

Water, health, and rights: challenges of drinking water and sanitation for indigenous communities in Tocantins, Brazil

Água, saúde e direitos: desafios do abastecimento de água potável e saneamento para comunidades indígenas no Tocantins, Brasil

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ABSTRACT

Indigenous communities in Brazil, particularly in the state of Tocantins (Brazilian Legal Amazon), continue to face persistent challenges regarding water security and sanitation. Historically marginalized by colonial structures and state policies, these populations experience unequal access to safe drinking water and basic sanitation services, undermining health, cultural practices, and environmental justice. This study analyzes the implementation and effectiveness of water supply and sanitation policies targeting Indigenous peoples, with an emphasis on the National Indigenous Peoples Health Policy (PNASPI). The methodology adopted combined a systematic review of literature, national legislation, and health policy documents with the analysis of sanitation infrastructure data from 160 Indigenous villages, sourced from official databases. The review also incorporated thematic mapping and epidemiological data on waterborne diseases, notably acute diarrheal disease (ADD). The results show that only 10% of villages have both water supply systems and sanitary modules, while 30% of the Indigenous population lacks treated water, violating PNASPI provisions. The persistence of high rates of waterborne diseases highlights policy failures and health inequities. The findings call for culturally sensitive, participatory governance models, improved sanitation infrastructure, and the integration of Indigenous knowledge to enhance water security and health outcomes in Indigenous territories.

Keywords: indigenous health equity; policy implementation; sanitation disparities; traditional knowledge; water governance.

RESUMO

Comunidades indígenas no Brasil, particularmente no estado do Tocantins (Amazônia Legal Brasileira), continuam a enfrentar desafios persistentes com relação à segurança hídrica e ao saneamento básico. Historicamente marginalizadas por estruturas coloniais e políticas estatais, essas populações vivenciam acesso desigual à água potável e aos serviços de saneamento básico, prejudicando a saúde, as práticas culturais e a justiça ambiental. Este estudo analisa a implementação e a eficácia das políticas de abastecimento de água e saneamento voltadas para os povos indígenas, com ênfase na Política Nacional de Saúde dos Povos Indígenas (PNASPI). A metodologia adotada combina uma revisão sistemática de literatura, legislação nacional e documentos de políticas de saúde com a análise de dados de infraestrutura de saneamento de 160 aldeias indígenas, provenientes de bancos de dados oficiais. A revisão também incorporou mapeamento temático e dados epidemiológicos sobre doenças transmitidas pela água, notadamente a doença diarreica aguda (DDA). Os resultados mostram que apenas 10% das aldeias possuem sistemas de abastecimento de água e módulos sanitários, enquanto 30% da população indígena não possui água tratada, violando as disposições da PNASPI. A persistência de altas taxas de doenças transmitidas pela água revela falhas nas políticas e desigualdades em saúde. Os resultados indicam a necessidade de modelos de governança participativos e culturalmente sensíveis, infraestrutura de saneamento aprimorada e a integração do conhecimento indígena para aprimorar a segurança hídrica e os resultados de saúde em territórios indígenas.

Palavras-chave: conhecimento tradicional; disparidades em saneamento; equidade em saúde indígena; governança da água; implementação e políticas.

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Introduction

Access to safe drinking water and sanitation remains an unresolved socio-environmental and public health challenge for Indigenous peoples in many countries, including Brazil. Historical processes of colonialism and state control over water resources have displaced Indigenous knowledge systems, disrupted traditional practices, and imposed governance models that disregard cosmology (Linton et al., 2020; Meehan et al., 2020). In Brazil, the forced sedentarization of Indigenous communities throughout the 20th century drastically altered their relationship with water. As former semi-nomadic peoples, Indigenous groups traditionally relied on seasonal hydrological knowledge, protected natural springs, and managed water sources based on cosmological and ecological principles. Settling in fixed villages exposed them to new vulnerabilities, such as poverty, land dispossession, contamination of water sources, and exclusion from decision-making processes on water management (Langdon and Grisotti, 2021).

The concept of water colonialism, or the appropriation and modification of Indigenous water sources by state and private actors, is necessary to understand contemporary water insecurity in Indigenous territories (Meehan et al., 2020). This process not only disrupts access to safe water, but also violates the spiritual and cultural dimensions inherent in Indigenous water governance systems (Whyte, 2019). At the same time, environmental injustice persists as public policies systematically neglect the cultural, ecological, and health needs of Indigenous peoples, reinforcing unequal power relations and undermining Indigenous sovereignty (Grisotti, 2019; Santos et al., 2022).

The chronic nature of water insecurity in Indigenous communities is also present in countries such as Canada and the United States, associated with poor infrastructure, exclusion from governance, and the imposition of colonial legal frameworks (Wilson and Inkster, 2018; Hartwig et al., 2021b). Culturally inclusive governance models that legitimize Indigenous leadership and integrate Indigenous ontologies into water management are needed.

