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SOCIO-ENVIRONMENTAL IMPACTS OF THE JOSÉ BOITEUX NORTHERN DAM ON XOKLENG INDIGENOUS LAND

IMPACTOS SOCIOAMBIENTAIS DA BARRAGEM NORTE DE JOSÉ BOITEUX NA TERRA INDÍGENA XOKLENG

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Abstract
This article aims to identify the socio-environmental impacts of the José Boiteux Northern Dam on the Xokleng Indigenous Land in the state of Santa Catarina, as well as to propose guidelines to reconcile regional water security with the protection of Indigenous rights and climate justice. This study adopts a hypothetico-deductive method, based on bibliographic and documentary research and socio-legal interpretation to question the impact the construction and operation of the dam has had on the climate justice and human rights of the community. Built without environmental licensing or prior consultation, the project flooded roughly 900 ha of fertile land, increasing vulnerabilities and violating territorial rights; hence the premise that only participatory, sustainable solutions can balance flood control with Indigenous protection. The findings reveal loss of territory, biodiversity, and food security; isolation of the community; occurrences of conflicts during emergency dam operations; and a growing structural risk, with jammed

Resumo
Este artigo tem como objetivo identificar os impactos socioambientais da Barragem Norte de José Boiteux sobre a Terra Indíge- na Xokleng, no estado de Santa Catarina, e propor diretrizes para compatibilizar a segurança hídrica regional com a proteção de direitos indígenas e de justiça climática. Questionando como a construção e a operação da barragem afetam a justiça climática e os direitos humanos da comunidade, adota-se o método hipotético-dedutivo, com pesquisa bibliográfica e documental e interpretação jurídico-sociológica. A obra, erguida sem licenciamento ambiental nem consulta prévia, inundou cerca de 900 ha de terras férteis, ampliando vulnerabilidades e violando direitos territoriais; logo, parte-se da premissa de que apenas soluções participativas e sustentáveis podem conciliar segurança hídrica regional e proteção indígena. Os resultados indicam perda de território, biodiversidade e segurança alimentar dos Xokleng; isolamento da comunidade e conflitos durante operações emergen-

floodgates and an elevated danger level after more than a decade of neglected maintenance. The study concludes that large hydraulic works implemented without Indigenous governance tend to reproduce injustices; flood-control policies must therefore incorporate nature-based solutions; free, timely, and informed consultation; and socio-environmental reparations to deliver genuine climate justice.

Keywords: José Boiteux Dam. Human Rights. Socio-Environmental Impact. Climate Justice. Xokleng Indigenous Land.

ciais da barragem; risco estrutural crescente devido à falta de manutenção há mais de dez anos, com nível de perigo elevado. Conclui-se que grandes obras hidráulicas implementadas sem governança indígena tendem a reprodu- zir injustiças; políticas de controle de enchen- tes precisam incorporar soluções baseadas na natureza, consulta livre, prévia e informada, além de reparações socioambientais, para assegurar a verdadeira justiça climática.

Palavras-chave: *Barragem José Boiteux. Direitos Humanos. Impacto Socioambiental. Justiça Climática. Terra Indígena Xokleng.*

1 INTRODUCTION

Extreme weather events have become increasingly frequent, disproportionately affecting vulnerable groups—including Indigenous people—and heightening socio-environmental risks. In this context of climate emergency, changes in hydrological patterns have intensified disasters such as cyclones, droughts, and flash floods, making discussions about climate justice and human rights ever more urgent.

Designed to control the flow of the Itajaí River and reduce the risk of flooding in the Middle and Upper Valley regions, the largest containment project in state of Santa Catarina, Brazil, is the José Boiteux Northern Dam, which holds back the Hercílio and Dollmann rivers.

This article investigates how the construction and operation of this dam affect climate justice and the rights of the Xokleng Indigenous community, as well as the broader socio-environmental implications of this intervention. Based on the premise that large-scale hydraulic projects can exacerbate vulnerabilities when implemented without free, timely, and informed consultation, this study seeks to answer the following question: How does the Northern Dam impact the Xokleng people's territory, culture, and socio-environmental security?

To address the proposed research question, the study is organized into three sections: (i) technical aspects and risk classification of the José Boiteux Northern Dam; (ii) a historical-legal analysis of the conflict between Santa Catarina State and the Xokleng people; and (iii) proposal of sustainable alternatives that recon- cile flood control, climate justice, and the realization of human rights. This is a qualitative study

that follows the hypothetical-deductive method and draws on bibliographic and documentary research, with a legal-sociological interpretation.

2 TECHNICAL ASPECTS AND RISK CLASSIFICATION OF THE JOSÉ BOITEUX NORTHERN DAM

The flood prevention system of the Itajaí Valley, in the state of Santa Catarina, consists of three dams: Taió, Ituporanga, and José Boiteux. The construction of the José Boiteux Northern Dam lasted from 1976 to 1992 and was widely acknowledged as the largest hydraulic project in Santa Catarina. It was specifically designed to regulate the flow of the Itajaí River and mitigate the floods that pe- riodically affect the Middle and Upper Valley regions. Despite its scale, the flood prevention system of this region has become outdated and only receives attention during critical situations. As part of its project, the imposing structure—capable of retaining 357 million m3 of water by damming the Dollmann and Hercílio (Itajaí do Norte) rivers—required the flooding of approximately 900 ha of the flattest and most fertile areas of the Xokleng Indigenous Land, 870 ha of which lie within the officially demarcated territory (Santa Catarina, 2019).

