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Urban Solid Waste Management in Brazil: Challenges, Public Policies, and Social Inclusion

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Gestão de resíduos sólidos urbanos no Brasil: Desafios, políticas públicas e inclusão social

RESUMO

Objetivo - A gestão de resíduos sólidos urbanos (RSU) é um dos maiores desafios enfrentados pelas cidades, especialmente em países em desenvolvimento, onde o aumento da urbanização e do consumo intensifica os problemas socioambientais. No Brasil, a implementação de políticas públicas, como a Política Nacional de Resíduos Sólidos (PNRS), ainda enfrenta dificuldades, incluindo falta de recursos, gestão desorganizada e a exclusão social dos catadores de materiais recicláveis. Sendo assim, o objetivo geral deste estudo é analisar a gestão dos resíduos sólidos urbanos no Brasil, focando nos impactos socioambientais, nas políticas públicas e na inclusão social. Os objetivos específicos são: (1) analisar os principais impactos decorrentes da gestão inadequada dos resíduos, (2) discutir os desafios na implementação da PNRS e (3) avaliar a integração dos catadores na cadeia de gestão de resíduos. indicar o objetivo do trabalho, ou seja, aquilo que ele pretende demonstrar ou descrever.

Metodologia - A metodologia adotada será uma análise qualitativa e bibliográfica, baseada na revisão de artigos, relatórios e estudos de caso.

Originalidade/relevância - A pesquisa justifica-se pela necessidade urgente de encontrar soluções eficazes para a gestão de resíduos, visando uma maior sustentabilidade e inclusão social.

Resultados - A conclusão aponta que é essencial a integração de políticas públicas mais eficazes, a valorização do trabalho dos catadores e a promoção de soluções sustentáveis, para garantir uma gestão eficiente e a construção de cidades mais resilientes e justas.

PALAVRAS-CHAVE: Resíduos Sólidos Urbanos. Gestão Ambiental. Políticas Públicas. Inclusão Social.

Urban solid waste management in Brazil: Challenges, public policies and social inclusion

ABSTRACT

Objective – Urban solid waste management (USWM) is one of the major challenges faced by cities, especially in developing countries, where increasing urbanization and consumption exacerbate socio-environmental issues. In Brazil, the implementation of public policies such as the National Solid Waste Policy (PNRS) still faces challenges, including lack of resources, disorganized management, and social exclusion of waste pickers. Therefore, the general objective of this study is to analyze the management of urban solid waste in Brazil, focusing on socio-environmental impacts, public policies, and social inclusion. The specific objectives are: (1) to analyze the main impacts of improper waste management, (2) to discuss the challenges in implementing the PNRS, and (3) to evaluate the integration of waste pickers into the waste management chain.

Methodology – The adopted methodology will be qualitative and bibliographical, based on the review of articles, reports, and case studies.

Originality/Relevance – The research is justified by the urgent need to find effective solutions for waste management, aiming for greater sustainability and social inclusion.

Results – The conclusion points out that it is essential to integrate more effective public policies, value the work of waste pickers, and promote sustainable solutions to ensure efficient management and the creation of more resilient and just cities.

KEYWORDS: Urban Solid Waste. Environmental Management. Public Policies. Social Inclusion.

Gestión de residuos sólidos urbanos en Brasil: Desafíos, políticas públicas e inclusión social

RESUMEN

Objetivo – La gestión de residuos sólidos urbanos (RSU) es uno de los mayores desafíos que enfrentan las ciudades, especialmente en los países en desarrollo, donde el aumento de la urbanización y el consumo agravan los problemas socioambientales. En Brasil, la implementación de políticas públicas como la Política Nacional de Residuos Sólidos (PNRS) aún enfrenta dificultades, como la falta de recursos, la gestión desorganizada y la exclusión social de los

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recicladores. Por lo tanto, el objetivo general de este estudio es analizar la gestión de los residuos sólidos urbanos en Brasil, enfocándose en los impactos socioambientales, las políticas públicas y la inclusión social. Los objetivos específicos son: (1) analizar los principales impactos derivados de la gestión inadecuada de residuos, (2) discutir los desafíos en la implementación de la PNRS, y (3) evaluar la integración de los recicladores en la cadena de gestión de residuos.

