



**Considerations on the influence of the implementation of the Bariri
Hydroelectric Power Plant on the landscape of the Tietê River.**

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ABSTRACT

The landscape is a living record of a region's history and culture. In this sense, studying it makes it possible to understand how people interact with the environment and how societies have adapted and shaped the landscape over time. Thus, the core purpose of this work is to make considerations and analyze the transformations that occurred in the landscape of the Tietê River after the implementation of the Bariri Hydroelectric Power Plant. The methodology is based on the study of the landscape and brings Besse (2014) as a theoretical reference, where the objectives will be achieved through the bibliographic and documentary survey, fostering the theoretical basis of the history of the city and the territory. Landscape studies are critical to the understanding and proper management of the natural and built environment, as they provide crucial information for conservation, urban planning, the protection of cultural heritage, and the promotion of people's quality of life and well-being. As a result, the article presents a brief history of the transformations that occurred in the Tietê River after the implementation of the Bariri Hydroelectric Power Plant and exposes what these transformations caused to the environment and the population of the region. This work contributes to the ongoing research with the Graduate Program in Architecture and Urbanism of the Faculty of Arts, Communication and Design, of the State University "Júlio de Mesquita Filho" – UNESP.

KEYWORDS: Landscape. Tietê River. Barrage.

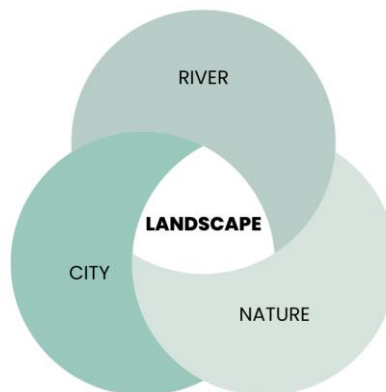
1 INTRODUCTION

1.1 River x city: an old relationship.

Throughout history of mankind, water has been a determining factor in the location of human settlements, the development of economic activities, and the growth of cities and civilizations. Rivers are one of the main sources of fresh water on the planet and play a fundamental role in maintaining life and the terrestrial ecosystem. They provide water for irrigating crops, supplying cities, generating hydroelectric power, shipping, fishing, and other economic activities.

[...] Rivers are important biological corridors that allow the presence and circulation of flora and fauna within cities, in addition to being free public spaces of great social value, providing opportunities for collective interaction and leisure that meet the most diverse interests. (Constantino, 2014, p. 3)

Figure 1 – Diagram of the interconnected landscape: river – city



Source: Prepared by the authors. 07/2023.

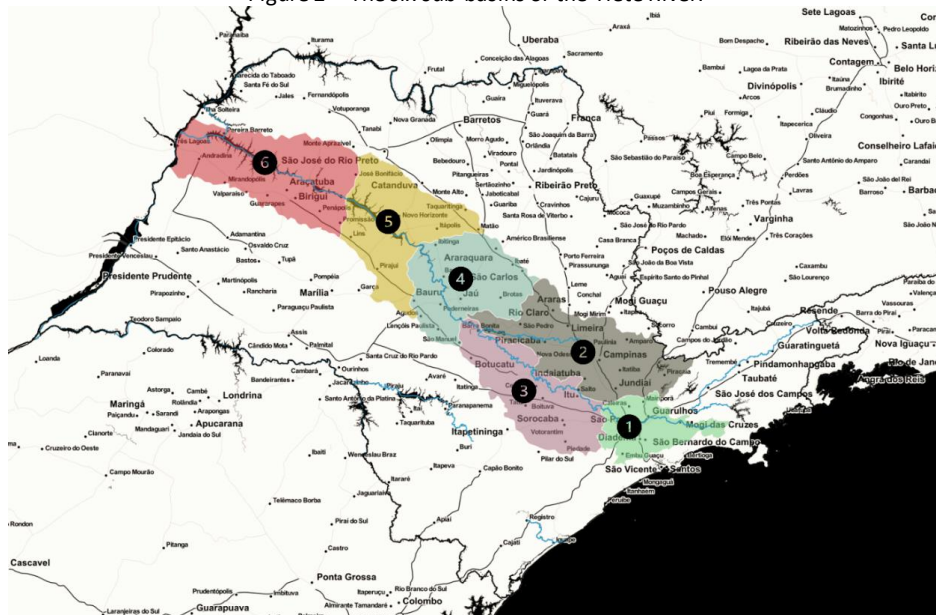
1.2 Tietê River.