Out of operation since 2014, the Northern Dam has shown clear signs of degradation and neglect. In October 4, 2023, the state Civil Defense agency reported it was unsafe to operate the floodgates, which was confirmed by the tech- nical team (Santa Catarina, 2023b). However, a later court decision authorized the emergency operation of the dam, based on a 2021 technical report which, despite recommending extensive maintenance, considered it feasible to close the floodgates without compromising structural integrity (Santa Catarina, 2023a).

Thus, in October 2023, in response to extremely unfavorable weather forecasts for the Itajaí Valley, the Northern Dam was activated and its floodgates were closed in an effort to prevent catastrophic flooding in downstream municipalities. Constant warnings—both in technical reports and from Xokleng people them- selves—had already highlighted the neglected state of the infrastructure. When authorities attempted to reactivate the system, one of the floodgates remained jammed, a consequence of at least a decade of inadequate maintenance. This situation shows that the risk is not limited to the Xokleng Indigenous Land, which has been affected for decades, but extends to several

municipalities across the Itajaí Valley, which would face immeasurable consequences if the structure ruptured (ISA, 2023).

This procedure would involve temporarily flooding areas occupied by the Xokleng. As a result, a negotiation process was initiated: Santa Catarina State committed to providing food supplies, drinking water, and logistical support to the villages, and the Indigenous community agreed to authorize the emergency operation, on the condition that a technical report be presented certifying the structural safety of the dam.

To comply with the judicial requirement, the state submitted the Inspection Report on Safety, Equipment Evaluation, and Project Design for Dam Recovery (August/2021), prepared by civil engineer Hideaki Ussami. The inspection classi- fied anomalies into four risks—0 (none), 1 (attention), 2 (alert), and 3 (emergen- cy)—and evaluated both the civil structure and electromechanical systems (Santa Catarina, 2021). Regarding the concrete structure and operational mechanisms, the report found a clear lack of preventive maintenance, resulting in issues mostly classified as level 1 (attention), which could be resolved promptly. However, in critical systems such as the actuation shaft, hydraulic oil system, electrical panels, and emergency generators, failures were recorded at level 2 (alert), indicating a significant risk to operational safety (Santa Catarina, 2021).

Among the items classified as "alert" were: (i) the mobile gantry and main- tenance overhead crane; (ii) the hydraulic oil system to operate the floodgates; (iii) the gate opening measurement sensors; (iv) associated electrical installations; (v) the diesel generator set; (vi) the power transformation and protection set; and (vii) the lighting and cabling of the operating platform (Santa Catarina, 2021). If left unaddressed, these failures could compromise both the closing and reopening of the floodgates during floods, increasing the risk of uncontrolled flooding or progressive dam rupture.

Based on this assessment, the Northern Dam received an overall risk classi- fication of level 2 (alert) regarding localized anomalies and level 1 (attention) for global hazard:

> **4.11 HAZARD LEVEL CLASSIFICATION OF ANOMALIES (NORMAL, AT- TENTION, ALERT, OR EMERGENCY)**
> The Northern Dam has a large number of identified anomalies, most of which are classified as level 1 (attention), meaning they do not compromise dam safety in the short term but must be monitored, controlled, or resolved over time.
> Despite the lack of maintenance and the inoperable condition of the discharge tun- nel floodgates, which are completely open, the lack of operational capacity, the

> inability to perform maintenance on the discharge tunnel gates, and the patrimonial domain of the dam and its operational components justify its classification as level 2, that is, Alert (SANTA CATARINA, 2021).
>
> **4.12 OVERALL HAZARD LEVEL CLASSIFICATION OF THE DAM (NOR- MAL, ATTENTION, ALERT, OR EMERGENCY)**
>
> In view of the set of observed anomalies, the Northern Dam is classified as being at an Overall Hazard Level of Attention, according to the guidelines of the ANA Dam Safety Manual (2016) and ANA Resolution No. 236 of 2017. The combined effect of the anomalies does not immediately compromise the safety of the dam but could do so if they worsen. Therefore, the anomalies must be controlled, monitored, or repaired[1] (Santa Catarina, 2021, free translation).

Although the structure is not yet in an emergency state, the combination of insufficient maintenance, aging components, and increasing hydrostatic pressure demands constant monitoring, as it turns a collective protection device into a potential source of humanitarian disaster—especially for the Xokleng population living near the reservoir.

The measure immediately triggered a confrontation between authorities and the Indigenous community; Xokleng leaders warned that the damming would flood parts of their territory, submerging homes in villages located at lower elevations. Despite Indigenous resistance and the precarious condition of the dam complex, the government—supported by a court decision—entered the site and completed the closure of the floodgates. The resulting clash left three Xokleng individuals injured and aggravated tension, especially because the operation in- volved the Santa Catarina Military Police, even though jurisdiction over Indige- nous lands lies with the Federal Police (ISA, 2023).

[1] In the original: "4.11 CLASSIFICAÇÃO DO NÍVEL DE PERIGO DA ANOMALIA (NORMAL, ATENÇÃO, ALERTA OU EMERGÊNCIA)
A barragem Norte possui grande número de anomalias verificadas sendo a maioria classificada como nível de perigo 1 (Atenção), que não comprometem a segurança da barragem a curto prazo, mas devem ser monitoradas e controladas ou sanadas ao longo do tempo.
Apesar da ausência de manutenção e das condições de inoperabilidade das comportas dos túneis de descarga, que encontram-se totalmente abertas, a falta de condições operacionais, de ausência de possibilidade de se realizar a manutenção das comportas dos túneis de descarga e, também, de domínio patrimonial da barragem e seus órgãos operacionais justificam a classificação da barragem no nível 2, ou seja, de Alerta (SANTA CATARINA, 2021).
4.12 CLASSIFICAÇÃO DO NÍVEL DE PERIGO GLOBAL DA BARRAGEM (NORMAL, ATENÇÃO, ALERTA OU EMERGÊNCIA)
Em vista do conjunto das anomalias observadas considera-se que a Barragem Norte encontra-se em Nível de Perigo Global classificado como Atenção de acordo com as diretrizes do Manual de Segurança de Barragens da ANA (2016) e da Resolução da ANA n. 236 de 2017. Correspondendo o efeito conjugado das anomalias não comprometendo de imediato a segurança da barragem, mas caso venha a progredir, pode comprometê-la, devendo ser controlada, monitorada ou reparada".

