region to the company’s performance, with the economic valuation allowing the comparison of actions in different scenarios. This is a first exercise seeking to use the valuation tool to subsidize the actions choice in the context of a climate change adaptation plan, and, as next steps, the analyzes can be expanded to compare the cost of the actions to the estimated costs of the likely impacts of climate change.

See a Braskem case of strategy development for adaptation to climate change at: http://adaptacao.gvces.com.br/
Reporting of dependencies, impacts and externalities
Responsible for completing: Gustavo Deguti Kajiura

Project drivers

Goals: Assess risks and opportunities; Compare options; Communicate internally or externally.

Description: After assessing the results of the potential impacts of climate risks on Braskem’s operations, the severe drought scenario for the Duque de Caxias plant in Rio de Janeiro was identified. The study of the Guandu basin was carried out within the adaptation plan, confirming this scenario and the high risk of water scarcity. Based on this diagnosis, it is intended to use the TeSE methodology, considering some scenarios (i.e. water authorization scenario) to obtain results that enable solutions for the reduction of water and climate risks.

Project scope

Object of the project analysis: Project.

Description: The project’s object of analysis comprises Braskem’s industrial unit in Duque de Caxias (UNIB 4).

Geographic Area: Guandu Basin (Duque de Caxias, Rio de Janeiro, Brazil).

Step(s) of the value chain included: Own operations.

Type of approach: Prospective.

Time horizon: 2022.

Ecosystem Services: Water provision.

Water provision

Role of ecosystems in the hydrological cycle and their contribution in terms of water quantity, defined as total production of freshwater.

Method(s) used: Marginal Productivity Method (MPM).

Results

Data used

<table>
<thead>
<tr>
<th>Dependency on the quantity of water</th>
<th>Type of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependency aspect was not evaluated.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hydrological balance of the water used by the business</th>
<th>Type of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Externality aspect was not evaluated.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Watershed from where water is collected, name and classification of the water body</th>
<th>Type of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guandu Basin – Class 2.</td>
<td>Secondary</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Watershed used for water replacement, name and classification of the water body</th>
<th>Type of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not considered in the pilot project.</td>
<td></td>
</tr>
</tbody>
</table>
Further information

Results of physical metrics: Confidential data.

Assumptions adopted in the valuation estimates:

- Analyzes carried out considering 2022 as base year.
- Assuming that the Q4 will suffer a concession reduction similar to the one that occurred in the PCJ Basins in 2014/2015.
- All Q4 water consumption, in scenario 2022, would come from reuse water.
- The price paid for the reuse water in Q4 is identical to that paid for the reuse water of the Aquapolô.
- Braskem would establish a long-term contract for the acquisition of reusable water for a fixed time, but without providing an initial investment.
- The Q4 water supply is quantitatively identical to its water collection.

Adjustments or derivations applied to the methods and tools used: The tool used was the Corporate Guidelines for the Economic Valuation of Ecosystem Services (DEVESE, its Portuguese acronym), with some calculation adjustments: the water deficit (Dh) was estimated using, as a reference, the resolution ANA/DAEE 50 of the PCJ Basins. The valuation considered the dose-response, following the marginal productivity method, not the replacement cost method.

Others: N/A.

Explanatory Notes: N/A.

Analysis of the results

Although the pilot project focused on the impacts for Braskem, it is important to highlight that several scenarios considered (reduction of water authorization by legislative measure, increase in the price paid for the water collected and reduction of concession due to the risk of shortage in the basin) may have impacts on the different users of the basin and, in many cases, may be a reflection of their performance. For this reason, Braskem reinforces the importance of thinking about solutions that involve different actors from the public-private sphere.

Management of ecosystem services

Use of ecosystem service valuation results: Cost-benefit analysis; Risk assessment.

Description: Braskem seeks to use the results obtained from the pilot project to make tangible the scenario of water scarcity in the region, raise awareness of leaders and enable some adaptation actions geared to the risk of water shortages in the region.
Ingredients: Measuring the climate benefits generated by the acquisition of raw material of non-timber forest production

EXECUTIVE SUMMARY

Concepta Ingredients is a division of the Sabará group, specialized in the development of natural and technological solutions focused on the food, beverages, animal nutrition and veterinary pharmaceutical industries. In order to conserve biodiversity and at the same time to make sustainable use of its products, Concepta has been marketing products of the Brazilian sociobiodiversity from agroextractivist origin since 2016.

Concepta’s Sociobiodiversity Project has a look from the supply to industry and involves, among other products of its line, two with Amazonian origin: Brazil nut oil and cupuaçu butter, produced respectively in the municipalities of Juruena, in the state of Mato Grosso, and Porto Velho, in the state of Rondônia. Both come from certified organic sources.

Sustainable extractivism of non-timber products depends on forests and agroforestry systems, their fruits and seeds to support the income of provider families, and, thus, to contribute to the maintenance of the standing forest. In this context, this study seeks to measure the benefits related to global climate regulation corresponding to the acquisition of raw material from non-timber forest production in the next five years, considering that this activity avoids the emission of greenhouse gases by deforestation in the supply areas.

As the objective is to make a projection of how Concepta’s work with extractive communities can avoid deforestation in the area, the analyzes were conducted considering a five-year projection using secondary data from the Project of Deforestation Monitoring in the Legal Amazon (PRODES, its Portuguese acronym) for the municipalities in the Amazon biome.

The valuation of the externality was based on the Replacement Cost method (RCM), considering the Social Cost of Carbon (SCC), which represents the estimated cost of the probable impacts - due to the addition of one ton of carbon in the atmosphere - in agricultural productivity, human health and infrastructure. It was considered that, if there were no extractive activity, the most likely occupation would be pasture for livestock farming, which would generate approximately 17,020 tons of carbon equivalent (tCO₂e) per year.

The results obtained demonstrate a positive externality of approximately R$10 million, in terms of avoided deforestation, due to the use of land for agroextractivist activity.

The results of this study will be used in the communication of the products and for monitoring in the coming years, comparing the projection of this study with the real effected. Although this case contemplates only one of the ecosystem services provided by standing forest maintenance, it is already possible to have a dimension of the importance of such actions, and may in the future have its analysis expanded to include other benefits.
Reporting of dependencies, impacts and environmental externalities
Responsible for completing: Thais Emilia Hiramoto

Project drivers

**Goals:** Understand the business relationship with ecosystem services.

**Description:** Measure the climatic benefits generated by the acquisition of raw materials from non-timber forest production, considering that the reduction of deforestation occurs in the supply areas and, consequently, avoid the emission of greenhouse gases. Currently, valuation is sought as a decision tool at strategic and operational levels in the acquisition of raw materials and expansion of collection areas.