Metodología – La metodología adoptada será cualitativa y bibliográfica, basada en la revisión de artículos, informes y estudios de caso.

Originalidad/Relevancia – La investigación se justifica por la necesidad urgente de encontrar soluciones efectivas para la gestión de residuos, buscando una mayor sostenibilidad e inclusión social.

Resultados – La conclusión señala que es esencial integrar políticas públicas más efectivas, valorar el trabajo de los recicladores y promover soluciones sostenibles para garantizar una gestión eficiente y la construcción de ciudades más resilientes y justas.

PALABRAS CLAVE: Residuos Sólidos Urbanos. Gestión Ambiental. Políticas Públicas. Inclusión Social.

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1 INTRODUCTION

The increasing production of urban solid waste (USW) has become one of the greatest environmental concerns in today's global context. With rising urbanization and intensified consumption, cities face significant challenges in managing this waste, including issues such as soil, water, and air contamination, as well as impacts on public health and the environment. The situation is even more critical in developing countries, where waste management is often disorganized and inefficient, leading to a range of socio-environmental imbalances. In this context, urban solid waste management emerges as a central issue for building more sustainable and resilient cities.

Thus, the core problem addressed in this study concerns the gap between public policies aimed at waste management and their effective implementation, particularly in Brazil, where current management practices still fall short of environmental and social needs. Although legislation such as the National Solid Waste Policy (PNRS) exists, its application faces structural challenges, including a lack of financial resources and difficulties integrating different levels of government, in addition to a widespread absence of environmental awareness among the population. Given this, the present study seeks to analyze the main difficulties and potentialities of urban solid waste management in Brazil, highlighting the importance of social inclusion for waste pickers and the need for a more effective and integrated approach to public policy.

The general objective of this study is to analyze urban solid waste management (USWM) in Brazil, focusing on public policies, environmental impacts, and social inclusion, while proposing sustainable solutions that address the various aspects involved. To achieve this objective, the specific aims are: (1) to examine the main socio-environmental impacts resulting from inadequate USWM, (2) to discuss existing public policies and their challenges in implementing the National Solid Waste Policy (PNRS), and (3) to assess the integration of waste pickers into the waste management chain, proposing improvements for their social inclusion.

The methodology adopted for this study was qualitative and bibliographic analysis, based on a review of scientific articles, reports, and documents related to urban solid waste management, environmental public policies, and the social inclusion of waste pickers. The analysis is complemented by case studies illustrating different urban realities in Brazil, with an emphasis on experiences from the Metropolitan Region of Rio de Janeiro and Belo Horizonte.

The rationale for conducting this study is based on the urgent need to find effective solutions to the problem of urban solid waste, which directly affects quality of life in cities. Through a critical and integrated analysis, it is expected to contribute to improving public policies in waste management, providing support for the development of more sustainable and inclusive solutions that involve all social actors, especially waste pickers, who play an essential role in the recycling chain and in promoting social justice.

URBAN SOLID WASTE MANAGEMENT IN BRAZIL

Proper management of urban solid waste is one of the greatest contemporary challenges in terms of sustainability and social inclusion. In this sense, the first section of this theoretical framework explores the theoretical foundations of urban solid waste, focusing on

the analysis of socio-environmental impacts and sustainable management practices. Within this context, the importance of social inclusion is highlighted, particularly the integration of waste pickers into the waste management process. Studies show that adopting sustainable management models can not only mitigate the environmental impacts caused by waste but also promote social justice by providing better living conditions for the most vulnerable populations. Furthermore, it is essential to consider the cultural and territorial dimensions involved in waste production and management, as these wastes reflect the social practices and consumption habits of different communities.