With the judicial authorization to operate the dam, safeguards were imposed to protect all interested parties: the Military Police was immediately withdrawn, the Federal Police remained on site, and the Santa Catarina State was required to present a technical report proving structural stability within 24 hours. In addition to these conditions, the judiciary determined measures to mitigate impacts of the floodgate closure, as the flooding of a significant portion of the territory had isolated the Indigenous community (ISA, 2023).

It was the responsibility of the state government to provide boats to rescue stranded residents, as well as to distribute drinking water, food, and other essential supplies to support the Xokleng. However, according to reports from the community itself, these obligations were not fully met, raising concerns on the effective- ness of government policies and highlighting the need for greater accountability and respect for Indigenous rights. The partial assistance left the population adrift, facing a situation of calamity and humanitarian degradation (ISA, 2023).

After the closure, the reservoir reached its maximum capacity and, for the first time in history, the Northern Dam began to outflow: water crested the dam and flowed through the spillway. In response to public outcry, the Santa Catarina government ordered a new operation to raise the floodgates, mobilizing more than ten Military Police vehicles—a measure that once again violated the agreement made with the Xokleng community. Although the community did not resist, it expressed strong indignation at repeated acts of disrespect (ISA, 2023).

It is important to remember that, just a few years after its inauguration, the dam already showed several issues, prompting the Federal Prosecution Service and the Public Prosecutor's Office of Santa Catarina to file Public Civil Action No. 97.2005198-1 (currently 5012227-71.2018.4.04.7205). The sentence upheld the request, ordering the federal government and the state to purchase four support vehicles, install radios to connect the three dams to each other and to the managing agency, provide emergency generators for the Northern and Southern dams, and acquire a computer for data collection. They were also required to repair the electrical network of the Southern and Western dams; renovate the administrator's residence of the Southern Dam; and build secure facilities for the control rooms and offices of all three dams, ensuring their operation even during floods. Additionally, they had to construct a 90 m² residence for the administrator of the Western/Taió Dam (Brasil, 2023).

Other tasks include improving the water supply system at the Southern/ Ituporanga Dam; dredging 55,000 mS from its reservoir; removing 50,000 mS of sediment from the Western Dam and 10,000 mS from the downstream section of the Taió Dam; repairing gabions and retaining walls along the riverbanks; restor- ing the access bridge to the Western Dam; and concreting the slab and flow-direction wall at the Ituporanga spillway. Further required actions include restoring the bottom outlet shielding at the Southern Dam, relocating the hydraulic oil unit from the floodgates, installing protective grates in the drainage gallery of the Northern Dam, and placing 2,000 m of fences around safety areas.

The list continues: replacing the last row of grates at the Southern Dam along with dredging; developing hydraulic and engineering models for the spillway discharge channel of the Northern/José Boiteux Dam; assessing the elevation of the upper wall of the Western Dam; maintaining 24-hour armed surveillance; hiring operators and support staff; removing debris; keeping lawns, slopes, ditches, and drainage channels clean; maintaining service roads; servicing motors and emer- gency generators; refueling and inspecting support vehicles; performing minor repairs in residences and offices; and replenishing consumable supplies. Finally, the alert system must be maintained with a technical staff, vehicle, fuel, spare parts, daily inspections, and payment of telephone bills (Brasil, 2023).

The decision made it clear that, beyond its role in flood control, the dam has become a point of tension between regional development projects and the defense of the Xokleng traditional territory. In this context, the disaster caused by closing the floodgates—which isolated villages and compromised livelihoods—has intensified the debate over the need for local public policies that integrate climate mitigation and adaptation on fair and participatory grounds. During the execution phase of the ruling, the responsible parties began submitting periodic reports on the implementation of the court-ordered measures. However, despite the comple- tion of some items, disagreements remain regarding the extent to which various aspects of the ruling have been fulfilled, a circumstance that has prolonged legal proceedings for several years.

The José Boiteux case exemplifies how, in contexts of deficient governance, large hydraulic infrastructures can shift from instruments of protection to drivers of humanitarian risk for historically marginalized populations. Therefore, it is urgent to seek alternative flood management strategies that are aligned with climate justice and human

rights. Although, in theory, the Northern Dam reduces river levels and mitigates floods in the Itajaí Valley, any cost-benefit analysis must give equal weight to the adverse impacts borne by the Xokleng community whenever the floodgates are closed (Santa Catarina, 2023a).

3 THE INFLUENCE OF THE JOSÉ BOITEUX NORTHERN DAM ON THE XOKLENG INDIGENOUS LAND AND CONFLICTING INTERESTS

According to data from the 2010 Demographic Census conducted by the Brazilian Institute of Geography and Statistics (IBGE – Instituto Brasileiro de Geografia e Estatística), the Indigenous population in Brazil was 896,917 individuals, of whom 572,083 lived in rural areas and 324,834 in urban areas, distributed across the national territory (IBGE, 2022). The 2022 Census registered an increase to 1,693,535 people, distributed across 5,972 municipalities (FUNAI, 2023). Based on this demographic picture, one can perceive, on a microscopic scale, the complexity it entails when transitioning to realities such as that of the Xokleng Indigenous Land, the traditional homeland of the people for over six millennia. In the early second half of the 19th century, the arrival of German and Italian settlers triggered so-called “bugreiro” expeditions that decimated villages in the name of economic progress—a fact that left a deep mark on the collective memory of the Indigenous population (ISA, 2023).