Most Brazilian cities were founded on the banks of or near rivers. The Tietê River, in the state of São Paulo, played an important role in the occupation and colonization of the interior of São Paulo. (Ribeiro, 2004). Its source is located in Salesópolis, and runs for 1100 km cutting through the state of São Paulo from east to west until it flows into the Paraná River on the border of Mato Grosso do Sul.

Corrêa, Alvim and Keating (2000) point out that the Tietê and its tributaries were present and essential for the direction, locomotion, supply and development of the interior of the state of São Paulo, and especially in coffee production. From the twentieth century on, the river gained a new role and began to be explored as an energy source through hydroelectric plants and later the construction of the Tietê-Paraná waterway, in the interior of São Paulo. (Rosa, 2020).

To promote the maintenance and environmental recovery of this state resource, it was necessary to use the concept of Hydrographic Basin as a planning unit. Federal Law No. 9433 of 1997 created the National Water Resources Management System, implementing the National Water Resources Policy, which established the country's major basins into hydrographic districts according to the characteristics and dynamics of the environment. Thus, the Tietê River basin is a hydrographic unit of the Paraná River basin, composed of six sub-basins: 1. Alto-Tietê, 2. Piracicaba/Jundiá, 3. Sorocaba/Médio Tietê, 4. Tietê-Jacaré, 5. Tietê-Batalha and 6. Baixo-Tietê.

Figure 2 – The six sub-basins of the Tietê River.



Source: Geoseade, adapted by the authors. Access on: 05/2023.

1.3 Tietê River as a source of energy: the implementation of hydroelectric dams in Brazil.

The generation of electricity from rivers has been an important source of energy in Brazil throughout history. Hydroelectric exploration received significant incentives from the government of Getúlio Vargas, who ruled Brazil from 1930 to 1945 and again from 1951 to 1954.

However, it is important to note that the development of hydroelectric plants in Brazil occurred in a global context in which the construction of large dams and hydroelectric plants was becoming a trend, even having been influenced mainly by the TVA (Tennessee Valley Authority).

The TVA was a development program for the Tennessee River region, which had been greatly affected by the crisis of 1929, led by the U.S. government beginning in 1933. This program combined regional planning with the use of natural resources and inaugurated the concept of multiple uses of a river (Oliveira, 2018, p. 328).

The ideas of this initiative arrived in Brazil as early as 1933 through Luiz Ignacio Anhaia Mello, a fervent defender of American regional planning and propagandist of the New Deal who, through his lectures, influenced heads at the Polytechnic School of USP.

Anhaia Mello was a teacher of Lucas Garcez, Lopez Leão, Souza Dias, among others, who were the mentors of the guidelines for the appropriation of the water potential of the state of São Paulo, and which years later would originate CESP. The Company not only generated energy, but also populated regions, founded cities and created bases for the territorial occupation of the interior with its dams. (Vianna, 2015, p. 60)

From the late 1950s, during the period known as the "economic miracle" in Brazil, the construction of hydroelectric dams gained even more momentum, especially during the military regime that lasted from 1964 to 1985. During this period, the Brazilian government prioritized the construction of large hydroelectric dams as part of a national development plan. Hydropower was considered strategic to meet the country's growing energy demand and boost industrialization.

