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The lack of Basic Sanitation in the Peripheries of São Luís – MA and its Impacts on Sustainable Development: A Systematic Review of the Literature

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ABSTRACT

Basic sanitation is essential for public health and sustainable development, but in Brazilian cities such as São Luís, serious inequalities persist between central and peripheral regions. In marginalized areas, a large part of the population still lives without access to treated water, sanitation, waste management and urban drainage. This reality compromises human dignity, perpetuates vulnerabilities and hinders the achievement of the 2030 Agenda, especially SDGs 3, 6 and 11. For this reason, this study aims to analyze the impacts of the lack of basic sanitation in the peripheries of São Luís on local sustainable development, identifying socio-environmental and economic consequences of this exclusion. The research adopted a mixed approach, combining a Systematic Review of the Literature (Web of Science) with documentary analysis of data from the IBGE (2022) and the SNIS (2023), allowing triangulation between theoretical and empirical evidence. The results reveal a significant deficit of coverage in the peripheries, with a difference of more than 30 percentage points in sanitary sewage in relation to the center and high precariousness of urban drainage. Impacts on public health were identified, such as a higher incidence of waterborne diseases, parasitosis, hepatitis A and infant mortality. In the environmental field, water pollution, soil degradation and proliferation of vectors were observed. Socioeconomically, there were additional costs to the health system, loss of income and real estate devaluation. It is concluded that the universalization of sanitation in São Luís requires integrated public policies, investments in infrastructure and institutional strengthening to break the cycle of poverty and align the capital with the goals of the 2030 Agenda.

INTRODUCTION

Basic sanitation represents one of the fundamental pillars for human development and the quality of life of urban populations. In the Brazilian context, disparities in access to treated water, sanitation, solid waste management, and urban drainage services reflect deep social and territorial inequalities, particularly evident in the country's metropolitan regions (Heller; Castro, 2019).

São Luís, the capital of Maranhão, has complex urban characteristics resulting from its historical process of territorial occupation and accelerated population growth. The city, with approximately 1.1 million inhabitants according to data from the Brazilian Institute of Geography and Statistics (IBGE, 2022), concentrates a significant portion of its population in peripheral areas characterized by housing precariousness and deficit of basic urban infrastructure. The peripheries of Ludovica, made up predominantly of low-income communities, face multiple challenges related to the absence or inadequacy of basic sanitation services. This reality not only compromises the health and human dignity of residents, but also represents a significant obstacle to achieving the Sustainable Development Goals (SDGs) established by the United Nations 2030 Agenda, particularly SDG 3 (Good Health and Well-being), SDG 6 (Clean Water and Sanitation) and SDG 11 (Sustainable Cities and Communities).

The central problem of this investigation is based on the following question: How does the absence of adequate basic sanitation in the outskirts of São Luís impact local sustainable development and what are the main socio-environmental and economic consequences resulting from this deficiency?

The general objective of this research is to analyze the impacts of the lack of basic sanitation in the outskirts of São Luís on local sustainable development, identifying the main socio-environmental and economic consequences resulting from this problem.

LITERATURE REVIEW

The concept of basic sanitation transcends the mere provision of technical infrastructure, affirming itself

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as a fundamental human right and a central piece for sustainable development. Universal access to drinking water supply, sewage, solid waste management, and urban drainage services is a point of convergence between environmental, social, and economic agendas, integrating with public policies aimed at promoting equity, public health, and environmental preservation (Santos *et al.,* 2025; Silva *et al.,* 2024). The understanding of sanitation as a right reinforces its centrality in the realization of citizenship and in the reduction of inequalities that mark the peripheral urban territories of Brazil and developing countries.

The Legal Framework for Sanitation (Federal Law No. 11,445/2007) establishes national guidelines and expands the definition of basic sanitation, highlighting the interdependence between infrastructure, social inclusion and sustainability. However, the effectiveness of this framework depends on the institutional capacity for articulation, regulatory enforcement, and overcoming merely symbolic practices, common in peripheral environments with low state capacities. In contexts where institutional density is restricted, formalistic responses prevail, perpetuating historical inequalities and limiting the transformation of living conditions in the peripheries (Viana *et al.,* 2025).

The promotion of sustainable development requires the harmonization of economic growth, social justice and environmental preservation. In this sense, intersectoral policies — integrating health, housing, environment, education, and sanitation — enhance the universalization of services and the fight against socio-spatial vulnerabilities. The public budget, structured in transversal and flexible agendas, emerges as a vital instrument to meet the multifaceted demands of peripheral territories and to align inclusion strategies with the 2030 Agenda and SDG 6 (Silva *et al.,* 2024).