Decades later, in contrast to this past of violent expropriation, the Brazilian legal system took a civilizing step by recognizing, in the 1988 Constitution, the original rights of Indigenous people and demanding the demarcation and protection of their territories. Nevertheless, everyday practice remains fraught with land conflicts and developmental pressures that threaten the effectiveness of these guarantees—a reality exemplified by the Xokleng case.

Indigenous territories lack sufficient state protection to ensure the preservation of culture, tradition, and, consequently, the subsistence of the villages. Arti- cle 231 of the 1988 Constitution guarantees Indigenous people their own social organization, customs, languages, beliefs, traditions, and original rights to the lands they have traditionally occupied, assigning the federal government the duty to demarcate and protect these territories (Brasil, 1988).

Such constitutional recognition represents progress but does not eliminate significant limitations. Article 20, item XI, of the Constitution states that Indigenous lands remain the property of the federal government, which restricts community autonomy (Brasil, 1988). Furthermore, Paragraph 4 of Article 231 prohibits the alienation of these areas and declares the corresponding rights as imprescriptible, meaning that Indigenous people hold only permanent possession and rely on an administrative procedure to have ownership formally recognized (Schonardie; Meotti; Bedin, 2021).

These legal tensions became evident in the recent Federal Supreme Court (STF) ruling on the Timeframe Thesis (Marco Temporal): by nine votes to two, the Court rejected the argument that traditional occupation must be proven as of October 5, 1988 (Brasil, 2023). Nevertheless, in September 2023, the Senate passed Bill No. 2,903, which, in practice, fully reinstates the premises of the Timeframe Thesis, revealing the ongoing clash between constitutional rights and developmental pressures.

Since at least 2009, the concept of the Timeframe Thesis has been used in the discourse of sectors linked to agribusiness, gaining prominence when then-STF minister Ayres Britto suggested its application while analyzing the demarcation process of the Raposa Serra do Sol Indigenous Land. In that ruling, the Court recognized the rights of Indigenous people to the territory, as their presence in the area was proven in 1988—the year the Constitution was enacted—and the term "timeframe thesis" was thus employed. Indigenous populations, however, have historically rejected this interpretation. They argue that many were forcibly removed from their lands before 1988—not by choice, but as a result of violent expulsions. This was the main ground presented by the Xokleng people in the case analyzed by the STF: they claimed to have been victims of persecution and massacres over decades, being forced to leave the territories they now claim as part of their original rights (Xokleng…, 2023).

The José Boiteux Northern Dam is situated within this context of land disputes. The flooding of significant portions of the Xokleng Indigenous Land to reduce socioeconomic damage caused by floods, as previously mentioned, threatens the community's subsistence and traditional way of life. Thus, although the project is aimed at regional water protection, it illustrates how economic development initiatives can directly clash with territorial rights guaranteed by the 1988 Federal Constitution (Santa Catarina, 2019).

The project was conducted without environmental licensing and without the free, timely, and informed consultation with the Indigenous community residing in the area, in violation of International Labour Organization (ILO) Convention No. 169 on Indigenous and Tribal Peoples and Article 225, Paragraph 1, of the 1988 Federal Constitution. The suppression of procedural safeguards has fueled disputes that persist to this day. The Convention establishes that governments must consult Indigenous people by means of appropriate procedures and their representative institutions whenever legislative or administrative measures likely to directly affect them are being considered, seeking to reach an agreement and obtain consent (ILO, 1989) regarding the proposed initiatives. It also recognizes the original right to ownership and possession of traditionally occupied lands, imposing on the State the duty to protect them and to establish mechanisms to resolve land claims. Furthermore, it prohibits the forced displacement of these people: any removal can only occur in exceptional circumstances and with their free, prior, and informed consent, along with full compensation for losses and damages (ILO, 1989).

In this regard, the Munduruku Consultation Protocol, mentioned by Oliveira (2021), represents an example of how Indigenous people have sought to consolidate the right to free, prior, and informed consultation in accordance with ILO Convention 169. The document is a tool for participation and a form of self-determination and affirmation their own juridical frameworks, aiming to reinforce legal pluralism and the need for horizontal dialogue with the State (ILO, 1989). Incorporating this type of practice into the governance processes of the Northern Dam would imply respecting culturally situated modes of deliberation, avoiding merely formal consultations, and ensuring that decisions on infrastructure truly account for the collective interests and rights of the Xokleng people.

However, it is important to remember that the operation of the José Boiteux dam has caused social and environmental impacts since its construction. Among negative repercussions are the loss of land and essential natural resources for the Xokleng, damage to biodiversity, and cultural conflicts generated by the presence of construction sites and the intensification of local economic activity. Moreo- ver, the expansion of extractive enterprises—often illegal and conducted under conditions akin to slavery—has increased the economic capital of the region at the expense of the health of Indigenous people, who fall ill and die due to envi- ronmental impacts on their territory and culture. The recent humanitarian crisis experienced by the Xokleng, resulting from damages caused by the

dam, has al- ready resulted in the loss of countless Indigenous lives and highlights the urgency of reparative and preventive actions (Santa Catarina, 2023a).