1.3.1 CESP – São Paulo Energy State Company

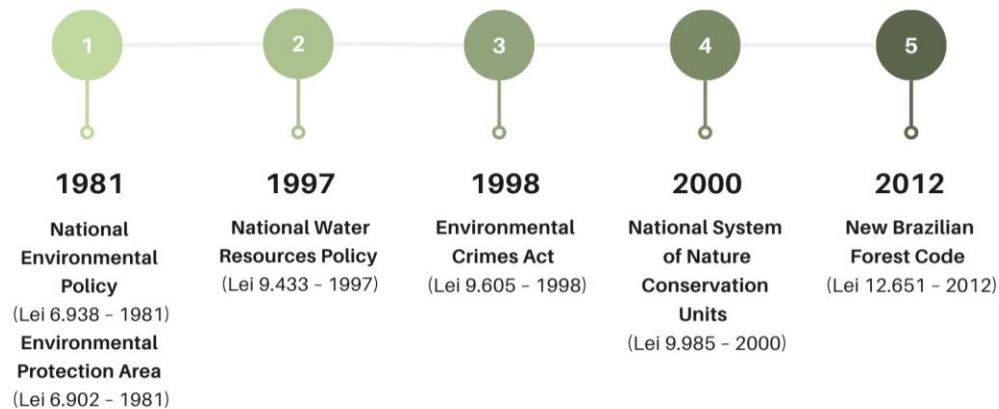
CESP was created in 1966, during the government of the state of Abreu Sodré, and was motivated by the need to develop its own energy resources for São Paulo, which at the time depended on energy generated in other states and arose from the merger of other companies, namely, the USELPA Companies (which explored energy resources from the Paranapanema basin), CHERP (connected to the Pardo and Tietê rivers) and CELUSA (connected to the Paraná river).

[...] In 1950, studies of the Tietê River in the state of São Paulo continued in the Paranapanema sector. Sorocabana, through its Works and Electrification Commission, already had the Salto Grande project practically completed. In 1951, the then governor, Professor Garcez, launched his Quadrennial Government Plan, which included the Salto Grande and Jurumirim power plants, in Paranapanema. In the case of the Tietê, there was already a sketch of the Barra Bonita, Ibatinga, Promissão and later Bariri Power Plants. (Vianna, 2015, p. 62).

The construction of CESP's first hydroelectric plants began in the 1960s, and the company became one of the main generators of electricity in Brazil.

All these projects, which were mainly aimed at development, were approved without any environmental law in force in the country, therefore without any plan that regulated their implementation. The timeline below shows that the main Brazilian environmental laws were approved only in the 1980s, almost 20 years after the beginning of the implementation of hydroelectric dams.

Figure 3 – Timeline on Environmental Laws in Brazil.



Source: Brazilian Institute of Forests, produced by the authors. Access on: 07/2023.