Governance models such as community-led water boards, exemplified by the Tsatsaros et al. (2018) in Australia, offer concrete alternatives to top-down, state-centered policies. In Brazil, although there are national health and sanitation policies, including the National Health Policy for Indigenous Peoples (PNASPI Portuguese acronym) and the New Legal Framework for Basic Sanitation (Law N°. 14,026/2020), that formally recognize the rights of Indigenous peoples, these frameworks rarely translate into effective and culturally appropriate services at the local level (Silva et al., 2020; Langdon and Grisotti, 2021). The incorporation of Indigenous knowledge systems into water and sanitation management remains superficial, and policy implementation continues to be marked by operational inconsistencies and weak Indigenous social control (Grisotti, 2019).

Internationally, studies from countries like Canada, Australia, and the United States emphasize participatory governance models and the integration of Indigenous epistemologies into water management

frameworks. Community-led water governance structures should be proposed that respect Indigenous sovereignty over water territories, recognizing water not merely as a commodity or resource, but as a living, relational entity integral to Indigenous cosmologies (Whyte, 2019; Linton et al., 2020). This relational ontology of water shapes community practices, conflict resolution, and ecological stewardship, a dimension largely absent from dominant state-centered governance systems. The comparative analysis reveals distinct emphases and conceptual framings between international and Brazilian national studies on Indigenous water security, governance, and sanitation. International studies advance most in participatory governance, Indigenous ontologies and the conceptualization of water; whereas national studies focus more on infrastructure and institutional public policies (Figure 1).

Despite the contributions of national and international studies, significant gaps remain. Most global research focuses on governance models in Canada, Australia, and New Zealand, with scant empirical data on the operationalization of water policies in Indigenous territories in Brazil, particularly in Tocantins, a region of the Brazilian Legal Amazon that has historically been neglected in academic and institutional studies. Few studies critically evaluate the implementation of the water and sanitation components of the PNASPI at the local scale or systematically analyze the interaction between state policies, Indigenous knowledge, and community health outcomes. This study aims to address these gaps by: i. analyzing the implementation and effectiveness of water supply and sanitation policies for Indigenous peoples in Tocantins, with an emphasis on the PNASPI framework; ii. proposing a reformulation of water security indicators that goes beyond infrastructure provision to integrate cultural perceptions, Indigenous knowledge systems, and participatory governance mechanisms; and iii. analyzing the conceptual debates on water colonialism and environmental injustice, contributing to a sociopolitical understanding of water governance in Indigenous territories in Brazil.

Indigenous water security issues go beyond infrastructure deficiencies, encompassing broader aspects of water rights, jurisdiction, and governance. These gaps compromise the health, dignity, and well-being of Indigenous peoples (Hartwig et al., 2021a). Indigenous worldviews recognize water not only as a resource, but as a living entity with which communities maintain reciprocal relationships. These visions guide social norms and practices, often transmitted by elders and embedded in spiritual, ecological, and cultural frameworks (Whyte, 2019).

This study focuses on the state of Tocantins, a territory in the Brazilian Legal Amazon that has been little studied in research on Indigenous water security. The research not only assesses the implementation of public policies, but also proposes a reformulation of water security indicators that go beyond physical infrastructure, integrating perceptions about water quality, Indigenous knowledge systems and participatory governance. Given this scenario, this study assesses the effectiveness of PNASPI in 160 villages in Tocantins, identifying gaps between the legislation and the local reality, in order to propose alternatives based on intercultural governance, reinforcing the gap to be filled and the originality of the approach.

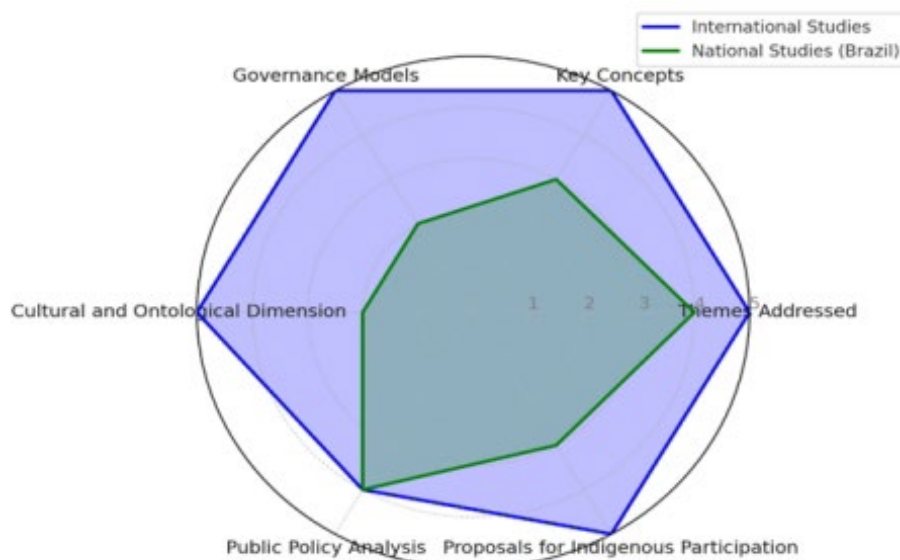


Figure 1 – A comparative analysis reveals distinct emphases and conceptual framings between international and Brazilian national studies on Indigenous water security, governance, and sanitation.

