

# RECENT HYDROPOWER PLANTS IN BRAZIL LEAD TO VARYING LOCAL ECONOMIC EFFECTS

CPI STUDY HIGHLIGHTS NEED FOR CASE-BY-CASE  
ANALYSIS OF DAM CONSTRUCTION IMPACTS

Hydroelectricity is the largest source of energy in Brazil's portfolio and has brought with it a charged economic and environmental debate about the impact of hydropower plants (HPP) on their surrounding areas. This debate often pits perceived economic benefits against environmental damage. However, without a systematic analysis of the effects that the construction of dams actually have on an area, these generalizations may paint an inaccurate picture.

As policymakers seek to maximize the economic, social, and environmental consequences of hydropower, a more robust analysis is needed to promote development more effectively while also addressing social and environmental concerns.

This brief summarizes an analysis conducted by Climate Policy Initiative/ PUC-Rio (CPI), under INPUT and in cooperation with the Brazilian Development Bank (BNDES), that **measures the effects of HPPs on economic performance and finances of municipalities**.<sup>1</sup> CPI researchers examined 82 municipalities (in 13 states) that had areas flooded by a hydropower plant between 2002 and 2011.<sup>2</sup>

The economic impact dams have on their local areas varies widely, but, on average, the results show that in municipalities where plants were constructed, the effects, both positive and negative, are short-lived. Economic growth that occurs during the first two to three years after the start of construction tends to dissipate after five or six years, which typically coincides with the end of construction.

Nevertheless, the researchers show municipalities vary widely post-dam construction and certain municipalities experience distinct effects. Some areas maintain economic momentum while others lose it. This variation highlights the caution needed when forming conclusions about the impact of dam construction and emphasizes the benefit of case-by-case analysis.

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<sup>1</sup> For the complete study, access: <http://www.inputbrasil.org/publicacoes/efeitos-economicos-locais-da-construcao-de-hidreletricas-no-brasil/?lang=en>.

<sup>2</sup> A municipality is considered affected by a dam if it has an area flooded by a HPP where construction began between 2002 and 2011. Municipalities that had areas flooded by more than one HPP were not included in the analysis, regardless of when the construction began. All HPPs considered in the study were financed by BNDES.

## MAIN RESULTS

CPI researchers used a rigorous methodology called synthetic control that isolates the effects caused *specifically* by the arrival of hydropower plants in Brazilian municipalities.<sup>3</sup>

The study compares municipalities that received plants to areas that did not receive plants, but were otherwise identical. This comparison isolates and quantifies the impact of construction on the local economies and municipal finances. While general trends emerge in each area, researchers find striking examples of how cases may vary.

### Local Economic Performance

Formal employment, the number of firms and visible night lights detected by satellite images are all indicators of how local economies change after dam construction.

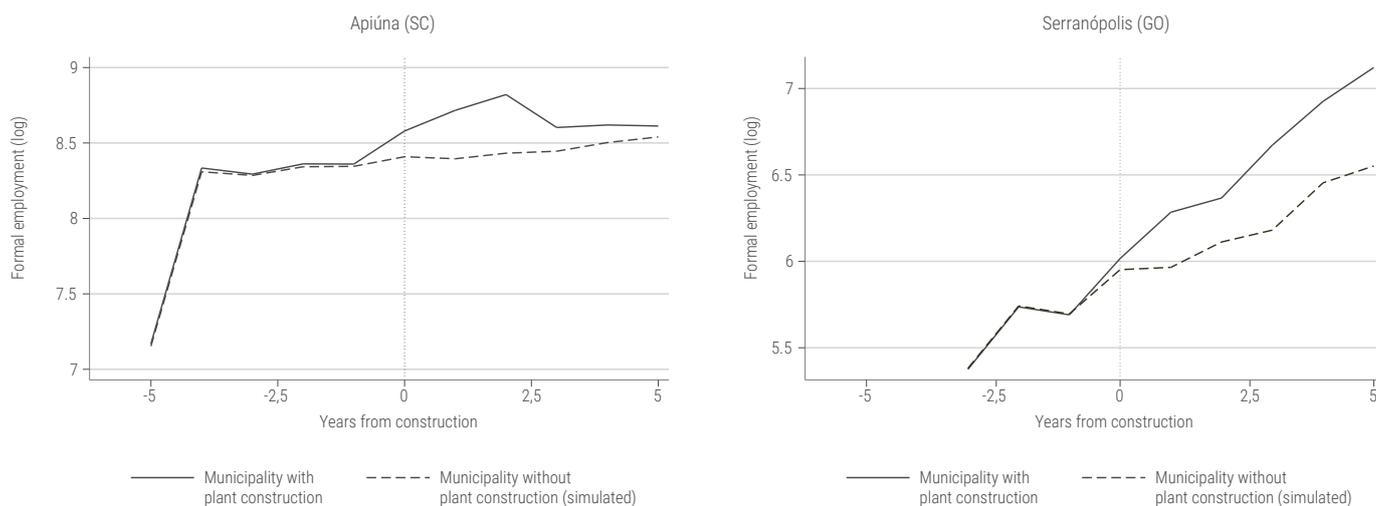
**The researchers find few signs that HPP construction transforms local economies. The overall effects are modest at best and the structure of the impacted economies remains the nearly the same post-construction.**