The second section addresses analyses of public policies and solid waste management, emphasizing the challenges Brazil faces in implementing effective policies for urban waste management. Critical analysis of solid waste management, through studies on the National Solid Waste Policy (PNRS), reveals both the weaknesses and potentialities of the current management models. The lack of resources and resistance to implementing sustainable practices are identified as significant barriers, hindering the application of public policies at the local level. However, at the same time, opportunities arise, especially when efforts are made to integrate different levels of government and promote more participatory and effective management with the collaboration of civil society and communities.

The third section addresses reflections on the implementation of the National Solid Waste Policy (PNRS), focusing on the Brazilian reality and the gaps observed in applying this policy across various urban contexts. The PNRS aims for integrated and sustainable waste management, but studies show that despite some progress, many of its objectives have not yet been fully achieved. This is due to structural challenges, lack of adequate planning, and scarcity of financial resources to make the necessary infrastructure feasible. However, public policies involving solid waste management can become more effective if accompanied by an integrated approach that considers both technical and social aspects, as well as fostering public awareness and active participation.

Theoretical Foundations on Urban Solid Waste

To begin with, the article "Urban Solid Waste: Socio-environmental Impacts and Sustainable Management Perspectives with Social Inclusion," by Gouveia (2012), addresses the challenges of urban solid waste management in the Brazilian context, highlighting its socio-environmental impacts and perspectives for sustainable management that includes social participation. Published in 2012 in the journal Ciência & Saúde Coletiva, the text seeks to contribute to the debate on the topic, especially after the institutionalization of the National Solid Waste Policy (PNRS) in 2010, using official documents, waste management data, and specialized scientific literature to support its analysis.

The article begins by highlighting the importance of the topic in the global context, especially after the United Nations Conference on Environment and Development (Rio-92) and Rio+20, which discussed strategies to reconcile development with ecosystem protection. Inadequate management of urban solid waste is identified as a problem that generates immediate environmental and health impacts, in addition to contributing to climate change. Furthermore, although the burning of fossil fuels is the main source of greenhouse gases (GHGs), solid waste also plays a significant role in this scenario (Gouveia, 2012).

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Every day, between 180,000 and 250,000 tons of waste are collected, with an estimated annual growth of 7%, which exceeds the growth of the urban population. Despite advances in waste disposal, such as the increased use of sanitary landfills, more than half of Brazilian municipalities still use open dumps or controlled landfills, which do not provide adequate environmental protection. Therefore, it is emphasized that selective waste collection and recycling are still incipient in the country, with only 18% of the dry fraction of waste being recycled (Gouveia, 2012).

The disposal of waste in dumps and landfills can contaminate soil, water, and air, generating toxic substances such as leachate and dangerous gases like methane (CH_4), which contribute to global warming. The anaerobic decomposition of organic matter in waste is a significant source of greenhouse gases (GHGs), accounting for about 3% of global emissions. In Brazil, this percentage is approximately 2%, but it grew by 77% between 1990 and 2005, exceeding GDP growth in the same period (Gouveia, 2012).

In addition to environmental impacts, it is also important to highlight the risks to human health resulting from inadequate solid waste management. Waste disposal in dumps and landfills can expose nearby populations to toxic substances such as heavy metals and organic compounds, which contaminate soil, water, and air (Gouveia, 2012). Studies cited by the author also show that populations living near these sites have a higher risk of developing cancer, congenital anomalies, low birth weight, and other health problems. Waste incineration, although rarely used in Brazil, is also identified as a practice that generates toxic emissions such as dioxins and furans, which can affect the health of nearby populations (Gouveia, 2012).

The occupational risks faced by workers involved in waste management, especially waste pickers, should also be noted. These workers, who operate under precarious conditions and without adequate protective equipment, are exposed to infectious agents, chemical substances, and accident risks. Despite this, they play a fundamental role in the recycling chain, helping reduce the amount of waste sent to landfills and saving energy and raw materials. In an ideal recycling scenario, it would have been possible to avoid emitting 18 to 28 million tons of carbon dioxide in Brazil between 2000 and 2007 (Gouveia, 2012).