Methodology

Study area

The state of Tocantins is located in Brazil's North region, within the Brazilian Legal Amazon. The state covers a total area of 277,423,627 km², has an estimated population of 1,607,363 people, and a demographic density of 4,988 inhabitants/km² (IBGE, 2021). In Tocantins, there are existing Indigenous ethnicities: these people are spatially located in different regions of Tocantins in officially demarcated Indigenous lands. Indigenous lands are subdivided into communities traditionally known as villages (IBGE, 2010).

Systematic literature review

A systematic literature review was conducted to examine peer-reviewed studies addressing the relationship between Indigenous populations and water and sanitation governance. The review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure transparency and reproducibility.

Search strategy and eligibility criteria

The literature search was performed in the SciVerse Scopus database. Three sequential steps structured the search process:

- ✓ **Keyword identification:** Keywords were identified through preliminary scoping and included terms such as water, sanitation, Indigenous communities, water security, water governance, and public policy. Controlled vocabulary was not applied due to the interdisciplinary nature of the theme.
- ✓ **Systematic query combinations:** The identified keywords were combined in pairs (e.g., water and sanitation AND Indigenous peoples;

Indigenous policies AND water security; water governance AND Indigenous rights) without restrictions by publication date or geography.

- ✓ **Abstract screening and eligibility:** Articles were included if they i. focused on Indigenous communities, ii. addressed water, sanitation, or water security, iii. analyzed policies or governance frameworks, and iv. were published in peer-reviewed journals. Exclusion criteria involved i. studies on non-Indigenous rural or urban populations, ii. reviews lacking original data or policy analysis, and iii. grey literature, dissertations, or non-peer-reviewed materials.

Study selection and data extraction

Titles and abstracts were independently screened. Disagreements were resolved through discussion. Data were extracted regarding study objectives, methodologies, geographic focus, thematic categories, and key findings.

Thematic Categorization: Indigenous perspectives and resistance; water governance and Indigenous rights; water security and environmental justice; and legislation, policies and quality of drinking water. This categorization allowed an analytical synthesis of international and national contributions on water and sanitation for Indigenous communities (Table 1).

The records were identified through a search in the Scopus database (n=423), then removed of duplicates (n=389) and selected by title and abstract (n=389). The records excluded (n=298) included those not related to Indigenous peoples (n=124), those focusing only on non-Indigenous urban/rural contexts (n=86), those that lacked a focus on water or sanitation (n=53) and those that were editorials/opinion pieces (n=35).

The full papers were assessed for eligibility (n=91), and the papers that were excluded (n=47) were those with no policy/governance analysis (n=25), no original data or empirical analysis (n=14) and those

consisting only of conference abstracts (n=8). The studies included in the qualitative synthesis totaled 44.

Policy and legislative review

A systematic review of national laws, decrees, ordinances, and public health guidelines related to drinking water, sanitation, and Indigenous health care in Brazil was conducted. Legal and regulatory documents were identified through official government databases and the Virtual Health Library (VHL) platform, using structured keyword searches (e.g., Indigenous health, sanitation law, water quality regulation) (Table 2).

Primary data collection in indigenous villages, and data sources and collection instruments

To complement the literature and policy review, quantitative and qualitative data were collected from 160 Indigenous villages in the state of Tocantins, Brazil, within the Special Indigenous Health Districts of Tocantins (DSEI-TO) jurisdiction. Secondary data were extracted from the Special Secretariat for Indigenous Health (SESAI) reports and health information systems available on the Virtual Health Library (VHL) platform (Brasil, 2019).

Table 1 – Search strings and results.

Search Combination	Records Retrieved
“water” AND “sanitation” AND “Indigenous communities”	97
“Indigenous policies” AND “water security”	58
“Indigenous governance” AND “sanitation”	76
“water quality” AND “Indigenous health”	54
“drinking water” AND “Indigenous Brazil”	43
“water rights” AND “Indigenous peoples”	56
Total (before duplicates removal)	423

Data treatment

Quantitative data were analyzed using descriptive statistics and, where applicable, chi-square tests and t-tests for comparisons between groups (e.g., villages with and without access to treated water). Significance was set at $p < 0.05$.

Results and Discussion

Water security: A mechanism to guarantee access to drinking water

Water security refers to the sustainable provision of adequate quality and quantity of water for various uses, safeguarding health, livelihoods, and ecosystems. In recent years, water security has gained attention as an essential dimension of human rights, particularly for Indigenous peoples, whose access to safe drinking water remains deeply unequal despite international recognition of their rights (de Coste et al., 2024).