Project scope

**Object of the project analysis:** Project.

**Description:** Primary forest areas in agroforestry systems in the Amazon biome.

**Geographic Area:** 2 municipalities, Juruena, in the state of Mato Grosso, and Porto Velho, in the state of Rondônia.

**Step(s) of the value chain included:** Upstream (suppliers).

**Type of approach:** Prospective.

**Time Horizon:** Projection in five years.

**Ecosystem Services:** Global climate regulation.

Global climate regulation

The role played by ecosystems in carbon and nitrogen biogeochemical cycles, thus influencing emissions of important greenhouse gases, such as CO₂, CH₄, and N₂O.

**Method(s) used:** Replacement Cost Method (RCM).

**Results**

**Externality:** approximately R$ 10,2 million

<table>
<thead>
<tr>
<th>Data used</th>
<th>Type of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoided deforestation</td>
<td></td>
</tr>
<tr>
<td><strong>Biome phytophysiognomy and land use:</strong> Open Ombrophilous Submontane Forest ; potential land use: pastures.</td>
<td>Secondary</td>
</tr>
<tr>
<td>Avoided deforestation, in hectares: 269 ha.</td>
<td>Secondary</td>
</tr>
<tr>
<td>Deforestation rate considered as base line: 0.63% in Juruena; and 0.74% in Porto Velho.</td>
<td>Secondary</td>
</tr>
<tr>
<td>Deforestation rate with the project: 0.10% for both regions.</td>
<td>Estimative</td>
</tr>
<tr>
<td>Avoided emissions, in tCO₂-equiv: 85,102,81 in five years.</td>
<td>Secondary</td>
</tr>
</tbody>
</table>
Further information

Exchange rate used to convert the Social Cost of Carbon (CSC) into Brazilian Reais: R$ 3.16, as of the date of completion of the tool (December 08, 2017).

Assumptions adopted in the valuation estimates: Project duration time: five years. Rate of deforestation at the baseline based on the average of the last 10 years of deforestation increment in the target cities. Deforestation rate with the project: considered 0.10%. Most likely use after deforestation: conversion to pasture is the most likely in the areas considered and in the Amazon as a whole.

Adjustments or derivations applied to the methods and tools used: N/A.

Others: N/A.

Explanatory Notes: The data on deforestation rates for the last 10 years were collected using the Prodes. Five years of project were assumed, considering the line of sociobiodiversity products reaching maturity in commercial terms in that period. The areas considered were informed by the supplier partners and are located within the municipalities evaluated in PRODES.

Analysis of the results

Although relatively small areas, considering the land status in the Amazon, these areas comprise important projects of considerable success according to the biodiversity conservation combined with the social benefit for the involved members. For this, there is a need for an established market that absorbs these products and that helps the forest to continue as a productive and economically viable asset.

Based on the above assumptions, in five years, 3% of the total area would be deforested in the absence of the project, in both regions, which represents approximately 73 thousand tons of CO₂e in the municipality located in Mato Grosso; and 12 thousand tons of CO₂e in the case of the municipality located in Rondônia. The presented externality is significant: around R$ 9 million in the region supplier of Brazil nuts, and R$ 1 million in the region supplier of cupuaçu.

Management of ecosystem services

Use of ecosystem service valuation results: Social and environmental impact assessment.

Description: This evaluation is an initial projection of the potential impacts generated by the acquisition of products of agroextractivist origin. In this way, the intention is to monitor them and monitor the performance of the project, using these numbers as indicators and components for decision making in relation to volumes and products marketed, location of projects and target markets.
Comparison of impacts and externalities between the use of integrated vegetation management in electrical systems and the use of mower on a distribution line in Parana

EXECUTIVE SUMMARY

The Companhia Paranaense de Energia (Copel) operates in the areas of generation, transmission, power distribution and telecommunications. In order to maintain the safety and quality of the energy supply, the concessionaires periodically carry out the maintenance of the passage lines and energy distribution networks in rural areas by means of manual or mechanized mowing, generally with the complete removal of vegetation.

In substitution of the mower, the electric sector has been discussing the use of Integrated Vegetation Management (IVM): a set of practices aiming the establishment, in the long term, of a community of plants whose growth characteristics do not interfere in the operational performance of the electrical facilities or that require the minimum of interventions, besides providing protection for the soil, shelter and feeding for the fauna, among other benefits.

The objective of this case study was to know the impacts and externalities of the use of integrated vegetation management in electrical systems in comparison to manual or mechanized mowing. In order to do so, the study evaluated which ecosystem services provided by the native vegetation can be maintained with the integrated management of vegetation in electrical systems. After identification, the evaluation of ecosystem services for global climate regulation and regulation of soil erosion was conducted.

As an example for this case, the high-voltage distribution line LDAT 138 kV Telêmaco Borba - Tibagi was considered, in a region of occurrence of the Mixed Ombrophilous Forest and Estepe (native Fields). The route has an approximate length of 28 kilometers and a passing bandwidth of 19 meters, in the municipalities of Telêmaco Borba and Tibagi, in the state of Paraná.

For global climate regulation, a negative externality of R$ 3.25 million was estimated in the mower scenario. In the scenario of implementation of the IVM, the negative externality decreases to R$ 1.22 million. Regarding the CO₂ emissions balance, the area in question resulted in a balance of -26,726.21 tCO₂e, while in the IVM the balance was -10,029.29 tCO₂e. Although the IVM also presents a negative externality for this ecosystem service, it is still more advantageous than traditional mowing, in addition to having a more favorable emissions balance. In addition, in the IVM, the interventions when more soft and spaced will allow greater land conservation both in physical-chemical properties and in its organic carbon stock. Regarding the regulation of soil erosion, the erosion rate in the mowing scenario was 310.51 tons per hectare per year, while in the IVM scenario it was 149.05 tons per hectare per year. Due to data restrictions, it was not possible to estimate the valuation, however, the erosion rate of IVM confirms the benefits of this alternative since the herbaceous-shrub cover will provide protection to the soil against erosion.

Approximately 25% of the traced on the studied distribution line is located in agricultural areas, and studies in the same region for other business indicate the occurrence of 35 species of native bees, in addition to other pollinators. This indicates that there is a great potential for pollination regulation with positive externality, but it was not possible at this moment to conduct the valuation study, due to data unavailability. In the future, it is recommended to conduct field research to better understand the relationship between increased supply of wild pollination for crops close to the Company’s facilities and to understand how rural owners could benefit from this. In addition to the ecosystem services reported above, integrated vegetation management can also contribute to wildlife habitat, forest fire prevention, and the provision of medicinal and non-wood products. Thus, it can be confirmed that the integrated vegetation management maintains in part the environmental benefits that the native vegetation provides, unlike the mowing, that would practically cancel them.
Due to restrictions found for a complete valuation, because the lack of data, this theme was included in a proposal for a research and development project on integrated vegetation management that is in elaboration. The ecosystem services approach will help in the communication with the interested parties, mainly as an argument with the environmental agencies for application of the methodology of integrated vegetation management in electrical systems in a larger scale.

### Project drivers

**Goals:** Assess risks and opportunities; Compare options; Communicate internally or externally; Understand the business relationship with ecosystem services.