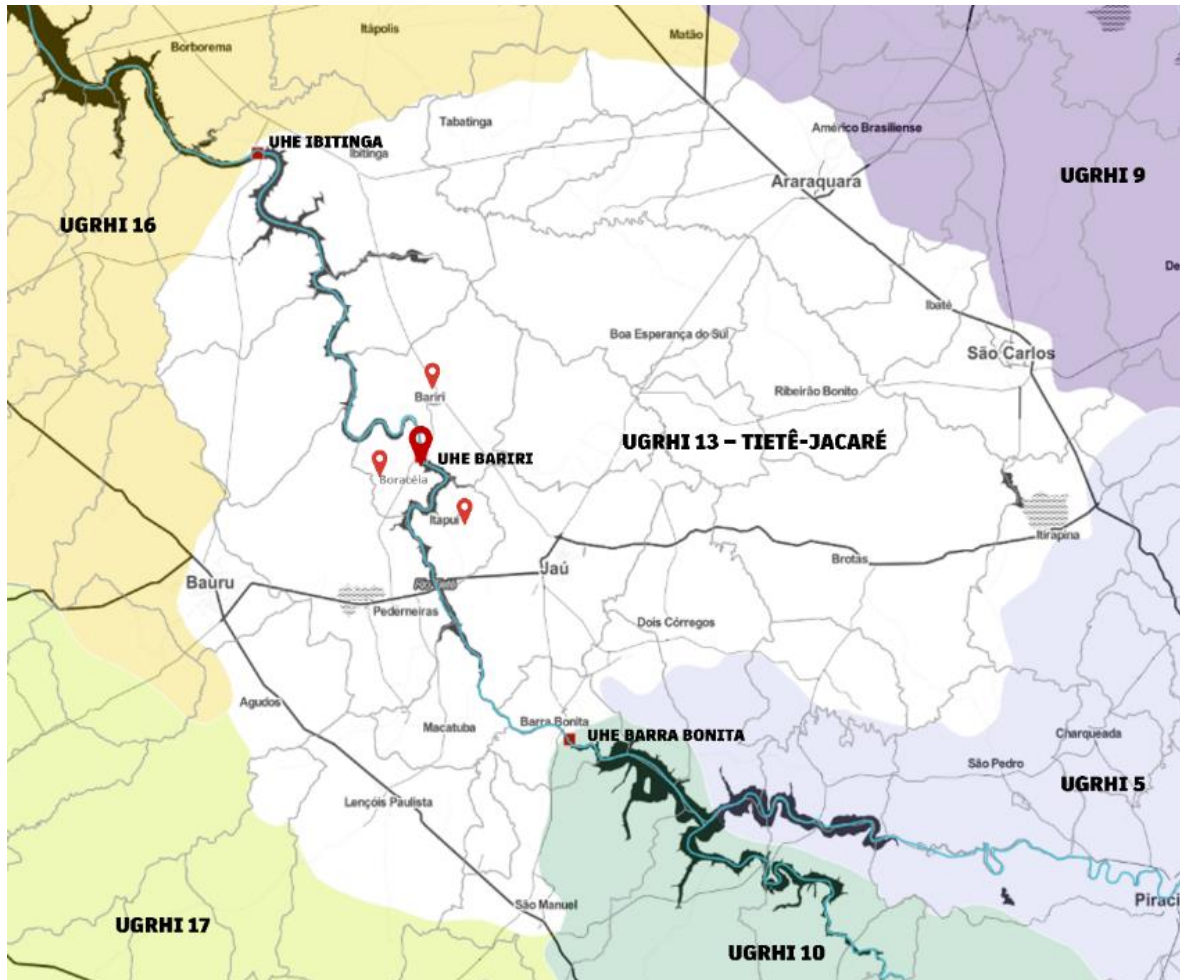
1.4 Bariri Hydroelectric Power Plant – Tietê-Jacaré Hydrographic Basin.

The city of Bariri is located in the state of São Paulo and is part of the 34 municipalities of the Tiete-Jacaré Hydrographic Basin. It is located at the confluence of the Tietê and Jacaré-Pepira rivers, a region that since the eighteenth century was frequented by the bandeirantes because it was a crossing point in the penetrations of the hinterlands of Goiás and Mato Grosso. In the Tupy-Guarani language, Bariry means "stretch of river with waterfalls with noisy and agitated waters". (IBGE, 2023)

The fertile lands on the banks of the river were the lure for the colonization of the region. Bariri's economy was initially based on agriculture, with emphasis on coffee cultivation. However, with the coffee crisis at the beginning of the twentieth century, the city diversified its agricultural production, also growing oranges, cotton and other products. Over the years, Bariri has undergone a process of urbanization and population growth. In 1923, the village was elevated to the category of municipality, dismembering itself from the municipality of Jaú.

The cities of Boracéia and Itapuú are the closest to the surroundings, located 25km and 20km away respectively, and, therefore, will also be addressed in this article, analyzing the transformations that occurred after the implementation of the Bariri Power Plant.

Figure 4 – Location of the cities of Bariri, Boraceia and Itapuí in the Tietê-Jacaré Hydrographic Basin.



Source: Geoseade, adapted by the authors. Access on: 07/2023.

The Álvaro de Souza Lima Hydroelectric Power Plant – HPP Bariri is an important dam for the use of the Tietê River, located between the cities of Bariri, on the right bank, and Boracéia, on the left bank. In terms of positioning in the flow of the river, it is the second dam, the first being the Barra Bonita Dam. It was one of the Hydroelectric Power Plants implemented in the 60's by CHERP (Pardo River Hydroelectric Company). In operation since 1965, it has a length of more than 856 meters and has three turbines. (Portal Sampi, 2020)

Figure 5 – Bariri Hydroelectric Power Plant, 1968 and 2022.



Source: Cetenco (1968) and Jr. Slompo Photos (2022), adapted by the authors. Access on 06/2023.