In general, it appears that the construction of a hydropower plant stimulates formal employment significantly in the short-term, but this effect tends to dissipate over the next few years. The study shows that in the first year after dam construction begins, the number of formal jobs on average is between 10% and 37% greater than areas without dam construction. However, five years after the beginning of construction, formal employment, on average, levels off to between 8% to 14%. Although local employment tends to increase after HPP construction, the degree to which it increased or fluctuated varies notably throughout most of the municipalities studied. For approximately a quarter of municipalities studied, formal employment was at least 38% greater than those without dam construction, and in another quarter of municipalities, employment was 15% less.

Figure 1 illustrates the effect on formal employment in the municipalities of Apiúna and Serranópolis. The effect of the HPP *Salto do Pilão* in Apiúna follows the median pattern of the municipalities studied. Three years after the beginning of construction, formal employment in Apiúna increases 30%, but that effect reduces to around 10% just two years later. The effect of the *Espora* plant in Serranópolis represents an extreme case: formal employment grows at a steady pace starting at the beginning of construction and remains 50% higher five years after the work began.

<sup>3</sup> Details on the methodology can be found at the end of this brief.

**Figure 1:** Impact of HPP Construction on Formal Employment (Percentage Effects)



**Note:** The impact of the plant on formal employment is calculated as the difference between the values depicted by the solid and dashed lines.

To make sure that these effects do not just reflect a formalization of the workforce, CPI researchers used visible lights detected by satellite images as a proxy for local economic activity. The effects follow a pattern strikingly similar to those of formal employment. The researchers note that the modest growth in visible lights in the medium-term is not due to the arrival of electricity, since all the municipalities were already connected to the grid before construction started.

The overall economic effects notwithstanding, the researchers find few signs of deeper transformations in the structure of local economies. The share of formal employment across different sectors – manufacturing, services, retail, agriculture and construction – does not change. Therefore, the construction of hydropower plants with overall modest effects, fails to transform local economies.

### Municipal Finances

The analysis also shows that the total revenue of municipalities (tax revenues, intergovernmental revenues, royalties, and others) with hydropower plants increases over the first and second years after the beginning of construction and stabilizes after that at around 4%.

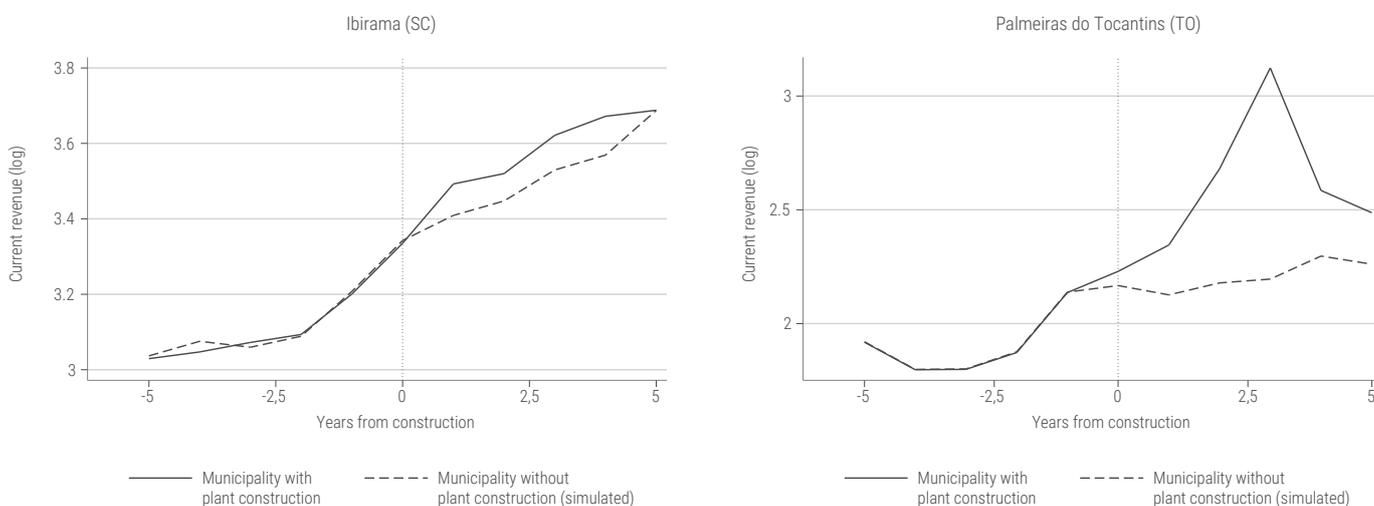
Although the specific sources of revenue increases are unclear, the study suggests that the primary driver of this total revenue increase comes through intergovernmental revenues and royalties rather than tax collection. When the researchers examined tax revenue specifically, the effects show a wide swing. Two years after the arrival of a plant, municipalities with dams experience a 35% increase