**Description:** Currently, the maintenance of safety ranges of networks and power distribution lines is performed by manual or mechanized mowing. With these techniques, there is habitat fragmentation, soil erosion and favoring invasive alien species. As a substitute for this process, the electric sector has been discussing the use of Integrated Vegetation Management (IVM) in Electrical Systems, with control only of species whose growth habits and size offer risks to the operational safety of the distribution lines and networks, most shrub plants and herbaceous cover.

With the characterization and quantification of related ecosystem services, it is possible to know the impacts and the externalities obtained with the implementation of this practice.

### Project scope

**Object of the project analysis:** Project.

**Description:** Assessment of ecosystem services for global climate regulation and regulation of soil erosion, aiming to know the externalities of the use of integrated vegetation management in electric systems in comparison to traditional or mechanized mowing. Although the ecosystem service of pollination regulation was initially considered in the analysis, it was not possible to quantify and evaluate it because of data unavailability.

**Geographic Area:** Telêmaco Borba and Tibagi, in the state of Paraná, Brazil.

**Step(s) of the value chain included:** Own operations.

**Type of approach:** Prospective.

**Time horizon:** Five years.

**Ecosystem Services:** Global Climate Regulation and Soil Erosion Regulation.

### Global climate regulation

The role played by ecosystems in carbon and nitrogen biogeochemical cycles, thus influencing emissions of important greenhouse gases, such as CO₂, CH₄, and N₂O.

**Method(s) used:** Replacement Cost Method (RCM).

**Results**

**Externality:** Scenario 1 (mower): - R$ 3,25 million; Scenario 2 (IVM): - R$ 1,22 million
Data used

<table>
<thead>
<tr>
<th>Type of data</th>
<th>Net emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Actual emissions resulting from deforestation or environmental degradation, in tCO₂e:</strong></td>
<td>Primary</td>
</tr>
<tr>
<td>Balance - 26.726,21 (mowing)</td>
<td></td>
</tr>
<tr>
<td>Scenario 1 (mowing) = 27.828,21</td>
<td></td>
</tr>
<tr>
<td>Scenario 2 (IVM) = 11.131,28</td>
<td></td>
</tr>
<tr>
<td><strong>Actual removals resulting from environmental recovery, tCO₂e:</strong></td>
<td>Primary</td>
</tr>
<tr>
<td>Balance - 10.029,29 (IVM)</td>
<td></td>
</tr>
<tr>
<td>Scenario 1 (mowing) = 1.102,00</td>
<td></td>
</tr>
<tr>
<td>Scenario 2 (IVM) = 1.102,00</td>
<td></td>
</tr>
<tr>
<td><strong>Avoided deforestation</strong></td>
<td></td>
</tr>
<tr>
<td>Biome phytophysiognomy and land use: Mixed Ombrophilous Montana Forest</td>
<td>Secondary</td>
</tr>
<tr>
<td>Area of avoided deforestation, in hectares: 53,2</td>
<td>Primary</td>
</tr>
<tr>
<td>Deforestation rate considered as base line: 53,2%</td>
<td>Primary</td>
</tr>
<tr>
<td>Deforestation rate with the project: 40%</td>
<td>Primary</td>
</tr>
<tr>
<td>Avoided emissions, in tCO₂e: 16.696,92</td>
<td>Primary</td>
</tr>
</tbody>
</table>

Further information

Exchange rate used to convert the Social Cost of Carbon (SCC), in Brazilian Reais: 3,20.

Assumptions adopted in the valuation estimates: With IVM, it is estimated that about 60% of the vegetation is maintained, while in the mowing 100% of the vegetation cover would be removed.

Adjustments or derivation applied to the methods and tools used: N/A.

Others: N/A.

Explanatory Notes: The calculation tool considers tree vegetation for the emissions calculation. However, in the IVM, the vegetation maintained will be only shrub and it was not possible to calculate this differentiation or find references to a value closer to the real.

As the objective was to compare IVM to mowing, two calculations were made for global climate regulation - one for each scenario. Scenario 1 - mowing; Scenario 2 - IVM.

Due to the fact that the tool does not have the mowing vegetation category, it was considered Pasture - Other Biomes.

As avoided emission, the difference between the emissions of the mowing and the IVM was considered.

### Soil erosion regulation

Role played by ecosystems in controlling soil erosion processes – natural processes, which can be accelerated or retarded depending on the type of use and the soil management practices adopted.

Method(s) Used: Valuation was not performed (quantification only).

Results

<table>
<thead>
<tr>
<th>Dependency:</th>
<th>Not calculated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact:</td>
<td>Not calculated</td>
</tr>
<tr>
<td>Externality:</td>
<td>Not calculated</td>
</tr>
</tbody>
</table>
TRENDS IN ECOSYSTEM SERVICES | 2017 CYCLE

Data used

<table>
<thead>
<tr>
<th>Total area covered in erosion estimates: 53.2 hectares.</th>
<th>Type of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Different soil uses: Degraded grazing (mowing) x reclaimed pasture (IVM).</td>
<td>Primary</td>
</tr>
<tr>
<td>Loss of soil nutrients (Method 1): N/A.</td>
<td></td>
</tr>
<tr>
<td>Turbidity in the body of water (Method 2): N/A.</td>
<td></td>
</tr>
</tbody>
</table>

Further information

Results from physical metrics: Scenario 1 (mowing) – 310.51 t/ha.year; Scenario 2 (IVM) – 149.05 t/ha.year.

Assumptions adopted in the valuation estimates: the mowing was considered as degraded pasture and the IVM, as pasture recovered.

Adjustments or derivation applied to the methods and tools used: N/A.

Others: N/A.

Explanatory Notes: For this analysis, an approximation was made with secondary data for ramp length and type of soil, due to the unavailability of stratified primary data for the entire length of the line.


We considered the restored pasture (IVM) as CPmin, and degraded pasture (mowing) as CPmax.

The valuation calculation was not performed, since we do not have reference data on the cost of land replacement in power lines, since it is a practice carried out on a timely basis (we have no recent historic of this cost).

Analysis of the results

Even with the lack of data, it was possible to compare the two procedures and to realize differences that justify the use of integrated vegetation management instead of mowing.

The deployment of power distribution lines is expected to modify the environment. The IVM appears as a less aggressive alternative, since it maintains part of the vegetal cover, favoring the habitats for the fauna, the native species and preserving the soil. Both the business and the surrounding community will benefit.

In order for IVM to be a routine practice in the implementation and maintenance of electrical systems, it is necessary to consider it in environmental studies where consistent data can be obtained to justify its choice.

Management of ecosystem services

Use of ecosystem service valuation results: Cost-benefit analysis; Social and environmental impact assessment; Reporting.