These turbines are responsible for generating electricity, totaling an installed capacity of 136.5 MW. This amount of energy is enough to supply approximately 453,000 homes, considering an average energy consumption per household. In addition to power generation, the unit, which is managed by AES Tietê, transports up to 300 passengers at each lock and moves tons of products per month along the Tietê-Paraná Waterway. (Portal Sampi, 2020)

2 GENERAL OBJECTIVES

The main objective of this article is to analyze the transformations that occurred in the landscape of the Tietê River after the implementation of the Bariri Hydroelectric Power Plant.

2.1 SPECIFIC OBJECTIVES

- Historically, survey some of the transformations that occurred in the Tietê River;
- Analyze transformations from the perspective of the landscape;
- Expose the social and environmental issues that these transformations have caused.

3 METHODOLOGY

The 5 doors of the landscape, based on the concepts of Besse (2014), are pointed out as a theoretical reference.

Chart 1 – Outline of the methodological procedures adopted in the research.

Teoretical Framework (Besse, 2014)	Methodological procedures	Results
I DOOR: Landscape as cultural representation II PORTA: Landscape as fabricated and inhabited territory	Historical bibliographic research; Memoirists; Survey of documents, legislation and maps;	Bibliographic and documentary survey → theoretical basis of the history of the city and the territory.
III DOOR: Landscape as a natural environment	Reconnaissance of the territory through analysis of Google Earth images and IBGE maps; Iconographic survey; Historical photographic records;	Elaboration of maps with data overlay → landscape recognition
IV DOOR: Experienced Landscape	Observation routes; Photographic record; Application of questionnaires and interviews;	Field survey and systematization of the data collected in the interviews → perception of the landscape
V DOOR: Landscape as a project	Analysis of plans (and projects related to the area of study);	Analysis of the Master Plan, environmental and tourism plan; municipal legislation → interventions in the landscape

Source: Prepared by the authors, 2023.

3.1 METHOD OF ANALYSIS OF RESULTS

Through the methodological procedures adopted and based on the theoretical framework of Besse (2014), through the five doors of the landscape, this article will bring approaches from the first door - the landscape as a cultural representation - and the second door - the landscape as a manufactured and inhabited territory -, where the objectives will be achieved through the bibliographic and documentary survey fostering the theoretical basis of the history of the city and the territory.

4 RESULTS

4.1 The landscape studied.

Studying the landscape has been the main parameter for understanding the inhabited space, natural or built. Santos (2003) emphasizes that the landscape is a social construction, which reflects human action on the environment. It is shaped by power relations and the economic, political and cultural interests of the societies that inhabit it. For Besse (2014), the landscape is the product of interactions, of combinations between a set of natural conditions and deconstructions (geological, morphological, botanical, etc.) and a set of human, economic, social and cultural realities. In this way, the landscape is not static, but dynamic, subject to transformations over time.

Thus, as a result, this article brings some considerations about the transformations that occurred in the landscape after the implementation of the Bariri dam on the Tietê River,

because, according to Besse (2014, p.32) "the one who intends to study landscapes has as his first and essential task to read and interpret the landscape forms and dynamics in order to capture in them something of the project of the society that produced these landscapes".

4.2 The transformed landscape – damming of the waters of the Tietê.

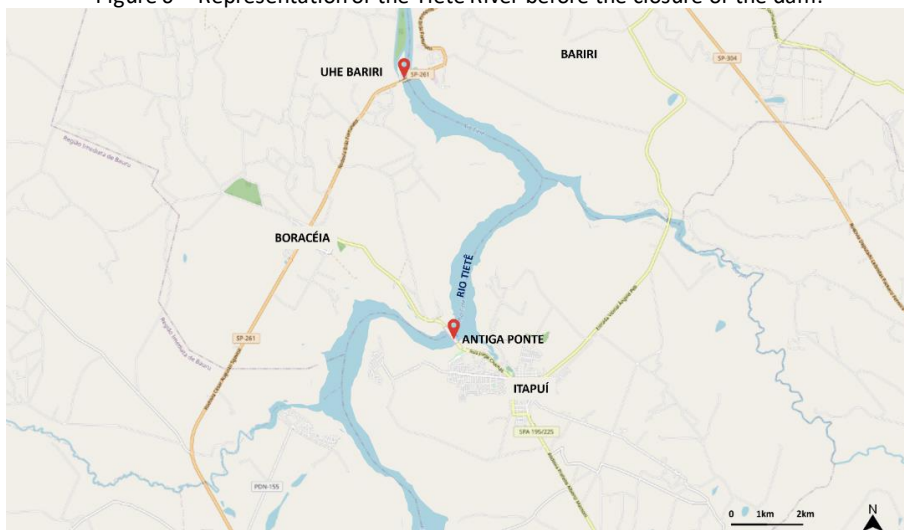
According to the Tietê River Exploitation Project, the construction of three plants (Barra Bonita, Ibitinga and Lages) was planned, but four were built, because the topographic measurements pointed to a greater difference than expected between Barra Bonita and Ibitinga. The solution was to intersperse a new plant and lower the level to be transposed.