Indigenous worldviews conceptualize water not merely as a resource but as a living entity, integral to identity, cultural continuity, and well-being (O'Donnell et al., 2023). However, colonial legacies and modern governance structures frequently exclude Indigenous perspectives, reinforcing structural inequalities and disregarding traditional knowledge systems (Kehinde et al., 2025). Integrated, culturally appropriate approaches to water security are increasingly advocated to address these inequities.

Indigenous communities worldwide face disproportionate water insecurity due to inadequate infrastructure, governance exclusion, and environmental degradation. In Canada, small and remote Indigenous communities experience chronic water challenges, including microbial and chemical contamination, insufficient water treatment, and financial and logistical constraints (de Coste et al., 2024). Similarly, Indigenous populations in Australia and North America contend with deteriorating water quality, partly exacerbated by climate variability and historic dispossession of land and water rights (Balasooriya et al., 2023).

Table 2 – Legal and regulatory framework governing water and sanitation for Indigenous communities in Brazil.

Documents	Objectives	References
Law N.º 5,371	Authorizes the establishment of the National Indian Foundation (FUNAI) and provides other measures.	Brasil, 1967
Constitution of the Federative Republic of Brazil	Constitution of the Federative Republic of Brazil	Brasil (1988)
Decree N.º 97,838	Approves the administrative demarcation of the Xerente Indigenous Area, in the state of Tocantins.	Brasil (1989)
Law N.º 9,836	Adds provisions to Law No. 8,080, of September 19, 1990, establishing the Indigenous Health Care Subsystem.	Brasil (1999)
Ordinance N.º 254	National Health Care Policy for Indigenous Peoples.	Brasil (2002)
Law N.º. 11,445/2007	Basic Sanitation Law	Brasil (2007)
Law N.º. 12,314	Amends Laws no. 10,683, of May 28, 2003, and of Ministries, 8,745, of December 9, 1993, and 8,029, of April 12, 1990; repeals provisions of Law N.º. 10,678, of May 23, 2003; and takes other measures.	Brasil (2010)
Law N.º. 12,651	Provides for the organization of social control in the Indigenous Health Care Subsystem.	Brasil (2012)
Law N.º. 14,026	Updates the legal framework for basic sanitation and other provisions.	Brasil (2020)
Ordinance n.º 888	GM/MS Ordinance No. 888. Amends Annex XX of GM/MS Consolidation Ordinance No. 5, of September 28, 2017, to provide for control and surveillance procedures for the quality of water for human consumption and its potability standard.	Brasil (2021)

An essential aspect of water security involves understanding local perceptions of water quality. Studies reveal physical, social, and cultural dimensions shape Indigenous people's relationship with water, influencing risk perceptions and consumption behaviors (Ratelle et al., 2022). In several subarctic Canadian communities, dissatisfaction with municipal tap water quality — often due to concerns about taste, odor, and safety — has led to reliance on bottled water, despite the socio-economic and environmental costs (Ratelle et al., 2022).

Addressing water insecurity in Indigenous contexts requires inclusive governance frameworks which integrate Indigenous knowledge systems and prioritize self-determination. Participatory models have demonstrated promise in fostering sustainable, community-led water management by aligning technical interventions with Indigenous values and relational worldviews (Acharibasam et al., 2024). These approaches emphasize the importance of engaging elders and knowledge holders in decision-making, recognizing cultural protocols, and respecting the spiritual and ecological significance of water (O'Donnell et al., 2023).

Moreover, legal recognition of Indigenous water rights and reforms in policy and institutional arrangements are pivotal for long-term water security (Kehinde et al. 2025). Collaborative frameworks should include capacity-building initiatives, cross-cultural dialogue, and mechanisms for Indigenous-led monitoring and management of water resources (Acharibasam et al., 2024).

Water security for Indigenous peoples transcends technical solutions. It necessitates systemic shifts in governance, respect for Indigenous sovereignty, and the acknowledgment of the cultural, spiritual, and ecological relationships underpinning Indigenous water governance (Balasooriya et al., 2023; O'Donnell et al., 2023).

Governance of Sanitation Actions for Indigenous People in the State of Tocantins.

In Brazil there are about 818,000 Indigenous people, of which 502,783 live in rural areas and 315,180 live in urban centers (IBGE, 2010). The lands belonging to the Indigenous peoples occupy 11.6% of the Brazilian territory and correspond to 991,498 km² (Figure 2) (IBGE, 2002).