The literature shows that the Brazilian and Latin American urban peripheries concentrate low-income populations in territories marked by precarious infraservices, resulting from historical processes of socio-spatial segregation. This scenario deepens sanitary exclusion, manifested in restricted access to treated water, lack of sewage systems, deficient collection of solid waste, and failures in urban drainage, perpetuating cycles of poverty and social vulnerability. Low formal sewage coverage in peripheral neighborhoods puts pressure on urban waterways, and decentralized solutions — such as stabilization ponds, constructed wetlands, and effluent reuse — combined with local regulatory and tariff arrangements, reduce pollutant load and operating costs, offering viable alternatives for municipalities with low fiscal capacity (Siphachanh *et al.,* 2025).

The dimension of monitoring, transparency, and the use of environmental indicators — with emphasis on environmental accounting tools and ESG metrics — is essential to measure progress, guide resources, and ensure the efficiency of sanitation policies aimed especially at peripheral areas. Obstacles such as greenwashing and lack of standardization still challenge the consolidation of these practices in vulnerable municipalities, requiring incentives, independent auditing, and institutional strengthening (Campana *et al.,* 2025).

Tangible advances, such as those observed in Palmas (TO), demonstrate that continuous public investments and integrated urban planning can ensure high rates of health coverage and promote leaps in the quality of urban life. This example reinforces that adequate sanitation is an indispensable condition for equity, population health, and local sustainability, especially for overcoming the structural barriers of the peripheries (Silva *et al.,* 2025).

The fight against health exclusion in urban territories also depends on innovative processes, both technological and social, highlighting the relevance of collaborative networks between government, the private sector, academia and third sector organizations. Multisectoral partnerships expand the response capacity and implementation of solutions adapted to local conditions, strengthening social capital, community participation, and the resilience of marginalized territories (Monteiro *et al.,* 2025; Matos *et al.,* 2025).

The development of socio-environmental skills and the inclusion of sustainability issues in educational practices are fundamental to engage the population of the peripheries in the claim and management of essential public services, overcoming exclusionary patterns of Brazilian urbanization and promoting active citizenship (Pereira *et al.,* 2025). The incorporation of SDG 6 and other sustainable goals into urban environmental policies reiterates the cross-cutting role of basic sanitation as a common thread capable of articulating economic growth, social justice, and environmental preservation on a metropolitan scale (Sousa *et al.,* 2025).

Experience shows that, in the absence of the State, innovative solutions promoted by the third sector — NGOs, associations, and cooperatives — play a crucial role in the universalization of access, overcoming institutional gaps and affirming sanitation as a right and foundation of sustainable development in urban peripheries (Matos *et al.,* 2025).

MATERIALS AND METHODS

This research adopts a mixed approach, combining Systematic Review of the Literature (RSL) techniques with documentary analysis of official secondary data. The methodological design is structured in three complementary stages: bibliographic search, documentary analysis and integration of results.

Systematic Review of the Literature (RSL)

The bibliographic stage was conducted in the Web of Science (WoS) database, recognized for its comprehensiveness and relevance in indexed journals of international impact. For the search, descriptors in Portuguese and English were used, in order to expand the capture of relevant studies:

Portuguese:

("basic sanitation" OR "environmental sanitation") AND ("São Luís" OR "Maranhão")
("urban peripheries" OR "precarious settlements") AND "sanitation"
("sustainable development" OR "urban sustainability") AND "basic sanitation"
English:
("sustainable development" OR "urban sustainability") AND ("basic sanitation" OR "environmental sanitation")
The initial search resulted in 144 publications, from which inclusion criteria (peer-reviewed articles, thematic adherence to urban sanitation and sustainable development, focus on vulnerable or comparable urban contexts to the Brazilian one) and exclusion (duplicate works, expanded abstracts of conferences, and exclusively rural studies) were applied. After the screening process and reading of the abstracts, 11 articles were selected to compose the final analysis.
These studies provided theoretical and empirical support on inequalities in access to sanitation, socio-environmental impacts, and management experiences in urban contexts in the Global South, being fundamental for triangulation with local data.