Description: The results show that the implantation of the integrated vegetation management at the analyzed area is more favorable than the manual or mechanized mowing, confirming what was already expected, based on the North American literature and experience.
Evaluation of the economic benefits enjoyed by the company as a result of recreation and tourism activities in its operation regions

EXECUTIVE SUMMARY

Ecocataratas is the company responsible for the administration of 387.1 kilometers of the BR-277 highway, between the cities of Guarapuava and Foz do Iguaçu, being one of the main routes to the Iguaçu Falls and to the rest of Latin America. The Concessionaire Ecovia Caminhos do Mar S/A maintains, under its administration, 175.1 kilometers of roads between the capital and the coastal cities of Paraná, connecting Curitiba to the Paranaguá Port. Both are part of the EcoRodovias Group, an integrated logistics infrastructure company.

Considering the relation of companies with the natural tourist attractions in Paraná, Ecocataratas and Ecovia have chosen to assess the impact of the cultural ecosystem service for tourism and recreation in the region and the consequent economic benefits for the activities of the companies, in the form of toll collection. Thus, these case studies considered companies as one of the beneficiaries of ecosystem services for recreation and tourism in their respective regions.

Such scope was selected in order to understand if the portion of users who use the highway for tourism purposes is significant to invest in this public and consider the promotion of recreation and tourism activities in the companies’ strategy. The quantification of the number of users traveling through the highways for recreation and tourism used the data from the satisfaction surveys performed by the companies in their toll plazas throughout 2016. It considered only tourists using light vehicles, except motorcycles. Taking into account that satisfaction surveys do not discriminate tourist destinations, the results obtained are simplified and it is not possible to attribute which portion of the externality is referring to each tourist site.

The Travel Cost Method (TCM) - which seeks to estimate the economic value of the ecosystem service through the demand for this service - was adapted taking into account that transportation, lodging, food and ticket expenses in travel for recreation purposes, leisure and tourism reflect minimally the benefits provided by ecosystems that promote such activities. In these cases, only the share of tourist expenses related to the toll was considered, which is the portion internalized by Ecocataratas and Ecovia.

For Ecocataratas and Ecovia, the number of users in 2016 for tourism purposes was, respectively, around 3.2 and 3.8 million, with impact valued at approximately R$ 39.7 million and R$ 69.6 million. These results represent the contribution of the ecosystem service of recreation and tourism in question directly to the results of the companies, which demonstrates the importance of considering it in the strategic planning.
Reporting of dependencies, impacts and externalities
(Ecocataratas) Responsible for completing: Marcelo Rançan

Project drivers

Goals: Understand the business relationship with ecosystem services.

Description: The highway concession for lot 03 of the State of Paraná covers the section of BR 277 that connects the municipalities of Guarapuava, in the central region of the state, to the municipality of Foz do Iguaçu, western region of the state. The objective was to evaluate the influence of recreation and tourism ecosystem service in the Iguaçu National Park/Iguaçu Falls region, as well as the attractions related to the leisure of the coastal states of Paraná and Santa Catarina, about tourism and the positive impacts on the revenue from charging fees by the company. The information will be used to analyze whether the total number of users using the highway in order to access the tourist areas is significant or not. These data will be considered in the definition of strategies in order to evaluate the ecosystem service in question.

Project scope

Object of the project analysis: Project.

Description: An analysis was made for the project related to the concession of the Integration Ring of the State of Paraná, corresponding to lot 03, operated by the Rodovia das Cataratas S.A/Ecocataratas (company of the Ecorodovias Group). The company considers, as a Product, the compliance with contractual guidelines, service and the provision of services guided by quality, mobility and safety of users.

Geographical area: Sections of conservation and operation of the highway:

- BR-277 – Guarapuava to Foz do Iguaçu, between the km 344 and 731,1;

Sections of conservation:

- PR-180 – Stretch linking the BR 277 to the municipality of Juvinópolis - 22 kilometers;
- PR-474 – Stretch linking the BR 277 to the municipality of Campo Bonito – 7,6 kilometers;
- PR-590 – Stretch linking the BR 277 to the municipality of Ramlândia – 13,5 kilometers;
- PR-874 – Stretch linking the BR 277 to balneário de Santa Terezinha de Itaipu – 13,4 kilometers.

Step(s) of the Value Chain Included: Own operations and downstream (clients).

Type of approach: Retroactive.

Time Horizon: 2016.

Ecosystem Services: Recreation and tourism.

Recreation and tourism

Role of ecosystems as places where people find opportunities for rest, relaxation and recreation.

Method(s) Used: Travel Cost Method (TCM).

Results

Impact: N/A

Externality: R$ 39.7 million
Data used

<table>
<thead>
<tr>
<th>Data used</th>
<th>Type of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total preserved area: N/A.</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Alternative economic use of area: N/A.</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Number of visitors in a year: 3,255,534.</td>
<td>Primary / Own</td>
</tr>
<tr>
<td>Visitor’s origin and representativeness of each source in relation to the others</td>
<td>Primary</td>
</tr>
</tbody>
</table>

(percentage of total visitors that was appropriate to each of these origins): considering the data obtained from the survey of user satisfaction, about 30% of the overall total of light/passengers vehicle is composed of tourists. The data indicate that this percentage comes mainly from the eastern and northern regions of the state of Paraná. There was no percentage breakdown by region at this time (this factor will be detailed with data for 2017, which will be tabulated at the beginning of 2018).

Further information

Assumptions adopted in valuation estimates: the general total of light vehicles that passed through the five toll plazas that are under the custody of the concessionaire in 2016 was adopted as a premise, as a basis for the percentage calculation of users who used the highway to access tourist attractions, search results of user satisfaction.

Adjustments or derivations applied to methods: considering that the focus of the study was the company as one of the beneficiaries of the impacts linked to the ecosystem service for recreation and tourism, the collected data were not perfectly applicable to the calculation tool, and, therefore, the calculations were done manually. The Travel Cost Method was adapted, considering only the tariff charged on the toll. In this case, the number of road users who declared traveling for tourism and recreation reasons, was multiplied by the cost of the tolls, considering the percentage increase in the rate that occurs in December.

Others: N/A.

Explanatory Notes: The data obtained from the Ecocataratas user satisfaction survey of 2016 did not discriminate in detail important data, such as tourist destination, for example: beaches of the coast of Paraná or Santa Catarina, or tourist attractions located in the central region of the state, or the exact percentage which moved to the natural attractions located on the triple border. This information, however, referred to the general total of users who used the highway for tourism, and it is not possible to specify the percentage of leisure and business tourism. This factor has already been corrected, and will be used in the satisfaction survey of 2017, clear data, such as origin, destination, detailed discrimination regarding tourism, and destination for leisure tourism in Foz do Iguaçu, or destination for business tourism in the Paraguay, will be analyzed in more detail. With these improvements, it is intended to obtain an accurate data and to be able to develop strategies to boost the interest of the target audience, thus promoting the valuation of the Ecosystem Services, object of this study on behalf of the company.