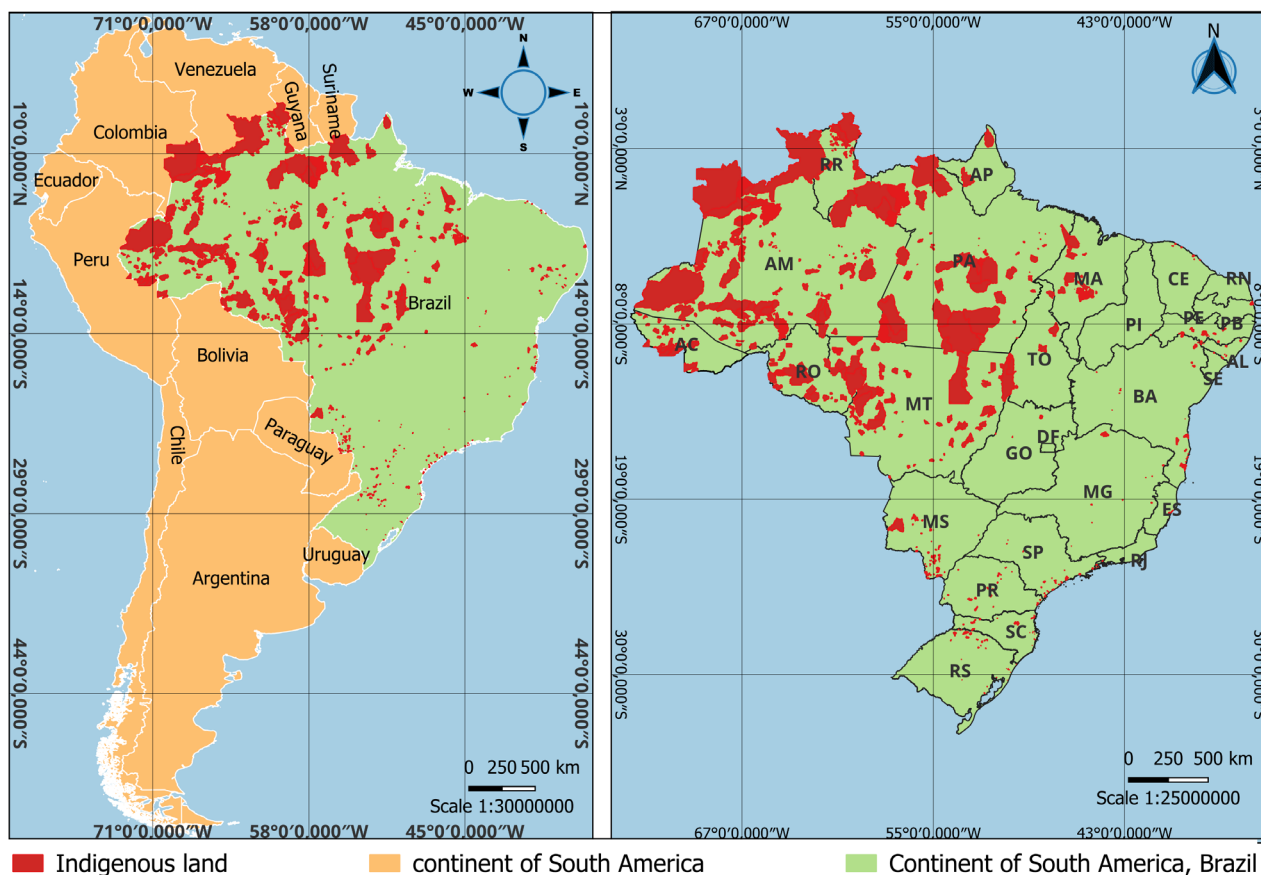


Figure 2 – Current land holdings of Indigenous people in Brazil (in green). Brazilian Health Care Policy for Indigenous Peoples: Water Supply and Effluent Treatment in Context.

Source: adapted from IBGE (2002).

Access to safe and adequate water is not explicitly guaranteed by the Brazilian Constitution (Brasil, 1988), though it is implicitly safeguarded through the right to life and health. This right was better articulated with the enactment of Law N° 11,445/2007, which established national guidelines for basic sanitation, defining access to drinking water and sanitation services as essential (Brasil, 2007). This framework was subsequently updated by the New Legal Framework for Basic Sanitation (Law N° 14,026/2020), which reinforced universal access to these services, extending provisions to rural and Indigenous areas (Brasil, 2020). While acknowledging the vulnerability of Indigenous peoples, the legislation often lacks the operational detail and cultural sensitivity necessary for its effective implementation in traditional communities (Langdon and Grisotti, 2021).

Significant advances in Indigenous health policy began in 1999 with the establishment of the Indigenous Health Care Subsystem (SasiSUS) through Law N° 9,836, administered by the National Health Foundation (FUNASA). Designed to respect Indigenous sociocultural, epidemiological, and logistical specificities, it institutionalized principles of decentralization, universality, equity, and Indigenous social participation (Brasil, 1999). Complementing this, the 2002 Health Care Policy for Indigenous Peoples mandated the promotion of healthy environments, water source protection, and basic sanitation infrastructure in Indigenous territories, prioritizing the integration of environmental and health measures (Brasil, 2002).

A pivotal restructuring occurred in 2010 with the creation of the SESAI within the Ministry of Health, via Law N° 12,314 (Brasil, 2010). SESAI operationalized Indigenous health care through decentralized DSEI, each defined by ethnocultural, geographic, and administrative parameters. These units are tasked with delivering contextually appropriate health and sanitation services, recognizing the unique vulnerabilities of Indigenous populations.