In addition, the project foresaw the construction of locks in these dams, with the aim of taking advantage of or improving the navigation of the Tietê River. Hence, the new plant would be built near the city of Bariri. (Massei, 2007, p.128)

The construction of the Bariri Hydroelectric Power Plant began in 1959 and ended in 1965, and its dam was closed in 1966, when the formation of the lake (dam) flooded an area of 31 thousand hectares. On the site there were areas for cattle grazing; land to plant coffee, cultivate sugar cane and subsistence crops, and also the floodplains from which clay was extracted that served as raw material for tiles and bricks that fed the ceramics of the cities of the region.

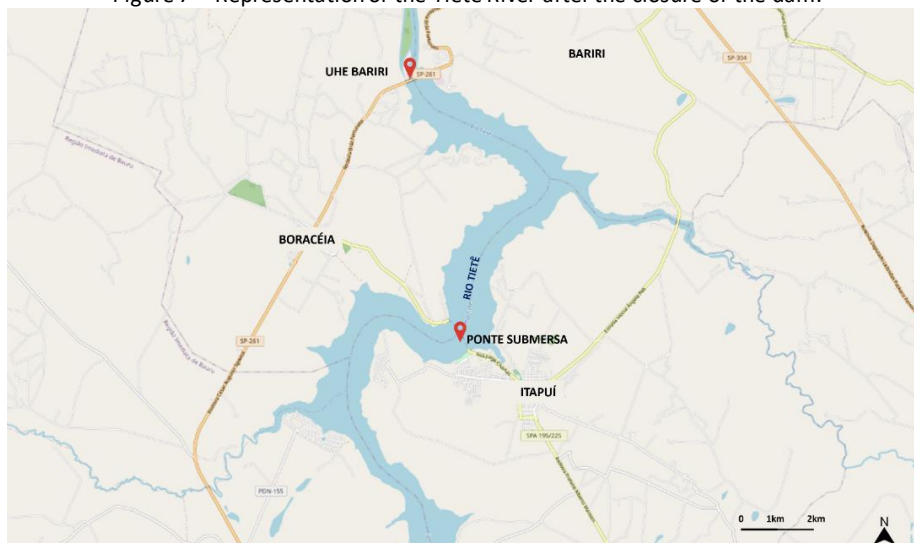
The construction of the dam caused several types of impacts in a very extensive area, as it submerged land that could be used for agricultural cultivation and made it difficult to extract clay in the floodplains. Many trees and native forests were destroyed, including the Atlantic Forest, and it also affected the flora, fauna and ichthyofauna on a large scale. In the long term, it is possible that the construction of the dam influenced the health of the population, as the water regime, from current to stop, became a habitat for types of plants, bacteria and microorganisms that did not exist previously. (Massei, 2007, p.167)

Figure 6 – Representation of the Tietê River before the closure of the dam.



Source: Geoseade, Open Street Maps, adapted by the authors, 07/2023.

Figure 7 – Representation of the Tietê River after the closure of the dam.



Source: Geoseade, Open Street Maps, adapted by the authors, 07/2023.