Analysis of the results

The impact with the collection of the toll tariff on the tourist users of the road system under concession generated, in 2016, an approximate turnover of R$ 39.7 million for the company. Considering that toll tariff collection directly influence EBITDA (all that the company collects from its activities), this factor demonstrates the significant collaboration of the ecosystem service with the results of Ecocataratas. In this way, it will be considered as a relevant issue and should compose the strategic planning for 2018.
Management of ecosystem services

**Use of ecosystem service valuation results:** Definition of strategic goals and monitoring of progress.

**Description:** Considering that the flow of users who use the stretch of highway under concession to access the state's tourist attractions is influenced mainly by holidays, July and summer holidays (season that extends from November to January), these factors lead to a considerable increase in the flow of vehicles that use the highway, which contributes to the revenue increase. These factors suggest that the business strategic development, exploring the domain stretch and the installation of advertising panels and Mega Panels of the five toll plazas with incentive to tourism in the region of the triple border, will be increased. In this context, there is potential to leverage results in visits to tourist attractions - ecosystem service for recreation and tourism. In 2015/2016, the company invested in campaigns to encourage tourism in partnerships with agencies in the region of Iguaçu Falls, promoting tourist attractions, thus boosting the visits. These processes will be considered, in 2018, in the planning of the company with the purpose of promoting the users interest in the road system for tourist visitation in the areas of interest in the triple border, as well as the access, by highway, to the coast of Paraná and Santa Catarina. In addition, the company maintains, through donation, the transfer of amounts to be applied on nature conservation actions in the Iguaçu National Park.

**Reporting of dependencies, impacts and externalities**
*(Ecovia Caminhos do Mar)* Responsible for completing: Felipe Augusto Copi Guilherme

---

**Project drivers**

**Goals:** Understand the business relationship with ecosystem services

**Description:** The highway concession for Lot 06, in the state of Paraná, covers the section of BR 277 that connects the capital to the state's main beaches, being the main route used by tourists who want to enjoy the coast of Paraná.

The objective is to assess the impact influence of cultural ecosystem services (beaches and natural wonders of the mountains and coast) on tourism in the region and the consequent economic benefits of the impact on the company’s activity (toll collection). Hence, it aims to understand if the portion of users that uses the highway for the purpose of tourism is significant, so to invest in this public.

---

**Project scope**

**Object of the project analysis:** Project

**Description:** It will be analyzed the project inherent to lot 06 of the Paraná State road concession, a concession operated by Ecovia Caminho do Mar S/A (company of the Ecorodovias Group), focusing on tourist users in light vehicles (except motorcycles).

**Geographical area:** The geographical area of Lot 6 is composed of a total of 175.1 kilometers of highways and respective domain stretches. The sections are detailed below:

**Sections of conservation (maintenance of roads and domain strip) and operation:**

- BR-277 – Paranaguá e Curitiba between the km 0 and 84.2;
- BR-277 – Avenida Ayrton Senna – 1.5 kilometer;
- PR-508 – Alexandra to Matinhos between the km 0 and 32;
- PR-407 – Paranaguá to Pontal do Paraná between the km 0 and 19.
Sections of conservation (maintenance of roads):

- PR-804 – BR-277 junction to PR 408 junction - 1.6 kilometer;
- PR-408 – Road junction from BR-277 to Morretes - 8.2 kilometer;
- PR-408 – Morretes to road junction of PR-340 – 9.6 kilometer;
- PR-411 – Morretes to road junction of PR-410 (S. J. da Graciosa) – 13 kilometer.

Step(s) of the Value Chain Included: Own operations and downstream (clients).

Type of approach: Retroactive.

Time horizon: One year (2016).

Ecosystem services: Recreation and tourism.

---

### Recreation and tourism

**Role of ecosystems as places where people find opportunities for rest, relaxation, and recreation.**

**Method(s) Used:** Travel Cost Method (TCM).

**Results**

<table>
<thead>
<tr>
<th>Impact</th>
<th>Externality: R$ 69.6 milion</th>
</tr>
</thead>
</table>

**Data used**

<table>
<thead>
<tr>
<th>Total preserved area</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative economic use of area</td>
<td>N/A</td>
</tr>
<tr>
<td>Number of visitors per year</td>
<td>3,851,807.</td>
</tr>
</tbody>
</table>

**Visitor’s origin and representativeness of each source in relation to the others (percentage of total visitors that was appropriate to each of these origins):** Overall total of light vehicles, about 85% of the total were composed of tourists, originating mainly from Curitiba, with participation of 60.5%.

**Further information**

**Assumptions adopted in the valuation estimates:** The overall total of light vehicles that passed through the toll plaza under the custody of the concessionaire in 2016 was adopted as a premise, based on the percentage calculation of users who used the highway to access the tourist attractions, the results of user satisfaction survey, which has an error margin of 5%.

**Adjustments or derivations applied to the methods:** Considering that the focus of the study was the business as one of the beneficiaries of the impacts generated by the ecosystem service of recreation and tourism, the collected data were not perfectly applicable to the calculation tool, and, therefore, the calculations were performed manually. The TCM was adequate, considering only the tariff charged on the toll. The number of road users claiming to travel for tourism and recreation reasons has multiplied by the toll cost.

**Others:** N/A.
Explanatory Notes: The data related to the Ecovia user satisfaction survey of 2016 did not discriminate, in detail, important data such as: beaches on the coast of Paraná or Santa Catarina, or tourist attractions located in the mountain region of the state, only the direction of the user in the highway. Considering that the majority originated from Curitiba, it is understood that the predominance of tourism is for the coast of Paraná and not the opposite, from the coast to mountain region/state capital.

Analysis of the results

The impact with the collection of the toll tariff generated a turnover of approximately R$ 69.6 million to the company’s accounts. This demonstrates the expressive collaboration of the ecosystem service with the results of Ecovia, being considered a relevant issue, and should comprise the strategic planning of 2018.

Management of ecosystem services

Use of ecosystem service valuation results: Definition of strategic goals and monitoring of progress.

Description: It is understood that the promotion of tourism activities should, mainly in the low season, be contemplated in the strategic planning of Ecovia, since tourism in the mountainous and coastal region represent a significant billing for the company, thus, the opportunity reached by the externality can be better explored. In the budget for 2018, the gastronomic event “Os Sabores do Litoral” is already planned, involving restaurants and hotels in the region, with Ecovia being the main promoter.

The environment conservation actions on the coast and Atlantic Forest can be considered in the strategic planning, but respecting the context of the organization and its budget commitment.
Evaluation of the relation of the User Assistance Service (UAS) Rio Grande with the ecosystem service of water provision

EXECUTIVE SUMMARY

The Empresa Concessionária de Rodovias do Sul, known as Ecosul, belongs to the EcoRodovias group, created in 1998 to manage the Pelotas’ Road Pole, which includes the BR 116/RS (from km 400 to km 659) and BR 392/RS (from km 0 to km 68 and from km 71 to km 200). Among the services provided by the company in the Pole, there is the UAS - User Assistance Service - which provides infrastructure for travelers, such as rest area and toilets.