Further regulatory advances were made with Ordinance GM/MS N° 888/2021, which stipulates SESAI's responsibilities in water quality control in Indigenous villages. The ordinance mandates water supply actions accounting for epidemiological, socio-environmental, and ethnocultural factors specific to Indigenous communities (Brasil, 2021). Despite these legal frameworks, critiques persist regarding their limited effectiveness in addressing the cultural, environmental, and territorial dimensions inherent in Indigenous health and water security (Langdon and Grisotti, 2021).

Brazil's persistent gaps in ensuring safe drinking water and adequate sanitation for Indigenous peoples also reflect its non-compliance with international norms, particularly the United Nations General Assembly Resolution A/RES/64/292, which recognizes water and sanitation as human rights (United Nations, 2010). Recent studies emphasize that governance models detached from Indigenous knowledge systems perpetuate water injustices and undermine local capacities for sustainable water management (Tsatsaros et al., 2018; Padowski et al., 2023). Scholars argue for the integration of Indigenous worldviews into national water security strategies to achieve more equitable and effective governance.

A critical reassessment of Brazil's water security policies is thus imperative. Future strategies must prioritize the incorporation of Indigenous knowledge, participatory governance, and culturally grounded practices to overcome persistent water injustices and promote health equity within Indigenous territories.

Indigenous communities in Tocantins and sanitation

The Special Indigenous Health District of Tocantins (DSEI/TO) encompasses the entire expanse of Tocantins, extending its presence across 15 municipalities with resident Indigenous populations. The Indigenous populace comprises 11,908 individuals, distributed across 160 villages, representing nine distinct ethnic groups: Karajá, Xambioá, Javaé (forming the Iny people), Xerente, Apinajé, Krahô, Krahô-Kanela, Avá-Canoeiro (Cara Preta), and Pankararu (Figure 3) (SIASI, 2019).

Although the Ministry of Health has reported on the implementation, reform, and expansion of sanitation infrastructure, encompassing the Water Supply System (SAA) and the Sanitary Module (SM), the treatment and disposal of sanitary sewage, delivery points (PEV) for recyclable waste, and solid waste shelters, challenges persist within Indigenous villages. Additional measures have been documented, including the supply of drinking water through tanker trucks, distribution of clay filters and 2.5% sodium hypochlorite, sanitary inspections of water supply infrastructure and water quality (Brasil, 2021).

Among the 160 villages in the state of Tocantins, data reveals only 17 (10.6%) possess water supply systems and domestic sanitary modules, 93 (58%) have water treatment plants without sanitary modules, and 51 (31.8%) lack access to treated water and sanitary modules (Brasil, 2019) (Table 3).

Upon scrutinizing the data (Table 3), it becomes clear that the National Policy for Health Care for Indigenous Peoples (PNASPI) (Brasil, 2002) has not been effectively implemented, despite providing for a complementary service organization model. This model aims to protect, promote, and restore the health of Indigenous peoples, highlighting the absence or limited dissemination of sanitation services on Indigenous peoples' lands.

In scenarios where both sanitation measures and infrastructure are either absent or inadequate, diseases associated with inadequate environmental sanitation (DRSAI) prevail, presenting substantial health challenges. Among the diseases indicative of deficient or non-existent sanitation, acute diarrheal disease (ADD) emerges prominently. The incidence of ADD has been systematically monitored in the state of Tocantins to assess its prevalence within Indigenous communities.

Considering solely the population with access to SAA and SM, a total of 360 cases of ADD were reported in 2017, constituting 11.85% of the population (Brasil, 2019). Among the 6,914 individuals relying solely on Alternative Health Actions (SAA), 933 ADD cases were identified, comprising 13.49% of this population (Brasil, 2019). Concerning the segment of the population devoid of access to SAA and SM, 51 ADD cases were reported (Brasil, 2019) (Table 4).