In this sense, the social inclusion of waste pickers within the solid waste management system is essential. Since 2002, waste picking has been recognized as a professional category in Brazil, but there are still significant challenges in ensuring decent working conditions and income for these professionals. Public policies should promote the organization of waste pickers into cooperatives and integrate these workers into municipal waste management plans, in accordance with PNRS guidelines (Gouveia, 2012).

The PNRS, enacted in 2010, is presented as an important legal framework for waste management in Brazil. The policy sets out guidelines such as eradicating open dumps, implementing selective waste collection, and developing municipal waste management plans. However, the technologies currently available, such as sanitary landfills and incinerators, face problems such as the depletion of suitable disposal areas and the risks of toxic emissions. Therefore, it is essential to adopt an approach that prioritizes waste reduction, reuse, and recycling, following the "three Rs" logic (Brazil, 2010; Gouveia, 2012).

Therefore, reducing waste generation and promoting recycling depend on behavioral and cultural changes, as well as educational actions that encourage conscious consumption. The

adoption of more sustainable production and consumption patterns can contribute to reducing greenhouse gas emissions, especially those from burning fossil fuels. Furthermore, recycling should be driven by expanding selective waste collection and improving the working conditions of waste pickers, who are the main agents in the recycling chain in Brazil (Gouveia, 2012).

In conclusion, urban solid waste management is a complex challenge that requires the integration of economic, social, and environmental policies. The PNRS represents a significant advancement, but its effective implementation depends on overcoming obstacles such as lack of infrastructure, scarcity of suitable final disposal areas, and the need for social inclusion of waste pickers. Public policies must ensure decent working conditions and income for waste pickers while promoting the reduction of environmental and health impacts caused by waste.

In summary, Gouveia (2012) proposes a sustainable waste management model that prioritizes reduction, reuse, and recycling, with the social inclusion of waste pickers as a fundamental part of the process. This approach not only contributes to mitigating climate change but also promotes social justice and public health, moving towards healthier, more equitable, and more sustainable development.

Thus, by emphasizing the need for sustainable solid waste management that values both the environment and the social dimension, the traditional understanding of the problem is broadened. Further supporting this perspective, Neves and Mendonça (2016) propose a geographic-cultural interpretation of waste, emphasizing that the analysis of this issue should also consider the social practices, cultural representations, and spatial dynamics involved.

In "For a Geographic-Cultural Interpretation of Solid Waste: Reflections for the Debate in Geography," by Fábio de Oliveira Neves and Francisco Mendonça, a geographic-cultural approach is proposed for analyzing solid waste, highlighting the importance of overcoming the purely technical and economic perspective that dominates the debate on this topic. Thus, it is stated that the waste issue is broad and complex, involving not only technological and financial aspects but also symbolic-cultural and spatial dimensions. The research assumes that waste is more than just disposable objects; it represents phenomena that reflect social practices, daily habits, and the cultural representations of societies.

Although waste valorization is a consensus in contemporary society, the principle of relegation still prevails in many contexts. The principle of relegation refers to the practice of removing waste from urban spaces, relegating it to marginal areas such as dumps and landfills, with no concern for environmental pollution or material reuse. In contrast, the principle of valorization emphasizes the usefulness of waste, promoting recycling and the reintegration of materials into the production cycle. The tension between these two principles is central to understanding waste management practices and formulating more effective public policies (Neves & Mendonça, 2016).

In this sense, a phenomenological approach can be used to analyze the relationship between waste and society, highlighting the ambiguity that permeates representations of the topic. On the one hand, waste is seen as a threat to health and the environment; on the other hand, it can be understood as a valuable resource, especially in contexts of scarcity or crisis. This duality is explored throughout the text, based on historical and theoretical studies that show how societies have dealt with waste over time (Neves & Mendonça, 2016).