This humanitarian crisis reveals the historically constructed view of Indigenous people in Brazil. At the core of this perspective, Indigenous individuals are depicted as "savages" whose cultures and heritage could be replaced or destroyed without constituting a crime, which resulted in the systematic expropriation of their lands and traditions (Perrone-Moisés, 2000). However, the media frequently ignores the complexity and long duration of the conflicts between the Xokleng Indigenous Land community and Santa Catarina State, as well as the connection between these recent disputes with climate change effects on the El Niño phenomenon, whose intensification caused exceptional rainfalls in the Itajaí Valley in October 2023.

Extreme weather events in that region, although systemic and historically predictable, have worsened greatly due to anthropogenic actions that intensify global warming. In early October 2023, precipitation exceeded twice the monthly average in several locations: Mirim Doce and Taió recorded the highest totals, with rainfall peaks concentrated in three periods: October 3–4, 6–8, and 11–12. The heavy rainfall triggered serious disruptions, especially floods. The Rio do Sul municipality, for example, entered a state of inundation in the first week of the month, when the Itajaí-Açu River reached 9.5 m, a level indicative of flooding; in Blumenau, the same river rose 10.8 m. In addition to material losses, four deaths directly linked to these storms were reported (Santa Catarina, 2023a).

In October 2023, when the floodgates were opened during torrential rain, the Northern Dam fulfilled its role of dampening peak flow, preventing catastrophic floods in Blumenau, Rio do Sul, and neighboring municipalities; this performance confirms the hydraulic utility of the project. Nonetheless, the epi- sode also revealed that the structure operates at the threshold of technical safety: the failure of a single system classified as "Alert" would be enough to turn the protection infrastructure into a source of disaster. Hence, it is urgent to carry out all restoration works already mandated by the courts, under penalty of the dam failing to offer the same level of resilience during the next extreme event.

However, prevention cannot be reduced to engineering measures alone. It is also imperative to adopt a permanent safeguard protocol for Xokleng villages, as each gate closure submerges agricultural areas, disrupts mobility routes, and compromises the

community's food security. Thus, public policies must advance along two inseparable fronts: (i) full rehabilitation of the hydraulic complex; and (ii) socio-environmental protection of Indigenous people directly exposed to op- erational risks.

Such measures of responsibility and prevention require, as a legal-political foundation, an ecocentric paradigm, that is, the recognition that environmental protection is justified not only by its human benefits but by the integrity of the ecosystem itself. In this regard, Leite and Canotilho (2010, p. 26-27, free trans- lation) emphasize:

> Adequate protection and prevention measures are all those that, as a matter of precaution, limit or neutralize the cause of environmental harm, whose total or partial irreversibility produces effects, damage, and imbalances that negatively affect the dignified survival of human life (anthropocentric responsibility) and all forms of life based on the balance and stability of natural or altered ecosystems (ecocentric responsibility)[2].

Moreover, the punctual effectiveness demonstrated by the dam cannot obscure the latent vulnerability of its components, nor relativize the territorial rights of the Xokleng people; only the combination of restorative engineering, participatory governance, and ecocentric responsibility will prevent a water protection instrument from becoming a humanitarian tragedy.

In this context, Boff warns (2011, p. 17-18, free translation):

> […] We must undertake a long transformation journey in our daily and political habits—both private and public, cultural, and spiritual. The increasing degradation of our common home, the Earth, reveals our adolescent crisis. It is crucial that we enter maturity and begin to show signs of wisdom. Without this, we will not guarantee a promising future. To frame the issue more formally, we could say: more than the end of the world, we are witnessing the end of a certain kind of world. We are facing a widespread civilizational crisis. We need a new paradigm of coexistence that fosters a more caring relationship with the Earth and inaugurates a new social pact among peoples rooted in respect for and preservation of all that exists and lives. Only from this transformation can we begin to think of alternatives that embody a new hope[3].

[2] In the original: "Medidas de proteção e de prevenção adequadas são todas aquelas que, em termos de precaução, limitam ou neutralizam a causação de danos ao ambiente, cuja irreversibilidade total ou parcial gera efeitos, danos e desiquilíbrios negativamente perturbadores da sobrevivência condigna da vida humana (responsabilidade antropocêntrica) e de todas as formas de vida centradas no equilíbrio e estabilidade dos ecossistemas naturais ou transformados (responsabilidade ecocêntrica)".

[3] In the original: "[…] Devemos percorrer um longo caminho de conversão dos nossos hábitos cotidianos e políticos, privados e públicos, culturais e espirituais. The increasing degradation of our common home, the Earth, reveals our adolescent crisis. It is crucial that we enter maturity and begin to show signs of wisdom. Without this, we will not guarantee a promising future. To frame the issue more formally, we

The experience of the Northern Dam embodies the ambivalence described by Beck (2011): technological advances coexist with diffuse threats, especially when precarious maintenance, unilateral decisions, and breaches of agreements exclude affected communities from decision-making processes. Even so, Beck also points to transformation paths grounded in prevention and shared risk management—premises that resonate with the notion of an "ecological rule-of-law state", in which nature constitutes the foundation of the human relations network.

Currently, José Boiteux is the epicenter of a conflict: on one side, the State's need to mitigate floods in the Itajaí Valley; on the other, the Xokleng people's original right to a territory free from permanent threats. Overcoming this impasse depends not only on effective technical solutions but also on deliberative mechanisms that guarantee safety, well-being, and dignity, which are essential steps towards achieving climate justice in the region.