The operating units of the concessionaire depend on water for proper operation, but public water provision systems are not available in the units’ locations. The concessionaire, therefore, captures water in the underground, which depend on authorization to explore the water. In this context, the company opted to evaluate its relationship with the ecosystem service of water provision, in terms of dependency and externality, in its new unit UAS Rio Grande. In the absence of the authorization for water use at the time of opening of the UAS, there may be unavailability of water in the operational units, and it is in the company’s interest to quantify and assess this risk, as well as to consider alternatives for water use in these locations.

Considering that the UAS Rio Grande is not operating yet, historical data from other units were used, considering the availability of 100% of the amount of water required for the normal operation of the UAS. Scenarios of water unavailability were not considered. The valuation was done by the Replacement Cost Method (RCM), considering the replacement of the water necessary for the operation of the UAS by water tank truck.

The dependence of the amount of water is 0.009 m$^3$ per UAS user, valued at approximately R$ 6.4 thousand. The externality was 1.7 thousand m$^3$ per year, which becomes unavailable to other users, since there is no return of the water captured by the company to the water body. The externality was valued at approximately R$ 7.9 thousand.

These results represent one of the indicators that should be considered when planning projects that require water provision and risk management by the business. Water unavailability may result in fines and other risks, such as disruption of activities and damage to the company’s reputation.

For the SAU Rio Grande, the only alternative method of water provision was the water tank truck. However, whenever possible, it is relevant to consider, when choosing the location of the operating units and its management, other alternatives for water replacement, as well as scenarios of unavailability and the comparison of these replacement costs with the possible costs resulting from suspension of operations.
**Project drivers**

**Goals:** Understand the business relationship with ecosystem services.

**Description:** The operating units of the concessionaire are totally dependent on water, for the use of employees and users and washing; there is no availability of public water supply in the localities where the units are established, forcing the concessionaire to capture the resource through underground wells, which depend on government authorization. If this authorization does not occur in time, there is a risk of water unavailability in the operational units, and it is important to quantify and assess this risk, as well as to think about alternatives for water use in these locations.

**Project scope**

**Object of the project analysis:** Project.

**Description:** Evaluate alternatives and related costs for provision of drinking water in the company's new user assistance service unit (UAS Rio Grande), as well as to identify alternatives to reduce the consumption of this resource.

**Geographic Area:** The area is located in the domain path comprised by Km 33 of BR-392, under the geographical coordinates Lat. 32° 1'16.52"S and Long. 52°17'17.36"O.

**Step(s) of the value chain included:** Own operations.

**Type of approach:** Retroactive.

**Time Horizon:** One year (2016).

**Ecosystem Services:** Water provision.

**Water provision**

Role of ecosystems in the hydrological cycle and their contribution in terms of water quantity, defined as total production of freshwater.

**Method(s) Used:** Replacement Cost Method (RCM).

**Results**

- **Dependency:** R$ 6,4 thousand
- **Impact:** Not calculated
- **Externality:** R$ - 7,9 thousand

**Data used**

- **Dependency on the quantity of water:** 0,009 m³/UAS user.
- **Hydrological balance of the water used by the business:** - 1.776,10 m³/year.
- **Watershed from where water is collected, name and classification of the water body:** Underground well (Mirim Lagoa Basin and Sao Gonçalo Channel).
- **Watershed used for water replacement, name and classification of the water body:** N/A.
Further information

• All water to be collected originates from underground tubular well.

• There is no possibility of water replacement through another natural water source. The only replacement option, if the water is unavailable, is the supply by water tank truck.

Results of physical metrics:

• Scenario of 1,434.29 m³ of unavailable water.

• Zero m³ of water collected, however, compared to the other existing UAS, a minimum of 1500 m³ would be required per guarantee.

• There is no water directly returned to the river basin.

Assumptions adopted in the valuation estimates: Considering that the SAU was not operating until then, for analysis purposes, historical data from other units were considered on the quantity of water required for the normal operation of the UAS, with availability of 100% of this water (scenarios of unavailability were not considered). For the valuation, the replacement by water tank truck was considered.

Adjustments or derivation applied to the methods and tools used: N/A.

Others:

• All the water used in the business activities comes from underground tubular well, which requires an environmental agency authorization for its use.

• There is no water return, used or not, for the water body.

Explanatory Notes: N/A.

Analysis of the results

It is clear that the use of alternative methods of drinking water supply becomes economically unviable when compared to the use of underground wells. Furthermore, with the use of wells, we can effectively monitor the quality of the water provisioned to the users/customers and not have external problems, i.e. unavailability of water tank trucks, of water from the supply source, etc.

Another extremely important point is that, if water is not available, the business can not operate, that is, there is no user assistance, a fact that can generate fines by the regulatory agency of the concession contract. In addition to the measurable costs of the fines, there are also other intangible costs, such as a possible negative image for the company, because in case of interruption of the activities of the UAS, there will be several complaints.

Management of ecosystem services

Use of ecosystem service valuation results: Environmental management systems.

Description: In order to avoid problems in the next projects/constructions in general, which demand water provision, it is clear that planning is necessary in order to anticipate the whole process of requesting the authorization with the environmental agency, since there may be setbacks during this procedure.
Assessment of the impact of water provision reduction in power generation in a Small Hydroelectric Plant (SHP)

EXECUTIVE SUMMARY

The Toctao Group presents, in its portfolio, private projects of different sizes and segments, from hydroelectric power plants to residential buildings. The Group activities, especially in energy generation, have a strong relationship with ecosystem services, since they depend directly on water provision. Thus, it is relevant to understand how these relations occur.

Since 2008, Toctao Group is operating two Small Hydroelectric Plants (SHP) at Palmeiras River, in the state of Tocantins. In this watercourse, there is a complex of nine hydroelectric projects in cascades, a run-of-river type, and Toctao projects are located further downstream. It was evaluated that, in the period from 2009 to 2016, there was an average reduction of 15% in energy generation, resulting from the river water flow. Considering that the generation reduction impacts the economic viability of the business, the Marginal Productivity Method (MPM) was used to calculate the impact of the water provision reduction for the business in the period from 2009 to 2016.

The results indicate that the water deficit generated a loss of revenue of approximately R$ 11 million in the period, counting only the years in which the necessary flow to generate the physical guarantee (the expected amount of energy within the technical parameters which can be used for trading through contracts) was not reached. Based on the dimension of this impact, the company sought to understand which environmental aspects were related to the water provision to guide actions of management and reduction of risks to which the business is exposed. They sought to understand the dynamics of the environment where the SHPs are installed, analyzing satellite images and the respective land uses in the period prior to the construction of the projects, as well as the rainfall data since the plants started its operations.

This study evidenced that degradation advance in the edges of the basin near the springs of the Palmeiras River is impacting the water provision for power generation and other uses related to the river. Although it is not possible to determine the dose-response of the impact of the land use alteration, it is evident the need for mobilization of actors and competent agencies for better management of the land and water use in the region.
Reporting of dependencies, impacts and externalities
Responsible for completing: Cinthia Martins dos Santos Peixoto e Bruna Gomides Gouveia

Project drivers

Goals: Understand the business relationship with ecosystem services.