The historical evolution of waste management, from ancient practices of disposal in rivers and vacant lots to the emergence of modern collection and final disposal systems, demonstrates this process. In the 19th century, waste was often viewed as a resource, especially in agricultural contexts where it was used as fertilizer. However, with urban growth and industrialization, the principle of relegation gained strength, leading to the emergence of dumps and landfills as the predominant solutions. This change reflects a transformation in social representations of waste, which came to be seen as something to be eliminated and hidden, rather than reused (Neves & Mendonça, 2016).

In the 20th century, solid waste management was characterized by the predominance of the principle of relegation, with the creation of public cleaning systems aimed at collecting and transporting waste to areas far from urban centers. This practice was driven by the hygienist discourse, which associated waste with disease and moral degradation, reinforcing the need to remove it from everyday life. However, this approach proved unsustainable, especially in the face of the exponential increase in waste production and changes in waste composition, which came to include non-biodegradable materials such as plastics and synthetic chemicals (Neves & Mendonça, 2016).

From the second half of the 20th century onwards, the model based on the principle of relegation began to be questioned, especially due to the environmental impacts caused by dumps and landfills. Soil, groundwater, and air pollution, as well as the shortage of suitable spaces for final waste disposal, highlighted the need to rethink management practices. In this context, the principle of valorization gained prominence, with the emergence of recycling and material reuse initiatives. Neves and Mendonça (2016) highlight that waste valorization is not limited to the technical and economic dimensions but also involves cultural and behavioral change, including the accountability of individuals and companies for proper waste management.

In this sense, the spatiality of waste is a fundamental aspect for understanding the problem. The location of dumps and landfills in marginalized and devalued areas reflects not only the logic of distancing waste but also social and environmental inequalities. Communities living near these areas are the most affected by the negative impacts of inadequate waste disposal, such as soil and water contamination, foul odors, and health risks. Moreover, waste production and management are closely linked to consumption dynamics and socioeconomic inequalities. While wealthier areas produce more diverse and larger amounts of waste, poorer areas face difficulties accessing basic collection and final disposal services (Neves & Mendonça, 2016).

Another important point to highlight in this context is the issue of waste pickers, who play a crucial role in the waste valorization chain but are often marginalized and stigmatized. Neves and Mendonça (2016) argue that including these workers in formal management systems is essential for promoting sustainability and social justice. They also emphasize the importance of public policies that encourage waste generation reduction, material reuse, and recycling instead of relying exclusively on final disposal solutions such as landfills and incinerators.

Starting in the 1980s, selective waste collection and recycling initiatives began to gain ground in several Brazilian cities, such as Niterói, Curitiba, and Porto Alegre, reflecting a change in social representations of waste. These initiatives demonstrated that waste is not a

homogeneous and undifferentiated mass, but a set of materials with valorization potential. However, the implementation of these practices still faces challenges, such as lack of infrastructure, insufficient public policies, and cultural resistance to changing habits. Moreover, shared responsibility among government, companies, and citizens is fundamental for the success of a sustainable waste management model.

Additionally, the concept of "refunctionalization" of relegated spaces, such as deactivated dumps and landfills, is discussed, which can be transformed into leisure areas, parks, or sorting and composting facilities. This approach contributes to the environmental recovery of these areas, promoting the symbolic and economic revalorization of urban spaces. However, this refunctionalization must be accompanied by control and monitoring measures to avoid health and environmental risks, especially in areas where hazardous waste was inadequately disposed of (Neves & Mendonça, 2016).

Thus, it can be stated that the issue of solid waste is a complex and multifaceted phenomenon that requires an interdisciplinary and integrated approach. It is necessary to overcome the instrumental rationality that dominates the debate on this topic, incorporating cultural, symbolic, and spatial dimensions into the analysis and management of waste. Therefore, the confrontation between the principles of relegation and valorization emerges as an important theoretical tool for understanding management practices and guiding more effective and sustainable public policies (Neves & Mendonça, 2016).

Finally, the visibility of the waste problem in the 21st century is paradoxical. The attempt to hide waste in dumps and landfills has proven unsustainable, highlighting the need to rethink the relationship between society and waste. Waste valorization through recycling and reuse is seen as a promising path, but it depends on cultural, behavioral, and political changes.