4 IMPLEMENTATION OF SUSTAINABLE PRACTICES AT THE JOSÉ BOITEUX NORTHERN DAM AND ADVANCES IN CLIMATE JUSTICE AT THE XOKLENG INDIGENOUS LAND

Climate inequality, a phenomenon that aggravates social disparities within and between nations, stems from the fact that industrialized countries have historically been the main emitters of greenhouse gases, while developing countries, with less responsibility for global warming, bear the most severe impacts (Robinson, 2021). Among the disproportionately affected groups are Indigenous communities, as their territories and ways of life depend directly on ecosystems now facing extreme weather events, rising temperatures, and resource scarcity.

In this context, climate justice requires acknowledgment of differentiated responsibilities: the Global North holds a "climate debt" to the Global South and must contribute to a just, solidary, and democratic socioecological transition that includes prevention, mitigation, and adaptation. This transition acquires ethical contours in Boff's

could say: more than the end of the world, we are witnessing the end of a certain kind of world. We are facing a widespread civilizational crisis. We need a new paradigm of coexistence that fosters a more caring relationship with the Earth and inaugurates a new social pact among peoples rooted in respect for and preservation of all that exists and lives. Só a partir desta mutação faz sentido pensarmos em alternativas que representem uma nova esperança".

(2011) concept of "integral ecology", which proposes a holistic approach (environmental, social, economic, and cultural) grounded in a new paradigm of respect for the interconnection of all life forms.

Although the exacerbated consumption typical of capitalism undermines social empathy, there is a growing demand in the Global South for a rupture with historical hegemony. The concept of the Global South adopted here—a metaphor for the suffering produced by capitalism, colonialism, and patriarchy—seeks to resist standards imposed by the Global North and expand political imagination based on peripheral knowledge (Santos; Araújo; Baumgarten, 2016). This per- spective is directly applicable to the dam conflict: breaking free from the predatory model requires solutions that balance economic and environmental interests, revise the project to minimize damage, ensure compensation, and respect the rights of the Xokleng people.

Applied to the Xokleng Indigenous Land and the Northern Dam, this perspective entails: (i) establishing participatory infrastructure governance, with free, prior, and informed consultation and Indigenous co-management of flood control; (ii) adopting sustainable energy practices—ensuring access to electricity by renewable sources and community microgrids, while avoiding fossil fuel expansion; (iii) guaranteeing basic social rights provided for in Article 6 of the 1988 Constitution (food, drinking water, sanitation, adequate housing) as local climate adaptation measures; (iv) promoting environmental restoration and community-based watershed monitoring to reduce siltation, restore riparian forests, and diversify livelihoods; and (v) implementing compensation and reparation mechanisms for existing damage, linked to national and international climate justice funds.

In this logic—prioritizing Indigenous co-management, decentralized renewable energy, guarantee of basic social rights, ecosystem restoration, and compensation for already incurred damages—this set of measures materializes, at a territorial scale, three core targets of Sustainable Development Goal (SDG) 13, which calls for[4] urgent action to combat climate change and its impacts (COP 21, 2025, free translation):

[4] The United Nations (UN) 2030 Agenda establishes 17 Sustainable Development Goals (SDGs) that guide global actions towards more just, resilient, and environmentally balanced world. These goals include eradicating poverty; combating hunger and promoting sustainable agriculture; ensuring universal access to health and well-being; guaranteeing quality education; promoting gender equality; ensuring access to drinking water and sanitation; advancing the use of clean and affordable energy; fostering decent work and economic growth; encouraging innovation, industry, and infrastructure; reducing inequalities; building sustainable cities and communities; promoting responsible consumption and production; addressing climate change; conserving marine life; protecting terrestrial life; strengthening peace, justice, and effective

> […] 13.1 Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.
> 13.2 Integrate climate change measures into national policies, strategies, and planning.
> […]
> 13.b Promote mechanisms for capacity building for effective climate change-relat- ed planning and management in least developed countries, including focusing on women, youth, and local and marginalized communities[5].

Thus, the participatory governance of the Northern Dam functions as a "glocal"[6] link between the 2030 Agenda and the concrete needs of the Xokleng Indigenous Land: while it meets international commitments on mitigation and adaptation, it also recognizes Indigenous leadership as a condition for the legiti- macy and effectiveness of climate action.

International experiences reinforce the importance of assessing social impacts of large dams, since such impacts are spatially significant, locally disrup- tive, long-lasting, and often irreversible. Studies such as the Lesotho Highlands Water Project (LHWP) show that large-scale projects can lead to forced migra- tion, resettlement, and changes in social and economic dynamics, including alterations in land and water use, loss of community networks, health risks, and disruption of psychosocial well-being. When articulated with the principles of social impact assessment (SIA) defined by the International Association for Impact Assessment, these aspects highlight the need to integrate prior consulta- tions, compensatory measures, and participatory governance in projects such as the José Boiteux Northern Dam, under the risk of reproducing patterns of so- cio-environmental injustice similar to those observed globally (Tilt; Braun; He, 2009).

For Robinson (2021), debating climate change implies seeking social justice by eradicating poverty and eliminating inequalities. Thus, the discussion cannot be limited

institutions; and promoting global partnerships to implement these goals. By integrating economic, social, and environmental dimensions, the 2030 Agenda proposes a structural transformation based on equity, sustainability, and solidarity among peoples and nations (COP 21, 2025).

[5] In the original: "[…] 13.1 Reforçar a resiliência e a capacidade de adaptação a riscos relacionados ao clima e às catástrofes naturais em todos os países.
13.2 Integrate climate change measures into national policies, strategies, and planning. […]
13.b Promover mecanismos para a criação de capacidades para o planejamento relacionado à mudança do clima e à gestão eficaz, nos países menos desenvolvidos, inclusive com foco em mulheres, jovens, comunidades locais e marginalizadas".