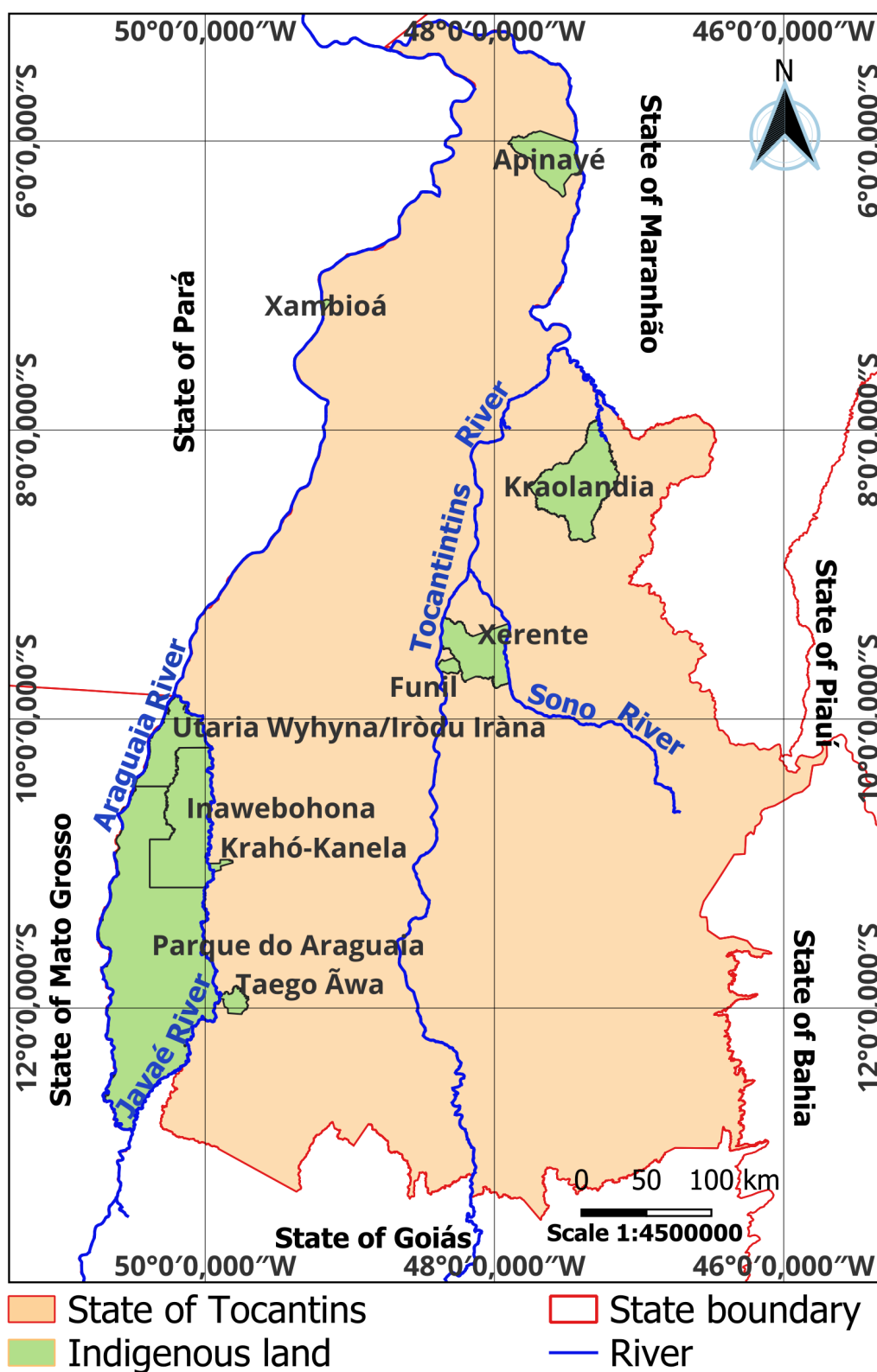


Figure 3 – Lands belonging to the Karajá, Xambioá, Javaé (which together make up the Iny people) and the Xerente, Apinajé, Krahô, Krahô-Kanela, Avá-Canoeiro (which together make up the Cara Preta and Pankararu people) in the state of Tocantins.

Table 3 – Sanitation infrastructure in Indigenous villages in the state of Tocantins (Brazil), comprising water supply systems and domestic sanitary modules*.

Ethnicity	With WSS and SM*		WSS		Without WSS and without SM		Total	
	Pop	Village	Pop.	Village	Pop.	Village	Pop.	Village
Javaé	715	3	859	11	97	4	1,671	18
Krahô	731	2	2,354	20	382	10	3,467	32
Karajá	27	1	324	5	0	0	351	6
Xerente	1,131	7	2,191	47	194	14	3,516	68
Apinajé	433	4	1,186	10	1,064	23	2,683	37
DSEI	3,037	17	6,914	93	1,737	51	11,688	161

*Sanitary module, casing made up of panels joined together, with a hole inside, a toilet; SMs: sanitary modules; WSSs: Water Supply Systems; DSEI: Special Indigenous Health District (Brasil, 2019).

Table 4 – Incidence of acute diarrheal diseases in Indigenous communities living in villages in the state of Tocantins (Brazil).

	With WSSs and SMs			Only with WSSs			Without WSSs and SMs		
	Pop.	Village	ADD	Pop.	Village	ADD	Pop.	Village	ADD
Javaé	715	3	59	859	10	127	97	4	6
Krahô	731	2	15	2,354	20	236	382	10	3
Karajá	27	1	0	324	5	98	0	0	0
Xerente	1,131	7	181	2,191	47	201	194	14	9
Apinajé	433	4	105	1,186	10	271	1,064	23	113
DSEI	3,037	17	360	6,914	92	933	1,737	51	131

Source: Brasil (2019).

WSSs: Water Supply Systems; SMs: sanitary modules; DSEI: Special Indigenous Health District; ADD: acute diarrheal disease.

