

GRUPO TOCTAO

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.

The data analysis made it possible to identify that the *Palmeiras River* sub basin is pressured in the west by the advance of intensive agriculture with the use of central pivots for irrigation. However, it was not possible to determine a dose-response function of the change in land use or the intensification of the processes in the region as a determining factor for the flow reduction. It was also observed that the advance of agriculture towards the west was barred by the topographic condition, making the use of machinery essential to this type of agricultural practice impossible, and that, within the micro basin, there were no significant changes in land use in the period between 2009 and 2016.

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

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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

Type of data

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 Primary

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*. Primary

Watershed from where water is collected, name and classification of the water body: Primary
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.

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.

Realização

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