Description: The company is dependent on the Palmeiras River for water provision that is used for hydroelectric power generation and is directly impacted by the consequences of variations in the water provision. However, it has been observed the reduction in the river flow, due to degradations close to the springs of the watercourse areas and abnormal variations of rainfall.

Project scope

Object of the project analysis: Project.

Description: It was analyzed the impact of the water deficit in the period between 2009 and 2016 in the generation of hydroelectric power in the SHPs of Riacho Preto and Lagoa Grande, in the Palmeiras River basin.

Geographic Area: Hydrographic Basin of the Palmeiras River to upstream of the SHP Lagoa Grande.

Step(s) of the value chain included: Own operations.

Type of approach: Retroactive.

Time Horizon: 2009 to 2016.

Ecosystem Services: Water provision.

Water provision

Role of ecosystems in the hydrological cycle and their contribution in terms of water quantity, defined as total production of freshwater.

Method(s) used: Marginal Productivity Method (MPM).

Results

Dependency: Not calculated

Impact: R$ 11 million (scenario A) and R$ 1.5 million (scenario B)

Externality: Not calculated

Data used

<table>
<thead>
<tr>
<th>Data used</th>
<th>Type of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependence on the quantity of water for 1 MW production: SHP Lagoa Grande 6.3 m³/s; and SHP Riacho Preto 11.45 m³/s</td>
<td>Primary</td>
</tr>
<tr>
<td>Deficit of flow in the watercourse: For Scenario A, the flow deficit was 21.48 m³/s; and for Scenario B, the flow deficit was 11.04 m³/s. It was noted that the contribution of the sub basin of Ribeirao do Inferno, an affluent of the Palmeiras River, have contributed to a better outflow in the SHP Lagoa Grande.</td>
<td>Primary</td>
</tr>
<tr>
<td>Watershed from where water is collected, name and classification of the water body: The Palmeiras River integrates the Tocantins River basin, being an affluent of the Palma River, which contributes to Paraná River and, in turn, is an important affluent of the Tocantins River. Class 2 river.</td>
<td>Primary</td>
</tr>
</tbody>
</table>
Further Information

Results from physical metrics: dependency of 6.3 m³/s to 11.45 m³/s and impact of 11.04 m³/s to 21.48 m³/s.

Assumptions adopted in the valuation estimates: The impact was considered only in the years when the generation level given by the physical guarantee was not reached (i.e. the real impact, not the impact scenarios).

Adjustments or derivation applied to the methods and tools used: N/A.

Others: The analysis was done observing the generation data.

Explanatory Notes: N/A.

Analysis of the results

With the valuation studies, it was possible to understand the impact dimension for the business regarding the ecosystem service of water provision. The existing data were diffuse and were incorporated in the management from the point of view of sustainability, evolving, also, the perspective of risk analysis. These data will support the scenarios projection and, consequently, the strategic planning of the business.

In this context, it was also possible to improve the understanding through investigation of the causes that are leading to the watercourse flow reduction, thus, to determine actions to be taken for better scenarios in the water provision. With the study, it was observed that the greatest impact on the water provision in the scenario in which the SHPs Lagoa Grande and Riacho Preto are inserted comes from the climatic conditions. Although the climate cannot be managed by the company, it is possible to have a management degree on the impacts on the water provision, through actions such as reforestation and maintenance of the forested areas around the SHP.

Management of ecosystem services

Use of ecosystem service valuation results: Cost-benefit analysis; Definition of strategic goals and progress monitoring; Risk assessment.

Description: The result obtained with the assessment of this ecosystem service will collaborate to upgrade the risk analysis of the business. This will lead to the improvement of the strategic planning of the coming years, taking into account the impact of water provision on generation. Climatological studies may be better evaluated in this sense. Another important action is the understanding of the importance of political action in the sense of promoting articulation among the entrepreneurs of the cascade, as long as actions of environmental planning are conducted in the region next to the springs of the Palmeiras River. It is necessary to create a River Basin committee and the definitions of strategic actions between the governments of the state of Tocantins and Bahia, for territorial planning and appropriate use of the land and water of the region.
Water Resources and the Mucuri River Basin – a study of the ecosystem services of water provision, water quality regulation and global climate regulation

EXECUTIVE SUMMARY

Suzano Pulp and Paper is the second largest global producer of eucalyptus pulp and is among the five largest producers of market pulp. In addition to its relationship with natural capital, in its forestry activities, the company also presents interfaces with natural capital in its industrial operations. For the present study, Suzano chose to evaluate this relationship in its industrial unit in Bahia. This is because, located in the Mucuri River Basin, the company supplies its water resources and develops environmental recovery actions of forest areas in the basin.

In relation to ecosystem services for water provision and water quality regulation, Suzano chose to evaluate, from an economic perspective, its dependencies and impacts. For the water provision service, a prospective exercise of water unavailability equivalent to 25% of the plant’s demand was carried out, and the economic valuation was calculated by the Replacement Cost Method (RCM), considering the substitution of own collection for provision by the water utility. In this scenario, the company would be impacted by an unavailability of about 14 million liters/year, an amount of R$ 288 million.

For the ecosystem service of water quality regulation, the parameters related to turbidity were evaluated using the RCM valuation, considering the modelling of a Water Treatment Plant (WTP) implementation. The company’s dependence was calculated at 182 UNT and the impact at 19 UNT, valued at R$ 1.2 million/year and R$ 717 thousand/year, respectively.

These results allowed the company to reflect on the business unit’s exposure to potential operational and financial risks, considering scenarios of changes in water availability patterns.

Complementarily, the company also opted to evaluate the potential positive externality to be generated by its forest restoration project in relation to the ecosystem service of global climate regulation. The Mucuri River Springs Project, started in 2017, aims to recover degraded areas of river sources. An average of one hectare per spring was considered, in areas of Dense Ombrophilous Submontane Forest, in the Atlantic Forest biome, degraded by pasture activity. Considering the recovery of 500 river sources over 5 years, it is estimated that approximately 540 thousand tCO₂e will be removed, which were valued at R$ 67.8 million, when using the Social Cost of Carbon, which considers the estimated costs of the probable impacts of the addition of one ton of carbon to the atmosphere.

The results of this study were used by the company in a context of results measurement and communication with stakeholders, providing information that can support the dialogue regarding the monitoring and performance of the forest restoration project.
Report on dependencies, impacts and externalities
Responsible for completing: Valeria Parisotto Victor

**Project drivers**

**Goals:** Communicate internally or externally.

**Description:** Assess the risks associated with the availability of water resources, as well as quantify and report the potential positive externalities of the Mucuri River Springs Project.

**Project scope**

**Object of the project analysis:** Project.

**Description:** Industrial Unity in Bahia.

**Geographic Area:** Mucuri River Basin.

**Step(s) of the value chain included:** Own operations.

**Type of approach:** Retroactive and prospective.

**Time Horizon:** For provision and regulation of water quality: one year (2016); for global climate regulation: five years.