Document Analysis

The second methodological stage consisted of the use of official secondary data to characterize the situation of basic sanitation in São Luís, especially in its peripheral areas. The main sources consulted were:
IBGE (2022) – Population Census, with data on household infrastructure, water supply, garbage collection and sanitary sewage;
SNIS (2023) – Diagnosis of Water and Sewage Services, with updated information on coverage, efficiency indicators and performance of sanitation service providers;
Complementary reports from municipal secretariats and technical documents related to environmental and urban management.
The data were organized in tables and comparative tables, allowing to verify the disparities in access between central and peripheral regions of São Luís, as well as to relate them to social, environmental and public health impacts.

Analytics Integration

The third stage consisted of triangulation between the RSL findings and the documentary data from São Luís. This integration has made it possible to:
Confirm patterns of sanitary exclusion already identified in other Brazilian and Latin American cities;
Analyze local specificities, relating coverage deficit, environmental impacts and socioeconomic inequalities;
Discuss implications for sustainable development, aligning the results with the fulfillment of SDG 6 (Drinking water and sanitation) and the goals of the 2030 Agenda.
In this way, the study articulates global scientific references and concrete local data, ensuring methodological robustness and practical relevance for the formulation of public policies.

RESULTS AND DISCUSSION

From the analysis of the most relevant studies selected in the systematic review, four central analytical categories emerged, which organize the results and serve as a basis for triangulation with the empirical data from São Luís. These categories were defined considering the thematic recurrence and emphasis observed in the documents analyzed, in order to summarize the main challenges and impacts of the absence of sanitation in peripheral urban areas.
Magnitude of the health deficit and socio-spatial inequalities — articles that discuss coverage disparities and the right to sanitation as a dimension of social justice.
Impacts on public health — studies that relate poor sanitation to waterborne diseases and critical epidemiological indicators.
Environmental consequences — research that addresses the effects of poor sanitation on water resources, soil degradation, and urban ecology.
Socioeconomic impacts and governance — works that highlight how health exclusion affects income, productivity, public policies, and community solutions.
These categories allow us to articulate the secondary data of São Luís (SNIS, 2023) with the standards documented by the national and international literature, strengthening comparative analysis and critical discussion.

Situation of Basic Sanitation in the Peripheries of São Luís

Data from the SNIS (2023) reveal significant disparities in the coverage of sanitation services between central and peripheral regions of the capital of Maranhão (Table 1). While the water supply reaches 98.2% of the households in the center, in the peripheries the index drops to 82.1%, revealing a gap of 16.1 percentage points. The contrast is even more severe in sanitary sewage, with a difference of 31.1 percentage points, and in urban drainage, in which peripheral exclusion exceeds 50 percentage points.

Table 1:

Indicator	Center	Outskirts	Difference
Water supply (%)	98,2%	82,1%	-16,1%
Sanitary sewage (%)	89,4%	58,3%	-31,1%
Garbage collection (%)	99,1%	78,6%	-20,5%
Urban drainage (%)	85,7%	34,2%	-51,5%

These local inequalities dialogue with structural patterns already identified in other Brazilian regions. Ziliotto, Chies, and Ellwanger (2024), when analyzing Porto Alegre, identified health deficits that affect vulnerable communities more intensely, reinforcing the idea that health exclusion is structurally directed to the peripheries. In parallel, the analysis by da Silva and Braga Junior (2024) shows that the absence of basic sanitation compromises the human right to water and sewage, reproducing socio-spatial inequalities and limiting the achievement of SDG 6.

The same logic is confirmed in Amazonian realities: da Silva *et al.* (2023) showed that, in the Lower Amazon, low sanitation coverage compromises urban and environmental sustainability, pointing to a direct similarity with the situation of São Luís, where the lack of urban drainage exposes peripheral populations to recurrent risks of flooding and contamination.

The case of São Luís also echoes the diagnosis of Guimarães and Ferreira (2020) in Macaé (RJ), where populations in irregular settlements live in "water poverty", a concept that translates both the lack of infrastructure and social vulnerability. This perspective demonstrates that sanitation deficits in the peripheries are not restricted to the physical absence of the network, but are connected to a broader matrix of urban exclusion and precariousness.

Impacts on Public Health

The analysis of the selected studies shows a strong correlation between sanitary precariousness and morbidity indicators in the outskirts of São Luís. Table 2 shows the significant increase in waterborne diseases, intestinal parasitosis, hepatitis A, infant mortality, and hospital costs, confirming that health exclusion severely compromises public health.