in tax revenue compared to those without. However, this decreases to only 2.5% over the medium-term. This trend indicates that higher municipal tax revenue is not the driver in the 2.5% increase in municipal income, but more analysis is needed to confirm this.

As with local economic performance, the effects could vary dramatically among municipalities. The cases of Ibirama and Palmeiras do Tocantins, shown in Figure 2, exemplify the distinct effects that hydropower plants can have on total revenue. The effect of the *Salto do Pilão* plant in Ibirama follows the typical pattern of the municipalities studied: the total municipal revenue increases 10% two years after construction, but that effect falls to nearly zero three years after. On the other hand, the impact of the *Estreito* plant in Palmeiras do Tocantins represents an extreme case: total revenue is five times larger three years after construction and even though it starts decreasing, it remains 20% larger five years later.

**Total revenue of municipalities with HPP increases over the first and second years after the beginning of construction and stabilizes after that at around 4%.**

**Figure 2:** Impact of HPP Construction on Total Municipal Revenue (Percentage Effects)



**Note:** The impact of the plant on total municipal revenue is calculated as the difference between the values depicted by the solid and dashed lines.

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## CONCLUSION

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The installation of hydropower plants generates debate about the tradeoffs associated with new construction. CPI's analysis shows that caution is needed in generalizing conclusions about the economic impact dams have on their surrounding areas and calls into question the argument that dam construction brings economic benefits to local areas. While general trends do emerge, they are, in large part, short-lived. This, coupled with such a wide variation between municipalities, requires policymakers to consider future impacts on a case-by-case basis.

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## ABOUT THE DATA

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### Methodology

The study uses a rigorous method of synthetic control that consists of designing a control municipality for each municipality affected by using a combination of municipalities not affected by hydropower plants. The method uses an algorithm that attributes weights to municipalities without plants in such a way that in the synthetic municipality the evolution of the indicators of interest such as municipal GDP before the construction of the plant is identical to that of the affected municipality. The effect of the plant is calculated as the difference between the affected municipality and its synthetic counterpart.

### Data Sources

**Municipalities affected by hydropower plants:** Agência Nacional de Energia Elétrica (ANEEL)

**Municipal GDP:** Municipal Gross Domestic Product series, Instituto Brasileiro de Geografia e Estatística (IBGE)

**Population:** IBGE

**Formal employment:** Relação Anual de Informações Sociais (RAIS)

**Night lights:** National Aeronautics and Space Administration (NASA)

### Limitations

The data used are the best available for the interval required by the study. The information about the municipal GDP is based on methodologies that have recently changed.

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*The Land Use Initiative (INPUT – Iniciativa para o Uso da Terra) is a dedicated team of specialists who work at the forefront of how to increase environmental protection and food production. INPUT engages stakeholders in Brazil's public and private sectors and maps the challenges for a better management of its natural resources. Research conducted under INPUT is generously supported by the Children's Investment Fund Foundation (CIFF) through a grant to Climate Policy Initiative. This study is also the result of a partnership between CPI and BNDES that contributed with data on hydropower plants as well as technical support and comments.*