**Ecosystem Services:** Water provision; water quality regulation; and global climate regulation.

**Water provision**

Role of ecosystems in the hydrological cycle and their contribution in terms of water quantity, defined as total production of freshwater.

**Method(s) Used:** Replacement Cost Method (RCM).

**Results**

- **Dependency:** R$ 1,15 billion
- **Impact:** R$ 288.5 million
- **Externality:** Not calculated

**Data used**

<table>
<thead>
<tr>
<th>Dependency on the quantity of water: 56,026,806,00 m³.</th>
<th>Type of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary/own</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hydrological balance of the water used by the business: the externality aspect was not calculated.</th>
<th>Type of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary/own</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Watershed from where water is collected, name and classification of the water body: Mucuri River Basin (MG-BA), class 2 - own funding according to grant.</th>
<th>Type of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary (ANA)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Watershed used for water replacement, name and classification of the water body: Mucuri River Basin, class 2 - water purchase of Embasa.</th>
<th>Type of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary (ANA)</td>
<td></td>
</tr>
</tbody>
</table>
Further information

Results from physical metrics:
Dependency on the quantity of water: 31.23 m³/t.
Quantity of demanded water, but unavailable: 14.006.701,50 m³.
Purchase cost: R$ 20.60/m³

Assumptions adopted in the valuation estimates:
Dependency on the quantity of water: 31.23 m³/t.
Quantity of pulp and paper produced in 2016 by the plant: 1.794.027,55 t.
Capture of 56.026.806,00 m³ for the entire plant.
Quantity of unavailable water: 14.006.701,50 m³
To calculate the impact of 25% of the demanded water if it is not available and is replaced by purchase of Embasa at 20,60 R$/m³ (consumption band > 50m³, industrial category).

Others: The logistics costs for water imports were not accounted for.

Regulation of water quality

The role played by ecosystems in water quality control, considering physical, chemical and biological parameters.

Method(s) Used: Replacement Cost Method (RCM).

Results

| Dependency: R$ 1.2 million per year | Impact: R$ 717,6 thousand per year | Externality: Not calculated |

Data used

Watershed catchment, name and class: Mucuri River Basin, Class 2.
Quality parameter in water considered: Turbidity.

Type of data

Secondary (ANA)
Primary/own

Further information

Results from physical metrics:

- Volume of water collected in 2016: 1.794.027,55 m³.
- Ideal turbidity for the industrial process: > 1 NTU.
- Average quality captured: turbidity of 20 NTU.
- Minimum quality captured: turbidity of 183 NTU.
- Treatment cost from 20 NTU to 1 NTU: 0,40 R$/m³.
- Treatment cost from 183 NTU to 1 NTU: 0,71 R$/m³.
- 78% increase in treatment cost per volume.
Assumptions adopted in the valuation estimates:

- Turbidity captured by the company: 20 NTU
- Corresponds to the average turbidity of daily monitoring from January 2015 to October 2017.
- Maximum turbidity, considering minimum quality: 183 NTU
- Corresponds to the highest turbidity measured in the period from January 2015 to October 2017, in daily monitoring. In this way, was adopted this value of turbidity, considering minimum ecosystem regulation.
- Treatment cost of collected water: 0.40 R$/m³
- Average monthly cost of raw water treatment in 2016.
- Cost of treatment, considering average turbidity of 183 NTU: 0.71 R$/m³
- To estimate the cost of treatment from 183 NTU to 1 NTU, were considered the data evaluated by CONSTANTINO and YAMAMURA (2009) for the WTP of the city of Maringa. An exponential regression (R² = 0.91) was performed to estimate the costs for a turbidity of 183 NTU. The costs for 20 NTUs were also calculated on this curve in order to define the proportionality between the result calculated by the curve and the internal value of the company.

Others: The most critical parameters for the process are pH, conductivity, alkalinity, color and turbidity. The turbidity was chosen because it cover several critical properties and its behavior in the historical series.

Coagulant used in the treatment of collected water: PAC

Reference article to estimate increase in treatment cost:


Explanatory Notes: It is important to emphasize that the method used to estimate the cost increase due to turbidity raise is a simplification and, therefore, has significant non-quantified errors.

The mentioned article considers only the coagulant, lime and water costs for equipment cleaning, so that other related costs - such as disposal and treatment of silt - are not covered. The parameters for a WTA of public supply are also different (<5 NTU). In addition, there are other parameters that interfere in the treatment and its cost, so it is necessary to conduct laboratory tests for the correct determination of the amount of chemical agents that should be used, considering the quality of the raw water as a whole and not based on parameters in isolation.

Thus, the increase of almost 78% in the treatment cost can be either a super or an undersizing. Since the relationship between cost and improvement in parameters is not linear, this increase was considered suitable for this study and should cover the other embedded costs that were not directly accounted.
Global climate regulation

The role played by ecosystems in carbon and nitrogen biogeochemical cycles, thus influencing emissions of important greenhouse gases, such as CO₂, CH₄, and N₂O.

Method(s) used: Replacement Cost Method (RCM).

Results

Externality: R$ 67.8 million

Data used

<table>
<thead>
<tr>
<th>Actual removals resulting from environmental recovery, in tCO₂e: 108,267,13.</th>
<th>Type of data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary calculated</td>
<td></td>
</tr>
</tbody>
</table>

Further information

Data used Type of data

Exchange rate used to convert the Social Cost of Carbon (SCC), in Brazilian Reais: R$ 3,30.

Assumptions adopted in the valuation estimates: The carbon removal potential of the Mucuri River Springs Project was calculated at the end of its implementation. That is, a projection was made, considering the recovery of the degraded areas of 500 river sources per year, during the five years of the project. Considering an average of one hectare per spring, at the end of the project, 2,500 hectares of third-party areas will be restored. They are areas of Dense Ombrophilous Submontane Forest (Atlantic Forest), degraded by pasture activity.

The quality of the project implementation is considered good, according to the TeSE tool. This is due to the monitoring of qualified professionals; from the removal of the degrading factor; ants control; periodic maintenance and fertilization of the base and cover; differentiation in the field of the location of pioneer species and diversity; besides the consideration of proximity to fragments of natural vegetation with seed bank.

Others: The Social Cost of Carbon considered was US$ 38.

Analysis of the results

The results of the study contributed to a reflection on the exposure of the business unit to potential operational and financial risks, considering scenarios of changes in water availability patterns. It also allowed to identify positive externalities related to projects of recovery of water springs and the climate variable.

Management of ecosystem services

Use of ecosystem service valuation results: Reporting.

Description: The results of the valuation were used by the company in a context of measurement of results and communication with stakeholders, when quantifying positive externalities of forest restoration actions, beyond those usually monitored. The results of the ecosystem services related to water provision and quality have now integrated/complemented existing studies related to the operational risks of the industrial unit.