4.2.1 The submerged bridge between Itapuí and Boracéia.

The need to connect the municipalities of Itapuí and Boracéia has been going on for a long time. The first bridge that connected the two cities came from a popular initiative, since transportation by ferry did not meet the satisfaction of the inhabitants in 1913, so a group of residents organized a petition requesting the Chamber of Jaú to represent to the state government the construction of a bridge over the Tietê River. at the place where the ferry made the crossing. (Prado & Prado, 2013, p. 87)

The first bridge was structured in wood and inaugurated in March 1919, on the initiative of part of the population, but it did not last many more years, since with the flooding of the Tietê in 1929 the timber was compromised and the old rafts returned to operation. The construction of the second bridge, in reinforced concrete, came from the initiative of politicians in the region. It ended in 1935. (Prado & Prado, 2013, p. 93)

Figure 8 – First and second bridge that connected the municipalities of Itapuí and Boracéia.



Source: Bica de Pedra Virtual Museum, accessed on 07/2023.

However, in 1959 the Pardo River Hydroelectric Company (CHERP) began the construction of the Bariri Hydroelectric Power Plant, in the Middle Tietê. The damming of the

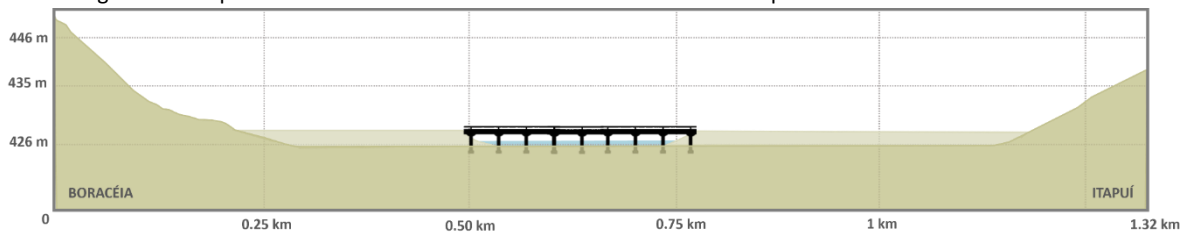
Tietê River left the bridge that connected Itapuí to Boracéia submerged. (Prado & Prado, 2013, p. 94). In 1966, with the closure of the plant's dam, the bridge was submerged, collapsing all the movement of goods and passengers between the two municipalities.

Figure 9 – Location of the old bridge that connected the municipalities of Itapuí and Boracéia.



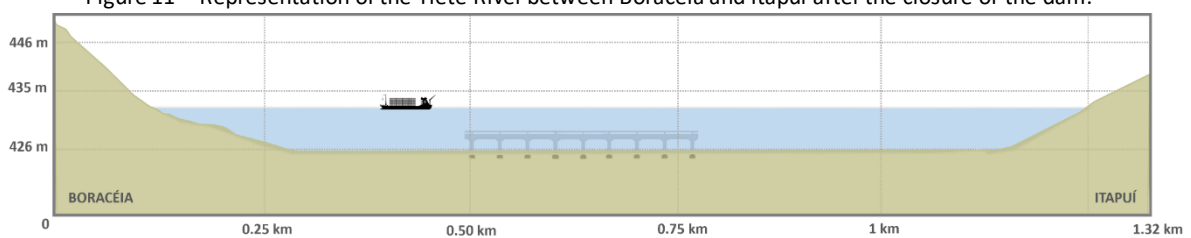
Fonte: Geoseade, Open Street Maps, adaptado pelas autoras, 07/2023.

Figure 10 – Representation of the Tietê River between Boracéia and Itapuí before the closure of the dam.



Fonte: Google Earth, adaptado pelas autoras, 07/2023.

Figure 11 – Representation of the Tietê River between Boracéia and Itapuí after the closure of the dam.



Source: Google Earth, adapted by the authors, 07/2023.

The dissatisfaction on the part of the population was great, and even before the damming took place there were already requests for CHERP to build a new bridge. A memorandum was drafted by the then Governor Carlos Alberto Carvalho Pinto, saying that the connection between the municipalities was indispensable and the CHERP board declared that the new bridge would be built. However, the administrative leadership was taking slow measures to resist the order of the governor of the state and the bridge was not built. (Prado & Prado, 2013, p. 95).