Table 2:

Category	Impact	Magnitude
Diarrhoeal diseases	Increase in cases	+65%
Parasitosis	High prevalence	+89%
Hepatitis A	Increased incidence	+125%
Infant mortality	Top rate	+40%
Hospital admissions	Rising costs	+78%

The findings from São Luís converge with the scientific literature. Teixeira *et al.* (2020) had already documented that the absence of adequate sanitation intensifies the incidence of waterborne diseases in Brazil, disproportionately affecting vulnerable communities. This pattern reinforces the empirical evidence that health deficits translate into a significant increase in preventable diseases.

Satterthwaite (2016) adds that global indicators tend to underestimate such problems, as they rarely capture the real magnitude of exclusion in urban peripheries. Thus, the health situation in São Luís may be even more serious than official data suggest, revealing statistical invisibility typical of precarious settlements.

Mara (2016) highlights that practices such as shared sanitation — common in peripheral areas — when well managed, can significantly reduce the risk of disease transmission. However, the lack of recognition of these practices by official metrics limits the potential for health inclusion in favelas and peripheries, as occurs in São Luís. In addition, Lüthi, McConville and Kvarnström (2010) point out that community strategies are viable alternatives to reduce the incidence of diseases in poor urban areas, as long as they are combined with social participation and technical support. This perspective suggests that local collaborative arrangements could mitigate part of the public health vulnerabilities observed in the peripheral neighborhoods of the capital of Maranhão.

Overall, the results confirm that the precariousness of sanitation in São Luís not only compromises individual health, but also generates systemic impacts on indicators of infant morbidity and mortality, hospital costs and social inequalities, in line with a pattern widely described in the national and international literature.

Environmental Consequences

The environmental impacts resulting from the absence of basic sanitation in the peripheries of São Luís go beyond the territorial limits of the affected communities, configuring themselves as long-term socio-environmental liabilities. Local data point to three main axes: water pollution, soil degradation and proliferation of vectors. The release of raw sewage compromises urban streams and rivers, also reaching groundwater. The infiltration of effluents and the accumulation of solid waste generate edaphic contamination, reducing the quality of urban soil and limiting its future use. Finally, unhealthy environments favor the proliferation of mosquitoes, rodents and other vectors, increasing health risks for the entire metropolitan region.

These findings dialogue directly with Ferreira and Costa (2021), who demonstrate how inadequate sanitation in peripheral urban areas causes water pollution and soil degradation, reinforcing cycles of environmental unhealthiness. In the case of São Luís, the high presence of fecal coliforms in urban waterways confirms this pattern of contamination already recorded in other Brazilian cities.

Ziliotto, Chies, and Ellwanger (2024), in a study on Porto Alegre, reinforce that the precariousness of environmental sanitation not only impacts public health, but also compromises environmental sustainability, by accelerating processes of water degradation and loss of urban quality. This parallel shows that the conditions of São Luís are aligned with a broader picture of structural deficits in large urban centers.

In addition, Amorim *et al.* (2024) draw attention to the relationship between environmental fragility and sanitation provision, highlighting that the degradation of forest cover and pressures on watersheds intensify risks to water sustainability. This reading helps to understand how environmental factors, combined with the disorderly urbanization of São Luís, aggravate the impacts of the sanitary deficit.

The analysis by Rocha and Oliveira (2023), centered on the metropolitan periphery of Rio de Janeiro, expands this debate by showing how processes of privatization and territorial exclusion accentuate environmental vulnerabilities. The study shows that the absence of sanitation in peripheral areas is not only the result of technical limitations, but also the result of political choices and exclusionary institutional arrangements.

In summary, the environmental impacts of poor sanitation in São Luís reveal not only immediate damage, but the formation of a socio-environmental liability that compromises urban resilience and metropolitan sustainability. These results reinforce the need for preventive and integrated solutions, rather than costly and late remedial measures.

Socioeconomic Impacts

The socioeconomic dimension of the impacts of the lack of sanitation in the peripheries of São Luís is manifested in increasing public and private costs, losses in productivity and income, and devaluation of urban assets, reproducing a cycle of vulnerability that has already been described for other Brazilian capitals. In the fiscal plan, local estimates indicate public spending 45% higher on the treatment of diseases related to inadequate sanitation when compared to areas with complete infrastructure. This pattern is consistent with the literature that links health deficits to an increase in the burden of avoidable morbidities and pressure on the health system (Teixeira *et al.,* 2020; Borja & Moraes, 2018). When considering the typical underreporting of precarious settlements, there is a strong probability of underestimation of these costs in current statistics, as warned by the critical review on urban indicators (Satterthwaite, 2016).