[6] Term coined by Soriano Gatica (2002): in "glocal", "local" represents the "we" of the global network and incorporates both the resistance and contributions of local and regional identity formations to globalization.

to classical redistribution, it must also address processes that generate maldistribution. The individual and collective recognition of Indigenous people emerges as a key element in achieving climate justice in countries from the Global South. Climate injustice is directly related to socio-environmental inequality, which, combining economic, social, cultural, and environmental factors, renders people and groups from less favored regions more vulnerable to climate change impacts (Observatório Sistema FIEP, 2022). From this perspective, vulnerability, understood as a form of social risk, manifests itself mainly in the concentration of deficiencies related to the provision of essential public services and the lack of in- vestment in infrastructure—that is, in resources and structures that enable access to opportunities. This condition results in the exposure of poorest populations to social insecurity. Such vulnerability may or may not be linked to environmental risks, as is the case with residences located on steep slopes prone to landslides and burying, or in areas susceptible to flooding and inundation (Penna; Ferreira, 2014).

> Ideas to postpone the end of the world, aligned with the notions of pachamama and hutukara, tells us that the idea of us humans detaching ourselves from the earth, living a civilizational abstraction, is absurd. It suppresses diversity and denies the plurality of existence […]. When we depersonalize rivers, mountains, when we strip them of their meanings—assuming these are attributes exclusive to humans—we open the way for these places to become residues of industrial and extractive activi- ties[7] (Krenak, 2019, p. 22-23, free translation).

It is under this lens that Article 225 of the Brazilian Constitution must be interpreted: in direct dialogue with the principles of human dignity (Article 1, III) and the objectives of building a just, egalitarian, and developed society, free from poverty and regional, gender, or racial discrimination (Article 3). A systemic reading of this provision thus requires the explicit inclusion of protections for Indigenous people (Article 231) and Quilombolas (Article 68 of the Brazilian Act of Transitional Constitutional Provisions) as an inseparable dimension of the fun- damental right to the environment (Brasil, 1988).

For multiple human rights (currently elevated to fundamental rights) to become enforceable, a dignified interaction between people and their environment must be

[7] In the original: “Ideias para adiar o fim do mundo, alinhado à noção de pachamama e hutukara, fala-nos que a ideia de nós, humanos, nos descolarmos da terra, vivendo uma abstração civilizatória, é absurda. Suprime a diversidade, nega a pluralidade de existência […]. Quando despersonalizamos o rio, a montanha, quando tiramos deles os seus sentidos, considerando que isso é atributo exclusivo dos humanos, liberamos esses lugares para que se tornem resíduos da atividade industrial e extrativista”.

ensured. This premise explains why environmental achievements always result from collective processes.

Drawing on theoretical contributions of Flores (2010), it can be stated that human rights fundamentally arise from collective social claims, creating spaces capable of strengthening citizenship and promoting effective conditions for a more just and dignified existence. From this perspective, human rights can be understood as a discursive field that connects normative reality to concrete social context, thereby clearly highlighting differences between material obstacles imposed by society and ethical and cultural aspirations defended by communities.

Regarding climate, Robinson (2021) highlights that adequately addressing climate change requires the promotion of social justice, including eradicating poverty and combating social inequalities. Therefore, the debate on climate jus- tice must go beyond the traditional focus on resource redistribution, advancing towards a critical understanding of structural processes that lead to distributive injustices. In these circumstances, the literature describes social vulnerability as the negative outcome arising from a mismatch between material and symbolic resources available to individuals or groups and the opportunities they can effectively access. To properly understand it, it is necessary to articulate both objective and subjective dimensions. From this perspective, vulnerability arises when available assets do not translate into improvements, due to an insufficient opportunity structure. This simultaneously compromises three essential sets of resources: per- sonal resources, rights, and social relationships (Monteiro, 2011).

In light of this diagnosis, Boff (2011) proposes an integral ecology that recognizes nature as a subject of rights: sustainable development requires respecting planetary boundaries, ensuring dignified living conditions for all, and adopting a responsible economy that is socially and environmentally committed. Thus, the formulation of post-disaster public policies must adhere to principles of solidarity and global cooperation, as environmental challenges transcend national borders.

In the case of the Xokleng Indigenous Land, the construction of the Northern Dam and the formation of its reservoir have, for decades, been degrading the community's quality of life and subsistence. For Beck (2018), such events act as "anthropological shocks" that mark collective memory and trigger social cathar- sis, revealing that past decisions can and should be reviewed when they lead to "self-endangerment":

> Anthropological shocks occur when many populations feel they have been subjected to horrendous events that leave indelible marks on their consciousnesses, forever shaping their memories and fundamentally and irrevocably changing their future. Anthropological shocks provide a new way of being in the world, seeing the world, and doing politics. From this, a social catharsis may emerge, including reflex, reflex- ivity, and reflection. Anthropological shock induces a kind of compulsive collective memory of the fact that past decisions and mistakes are embedded in what we are exposed to; that even the highest degree of institutional reification is nothing but a reification that can be undone—a borrowed mode of action that can and must be changed if it leads to self-endangerment[8] (Beck, 2018, p. 161, free translation).