The lower incidence of ADD among those lacking access to SAA and SM (Brasil, 2019), in comparison to their counterparts with access, appears to suggest a deficiency in notification rather than a lower occurrence, given the adverse sanitary conditions prevalent.

Despite the incorporation of principles and guidelines such as decentralization, universality, equity, community participation, social control, and consideration of the cultural, epidemiological, and operational specificities of Indigenous peoples during the formulation of the policy, the effective implementation of these principles has proven elusive. Additionally, concerning the financial resources allocated to the implementation of the Indigenous health subsystem, their impact on health indicators has been constrained.

The Indigenous social control mechanism in Brazil remains fragile, and discourse within this realm reveals users' dissatisfaction with the system (Pontes and Santos, 2020). The PNASPI (Brasil, 2002) underscores the concept of differentiated care, signifying the imperative for specific and culturally sensitive approaches in delivering health services to Indigenous populations. This acknowledgment recognizes the cultural, social, and historical distinctions between Indigenous communities and the general population. However, critiques contend the PNASPI harbors contradictions and lacks integration with traditional knowledge and authentic perspectives of Indigenous peoples, particu-

larly in the context of their processes of suffering and healing (Langdon and Grisotti, 2021).

Despite Brazilian legislation establishing health and sanitation rights for Indigenous peoples, these communities remain largely excluded from water supply and sanitation management processes. While some progress in participation and social control has occurred, persistent barriers undermine full implementation. Recent studies highlight systemic barriers exacerbating health disparities and mortality among Indigenous populations in Brazil (Martins-Filho et al., 2024).

Water insecurity intensifies the vulnerability of Indigenous communities, particularly in isolated areas, where contamination risks are heightened and infrastructure to maintain drinking water systems is scarce. Research indicates Indigenous populations in Brazil exhibit disproportionately adverse health indicators, with mortality rates showing a moderate upward trend over time (Martins-Filho et al., 2024).

Although the SESAI is tasked with ensuring culturally appropriate healthcare models and Indigenous participation in policy processes, current management structures often foster standardized approaches, disregarding cultural differences and local knowledge systems. This scenario reinforces socioeconomic and health disparities for Indigenous peoples compared to other Brazilian citizens. Addressing these challenges requires establishing legal protections and adopt-

ing deliberative, collaborative planning involving Indigenous representatives. Effective water management must consider Indigenous norms, cosmologies, and decision-making processes, conduct culturally sensitive feasibility assessments, align water monitoring with Indigenous perceptions, and promote ongoing community training. Failure to involve Indigenous leaders exacerbates conflicts and perpetuates exclusion from water governance, as decision-making remains predominantly state-controlled and dismissive of Indigenous rights and governance systems (Pontes and Santos, 2022; Young et al., 2023).

Conclusion

Despite the establishment of the PNASPI in Brazil, its implementation has been marked by significant shortcomings, particularly in the provision of water supply and sanitation services in Indigenous territories. In the state of Tocantins, for example, only 10% of villages have access to water supply systems and domestic sanitary modules, while 30% of the Indigenous population remains without treated water. This scenario directly contributes to the persistence of waterborne diseases, notably ADD, and exposes the severe health vulnerabilities experienced by Indigenous communities.

Persistent challenges in implementing health and sanitation policies include inadequate resource allocation, poor financial management, limited effectiveness of social control mechanisms, and insufficient cultural sensitivity in health service delivery. Moreover, Indigenous communities frequently face disregard from gov-

ernment authorities in decision-making processes related to water management, undermining both their legal rights and traditional knowledge systems.

To reverse this situation, it is imperative to: i. strengthen the enforcement of existing legislation and ensure compliance with financial resource allocation protocols for sanitation and health actions; ii. integrate Indigenous perspectives and knowledge systems into the planning and management of water services, ensuring culturally appropriate interventions, iii. expand investment in basic sanitation infrastructure and safe drinking water provision in Indigenous territories, prioritizing communities with the most critical access deficits, and iv. enhance the capacity and participation of Indigenous councils and health forums in monitoring and evaluating sanitation policies and programs.

Future research should focus on: i. assessing the effectiveness of decentralized, community-led water and sanitation management models; ii. investigating the impact of culturally adapted health promotion initiatives on the reduction of waterborne diseases in Indigenous territories, iii. examining the long-term effects of inadequate sanitation infrastructure on Indigenous health outcomes and environmental sustainability, and iv. advancing Indigenous health and sanitation rights in Brazil, which requires not only technical interventions but also a political and ethical commitment to respecting Indigenous autonomy, promoting equitable resource distribution, and valuing Indigenous knowledge in environmental and health governance.

Authors' Contributions

Xerente, V.S.: conceptualization, investigation, data curation, writing – original draft, writing – review & editing. **Naval, L.P.:** conceptualization, formal analysis, methodology, project administration, resources, software, supervision, validation, visualization, writing – original draft, writing – review & editing.

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