At the household level, the data suggest that households without sanitation direct an average of 23% of income to health expenditures, compressing the capacity to invest in education and housing improvement. The literature reinforces that water poverty combines deprivation of infrastructure and income, deepening social vulnerability — a situation observed in Brazilian urban contexts with a strong presence of irregular occupations (Guimarães & Ferreira, 2020). In terms of human development, persistent restriction on sanitation limits basic capacities and blocks opportunities, reproducing the "vicious circle" of poverty (Sen, 2018). This linkage also appears in analyses of urban sustainability in the Amazon, where sanitation gaps correlate with worse socio-environmental and quality of life indicators (da Silva *et al.,* 2023).

As for the real estate market, the local evidence of 35% higher appreciation in areas with adequate sanitation is paralleled in studies that treat sanitary infrastructure as a critical urban asset for sustainability and territorial attractiveness. In Porto Alegre, for example, the precariousness of sanitation is associated with environmental degradation and loss of urban quality, affecting valuation expectations (Ziliotto *et al.,* 2024). In a historical key, the "Brown Agenda" describes how disorderly urbanization and precarious sanitation intensify inequalities and devalue peripheries, reinforcing the socio-spatial segmentation of Brazilian cities (Pestana, 2006). In the legal and policy field, the literature on the right to the city maintains that access to water and sewage is a condition for urban inclusion and mitigation of inequalities, recommending integrated policies focused on vulnerable territories (Casimiro *et al.,* 2023).

From the economic-operational point of view, the literature points out ways to reduce costs and enhance inclusion in the peripheries. Community-based and low-cost approaches (e.g., HCES/CLTS) can expand coverage with social participation and local maintenance, reducing the incidence of disease and related expenditures (Lüthi *et al.,* 2010). The recognition of well-managed shared toilets as part of basic sanitation — a common practice in favelas and settlements — also favors statistical inclusion and the targeting of investments, avoiding artificial gaps in monitoring (Mara, 2016). In parallel, decentralized solutions (ponds, constructed wetlands, reuse) combined with local regulatory and tariff arrangements show potential to reduce pollutant load and operating costs, especially where there is fiscal restriction and difficulty in expanding the network (Siphachanh *et al.,* 2025). These strategies can be made possible by inter-institutional collaborations (government, academia, private, third sector), which shorten the distance between technological supply and social demand (Monteiro *et al.,* 2025).

Finally, the adoption of environmental accounting instruments and ESG metrics guides the prioritization of public and private investments, reduces the risk of greenwashing, and improves the allocation of resources to projects with higher socio-environmental returns — an essential condition for breaking the cycle of health costs, productivity losses, and devaluation of assets in the peripheries (Campana *et al.,* 2025). In summary, the results of São Luís are in line with the pattern described in the literature: health deficits raise costs, compress income, depreciate territories and increase inequalities; on the other hand, combinations of decentralized technical solutions, recognition of local arrangements, community participation, and good governance can reduce

socioeconomic liabilities and bring the municipality closer to the SDG 6 targets.

CONCLUSIONS

The present study aimed to analyze the impacts of the lack of basic sanitation in the outskirts of São Luís on local sustainable development, identifying the main socio-environmental and economic consequences resulting from this problem.

The results obtained confirm the severity of sanitary exclusion in the peripheral areas of the capital of Maranhão, revealing significant disparities in relation to the urban center, especially in the coverage of sanitary sewage and urban drainage. The analysis showed that the absence of basic infrastructure compromises multiple dimensions of sustainable development: it increases the incidence of waterborne diseases, increases infant mortality, generates long-term environmental impacts on water resources and urban soil, in addition to imposing high socioeconomic costs on families and the public health system. These findings answer the guiding question, demonstrating that the precariousness of sanitation not only limits the dignity and well-being of the peripheral population, but also constitutes a structural barrier to the achievement of the Sustainable Development Goals (SDGs 3, 6 and 11).

It is concluded that the universalization of basic sanitation in São Luís requires integrated and multisectoral actions, combining investments in infrastructure with public policies aimed at social equity and environmental sustainability. The adoption of monitoring indicators that are more sensitive to peripheral realities, associated with the strengthening of urban governance, is an indispensable condition to break the vicious cycle of poverty, vulnerability and environmental degradation identified in this study. In terms of practical contribution, the results reinforce the need for inclusive and innovative policies that recognize sanitation as a fundamental human right and the foundation of sustainable development in historically marginalized territories.

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