This scenario is part of a Brazilian history of colonial domination marked by mercantilist exploitation and a perception of natural resources as infinite. Brazil's colonial past—as a Portuguese exploitation colony guided by a mercantilist logic that regarded natural resources as inexhaustible and the environment as disposable—laid the foundation for a predatory relationship that erased Indigenous cultures and identities (Dussel, 1993). This legacy remains visible in the context of the José Boiteux Northern Dam: the same developmentalist impulse that once disregarded environmental limits now ignores Xokleng territorial rights, reiterat- ing the exploitation pattern denounced throughout history. The identity of any people depends on concrete social and material conditions; when a group is symbolically marked as an enemy or taboo, it undergoes social exclusion and material disadvantage (Silva; Hall; Woodward, 2014, p. 14). In the case of the Xokleng, such marking is expressed in the imposition of infrastructure that takes away tra- ditional lands, fragments cultural practices, and compromises subsistence, placing the people at the "receiving end" of state action (Bauman, 2013).

Currently, the flooding of areas adjacent to the dam causes the loss of traditional Xokleng lands, compromising community autonomy and altering the local ecosystem. Each time the floodgates are closed, vast stretches of riparian forest and family crops are submerged, further fragmenting native fauna and flora and reducing subsistence options of the Indigenous population. Added to this is the abrupt external interference: the state

[8] In the original: "Choques antropológicos ocorrem quando muitas populações sentem que foram submetidas a eventos horrendos, que deixam marcas indeléveis em suas consciências, que marcarão suas memórias para sempre e mudarão seu futuro de maneira fundamental e irrevogável. Anthropological shocks provide a new way of being in the world, seeing the world, and doing politics. From this, a social catharsis may emerge, including reflex, reflexivity, and reflection. O choque antropológico induz uma espécie de memória coletiva compulsiva do fato de que decisões e erros do passado estão contidos naquilo a que nos vemos expostos; de que mesmo o grau mais elevado de reificação institucional não é nada senão uma reificação que pode ser anulada, um modo de ação emprestado, que pode e deve ser modificado se levar ao autocomprometimento".

government's decision to build the dam without prior consultation produced a forced cultural transformation, as the Xokleng were compelled to adapt their rituals, agricultural practices, and ways of living to conditions imposed by the new hydric reality.

The ancestral relationship of the community with water—an element used in spiritual ceremonies, oral narratives, and fishing systems—was destabilized by the river's diversion and damming. Whenever the reservoir rises, entire villages become isolated, drinking water sources are contaminated, and the lack of basic sanitation favors outbreaks of infectious diseases. This succession of impacts, ag- gravated by the state's failure to provide adequate infrastructure or resettlement alternatives, constitutes a blatant violation of the Xokleng's human dignity and fundamental rights, turning a flood control initiative into a large-scale environ- mental and humanitarian crisis.

To mitigate such impacts, a set of measures is proposed: adequate and informed consultations that ensure real participation of the Xokleng in decision-making; fair compensation for the loss of territory and resources; cultural preservation programs that strengthen traditions and languages; and rigorous environmental monitoring to protect biodiversity. These instruments are not merely technical but concrete steps toward breaking the historical cycle of socio-envi- ronmental inequality and aligning the management of the Northern Dam with principles of climate justice and human rights that underlie this study.

5 CONCLUSION

The analysis of the three axes developed in this study—namely, technical dimensions of the Northern Dam, Xokleng territorial conflicts, and sustainability guidelines—revealed that the climate emergency intensifies preexisting risks and exposes the fragility of infrastructures designed under developmentalist logics that neglect human rights. In a global context of increasingly frequent extreme events, recognizing climate protection as a fundamental right is not mere rheto- ric: climate stability conditions the effectiveness of constitutional guarantees such as housing, health, food, and culture, especially for Indigenous people who face overlapping socio-environmental vulnerabilities.

As emphasized, even though the Northern Dam helps mitigate peak river flows in the Itajaí Valley, the costs imposed on the Xokleng Indigenous Land— such as the loss

of 900 hectares of fertile territory, disruption of water-related rituals, recurrent isolation, and growing structural risk—outweigh the benefits when unaccompanied by participatory governance. The emergency operation in October 2023, conducted without full compliance with the agreements, crystal- lized this asymmetry: beyond injuries and material losses, the community remains exposed to water and health insecurity.

The tragedies of Mariana and Brumadinho, municipalities from the state of Minas Gerais, should have raised public authorities' awareness about dangers associated with dams in Brazil; however, effective prevention measures remain lacking. Therefore, the situation of the Northern Dam synthesizes the combination of state negligence, structural fragility, and social vulnerability that turns a water safety infrastructure into a potential source of humanitarian collapse.

Considering the principles of integral ecology (Boff, 2011) and risk society (Beck, 2011), dam management must shift from a technocratic model to an ecocentric and climate justice paradigm, which includes: (i) Indigenous co-management, i.e., free, prior, and informed consultation and Xokleng participation in the operations committee during extreme events; (ii) compensation and repa- ration, via specific funds for environmental restoration, sanitation infrastructure, and cultural preservation programs; (iii) basic social rights as adaptation measures, guaranteeing drinking water, dignified housing, and permanent access to health- care and mobility during floods; and (iv) community monitoring of the watershed using environmental and social indicators monitored by state agencies, the local university, and Xokleng representatives.

These pillars enable transforming the Northern Dam from a vector of humanitarian risk into an instrument of sustainable protection, aligned with goals of the 2030 Agenda and constitutional duties enshrined in Articles 225 (environment), 231 (Indigenous rights), and 6 (social rights) of the 1988 Brazilian Federal Constitution. This article concludes that, given that flood management must respect the dignity and self-determination of Indigenous people, the harmonious future of the region depends on implementing plural, ecocentric, and participatory public policies to reconcile water security, climate justice, and human rights.

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Authors' participation

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All authors participated in the discussions of the findings, reviewed, and approved the final version of the study.

Data availability

All datasets relevant to this study's findings are fully available within the article.

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