By highlighting the need for cultural and behavioral changes to address the issue of solid waste, Neves and Mendonça (2016) broaden the scope of the debate beyond technical solutions. In this context, the work of Siqueira and Moraes deepens the analysis by linking the waste issue to public health, highlighting the socio-environmental impacts of urban waste production and the vulnerability of waste pickers.

The article "Public Health, Urban Solid Waste, and Waste Pickers" by Mônica Maria Siqueira and Maria Silvia de Moraes, published in the journal Saúde e Sociedade, addresses the environmental issues of urban solid waste (USW) production and generation and its relationship with public health, highlighting the role of waste pickers as a vulnerable population group. It is based on the premise that the production and consumption patterns of postmodern society generate social exclusion and significant environmental impacts, directly affecting public health and the quality of life of populations, especially waste pickers.

The study begins with a reflection on the concept of health and environment, understood as social representations constructed from the historical and socioeconomic conditions of a society. In this context, health is not seen merely as the absence of disease but as a state of well-being that encompasses factors such as nutrition, housing, education, income, and access to basic services. Environmental degradation, in turn, is the result of the development model adopted by modern society, which prioritizes excessive consumption and the predatory exploitation of natural resources, generating negative impacts on both the environment and population health (Siqueira & Moraes, 2008).

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The interrelationship between health and the environment gained emphasis in the second half of the 20th century, with the World Health Organization (WHO) defining environmental health as the field of public health concerned with environmental conditions that influence human well-being. In this sense, environmental degradation, caused by accelerated industrialization and urbanization, has generated problems such as air, water, and soil contamination, as well as contributing to the emergence of infectious, degenerative, and psychological diseases. Agenda 21, a document developed during the United Nations Conference on Environment and Development (Rio-92), warns against unsustainable consumption and production patterns, which exacerbate poverty and environmental imbalances (Siqueira & Moraes, 2008).

The issue of urban solid waste (USW) has become one of the main challenges for contemporary societies. Waste generation is directly influenced by consumption patterns and population density, with industrialized countries responsible for most of the world's waste production. In Brazil, the lack of effective public policies for USW management results in inadequate waste disposal, often dumped in open-air dumps without any treatment. This practice not only contaminates the environment but also exposes waste pickers to significant health risks, such as infectious diseases, poisoning, and work-related accidents (Siqueira & Moraes, 2008).

Waste pickers are therefore presented as a population group that arises as a direct consequence of modern society's consumption and production model. These individuals, often marginalized and socially excluded, survive by collecting and sorting recyclable materials, playing a crucial role in the recycling system while simultaneously facing precarious working conditions and health risks. In Brazil, it is estimated that there are around 800,000 waste pickers, organized into cooperatives or working independently, many of whom work in dumps where they are exposed to diseases, accidents, and unhealthy living conditions.

Furthermore, waste picking is often associated with social exclusion and poverty, as many waste pickers are rural migrants or unemployed individuals who found in waste collection a means of subsistence. In other words, despite their importance for recycling and the waste economy, waste pickers receive little recognition and face difficulties in organizing themselves and gaining social acknowledgment. Thus, the lack of public policies that ensure decent working conditions and access to healthcare for these workers is one of the main challenges highlighted by Siqueira and Moraes (2008).

Brazil, despite being one of the world leaders in recycling materials such as aluminum and packaging, still has an incipient selective waste collection system. According to data from the Business Commitment for Recycling (CEMPRE, 2008), only 3.5% of Brazilian municipalities have selective waste collection programs, reflecting the lack of priority given to proper solid waste management. Recycling, although an important solution to reduce waste volume and environmental impacts, is seen by the authors as a palliative measure that does not solve the core problem of excessive consumption and uncontrolled waste generation (Siqueira & Moraes, 2008).