To re-establish transportation between the two municipalities, the company installed a motorized ferry service, the so-called "ferrys boats", such a service solved the problem in part, since the population was subject to schedules established by the company. In 1969, journalist Murillo de Almeida Prado wrote in the newspaper O Estado de S. Paulo:

[...] Boracéia was the one who felt it the most. If the construction of the dam of the Álvaro de Souza Lima power plant brought benefits to the State and even to some municipalities in the region, it caused difficult problems for Boracéia, leaving it isolated from other localities in terms of road communications. (Prado & Prado, 2013, p. 95).

4.2.2 The formation of the fluvial beach of Itapuí – apex and decline.

The fluvial beach of Itapuí was formed as a result of the damming of the waters of the Tietê, in the 1960s, for the construction of the Bariri hydroelectric plant, which represented for the municipality the loss of more than 700 bushels of arable land. Yet, the incentive to tourism also took shape as a way to seek new sources of income, which would mitigate the damage caused by the dam. (Prado & Prado, 2013, p. 261).

Betting on tourist activities, the then mayor Waldomiro Guarinon, determined the opening of a public competition for the choice of a project for the use and urbanization of the beaches of the municipality. The volume of water and the infrastructure of the campsite made it possible to practice sports in the place, and for several years, motorboat races were held there with the presence of the main state competitors of the sport. The kiosks and bars that have sprung up have also attracted a large number of tourists. "There were weekends that up to twelve tour buses arrived in the city" (Prado & Prado, 2013, p. 262).

Figure 12 – Itapuí prainha in the 70s and in 2022.



Source: Virtual Museum of Bica de Pedra (70/80) and Itapuí City Hall (2022), adapted by the authors, 07/2023.

Musical and sports activities or the simple search for sunbathing, made Prainha one of the most frequented places in the region, the movement only increased, but brought with it some inconveniences, such as the accumulation of garbage and environmental degradation. Another very negative complication that kept bathers away, not only in Itapuí, but in other river beaches in the region, were piranha attacks.

In the mid-1970s, there were several reports of accidents involving this type of fish in cities bathed by the Tietê River, where mayors and merchants avoided touching the subject so as not to disrupt tourism. In 1977, Mayor João da Silva Fonseca told the newspaper O Estado de S. Paulo:

[...]The piranhas still exist, but they have attacked less. We have already asked CESP and the Fisheries Institute for help with the problem, and the technicians have already talked about using peacock bass to fight piranhas, but so far nothing has been done. We are investing in this beach, the city expects a lot from tourism, but these piranhas can still disrupt our plans. (Prado & Prado, 2013, p. 264).

With or without piranhas, the fact is that from the 1990s onwards, the tourist movement in Prainha cooled down, initiating a process of decadence, with the increase in cases of vandalism and prostitution in that region. The revitalization of that public space is still a desire of the population of Itapuí. (Prado & Prado, 2013, p. 265).

5 CONCLUSION

This article sought to present some of the transformations that occurred in the landscape of the Tietê River after the implementation of the Bariri Hydroelectric Power Plant, bringing the economic and political intentions that led to its construction and that promised development throughout the State of São Paulo. Although there are no laws that directly consider the impacts caused to the environment, it was noticed on the part of the entrepreneurs that there was little attention in the implementation of such a large infrastructure impacting an important natural resource for the entire ecosystem of the region.

The dam formed after the closure of the floodgates changed the water regime of the Tietê River and consequently had its entire landscape transformed, as well as changed the lives of a good part of the riverside population who sought in the river and its banks a source for their subsistence. Through the above, some questions come to the fore, and the question remains: did the implementation of the Bariri Power Plant bring more positive or negative transformations to society? What about the environment?

Undoubtedly, the transformed landscape tells us the story of a not-so-distant past, either by time or by actions that disregard the environment, and that, even today, despite the changes in current laws, leave nature in the background. Regardless of the value of these changes, when studying the landscape, one observes a palimpsest formed by the superimposition of layers, where past and present marks and footprints appear, where the transformation is imminent to human will, but it is up to the local population to give their opinion and decide participatively.

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