Public health risks associated with urban solid waste are another central point in Siqueira and Moraes' inquiries (2008). Inadequate waste disposal, especially in open-air dumps, contributes to the proliferation of disease vectors such as rats and insects, as well as

contaminating the soil, water, and air. In this case, waste pickers, who are in direct contact with this waste, are particularly vulnerable, especially to infectious diseases, poisoning, and work-related accidents. Moreover, prolonged exposure to toxic materials and the lack of personal protective equipment worsen the health risks for these workers.

Thus, the issue of urban solid waste and the situation of waste pickers are matters that require an integrated approach involving effective public policies, public awareness, and changes in consumption patterns. Environmental education is identified as a fundamental tool to promote reduced consumption, material reuse, and selective waste collection practices. However, recycling alone is not sufficient to solve the environmental and public health problems resulting from excessive waste generation. It is necessary to rethink the current development model, which prioritizes rampant consumption and the predatory exploitation of natural resources, in favor of a more sustainable and equitable model (Siqueira & Moraes, 2008).

Finally, the importance of civil society and private sector participation in seeking solutions for solid waste management is highlighted. Pressure from citizens and the adoption of more sustainable practices by companies and governments are essential to ensure a future with fewer environmental impacts and greater social justice. Moreover, there is a need for public policies that ensure decent working conditions and access to healthcare for waste pickers, recognizing the crucial role these workers play in the recycling system and waste economy (Siqueira & Moraes, 2008).

In summary, the article offers a deep reflection on the challenges related to urban solid waste and its relationship with public health, highlighting the situation of waste pickers as an emblematic example of social exclusion and the environmental impacts generated by modern society's consumption model. Building a more sustainable and just future necessarily involves revising production and consumption patterns, implementing effective public policies, and valuing waste pickers, who play a fundamental role in reducing environmental impacts and promoting public health (Siqueira & Moraes, 2008).

In order to establish a dialogue with the aforementioned authors, some scholars bring important reflections to understand the complexity of solid waste issues and ways to address the labor exploitation of recyclable material pickers within the context of the current economic system.

In the article "Borders and Solid Waste: a critical and scientific reflection," Gonçalves and Gonçalves (2015) point to the appropriation of nature by capitalist agents within a scenario of globalization of borders, which has worsened environmental impacts — a process the author calls "globalized economic dynamics." An important aspect of these reflections concerns cross-border movements of solid waste, a current issue in Brazil, which was recently the target of a presidential decree attempting to enable the importation of recyclable materials.

This measure generated a strong reaction from recyclable material pickers' associations and movements, as it would clearly and directly harm the entire commercialization chain of these materials, further worsening the precarious conditions of workers in the sector. Moreover, the proposal directly contradicted the principles of the Basel Convention. According to the authors, these developments would further widen the social and economic gap experienced by recyclable material pickers (Gonçalves & Gonçalves, 2015).

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In the article "Buried Alive: socio-environmental antagonisms and breaches for waste pickers under the global destructive production of capital," Gonçalves et al. (2016) portray the brutalization of waste pickers in their work with waste, depicting them as almost objects—mere vehicles for the reproduction of capital in its contradictory and exclusionary process. They also present relevant data on the precarious conditions faced by waste pickers organized in associations in the Rio Ivinhema Basin – MS. Waste pickers are unable to earn sufficient income, further precarizing their survival in a waste market that clearly does not favor them: "recycling follows the capitalistic process of expanded and diversified material reproduction of surplus value," an expression that strongly summarizes the reality of waste picking in the country (Gonçalves et al., 2016).

Still within the theoretical reflections on the challenges of integrated management and solid waste administration in Brazil, Andrade and Camuci (2020) make relevant observations about selective collection programs and waste management in 25 municipalities of the Rio Ivinhema Basin – MS. The authors identified, in line with the previously mentioned studies, several structural and institutional barriers to implementing an efficient selective collection system.

They concluded that significant bottlenecks persist in the structures responsible for maintaining the recycling circuit in these municipalities. One of the most critical aspects observed was the "confusion" among public administrations regarding what actually constitutes a selective collection system. Although 15 of the 25 municipalities surveyed claimed to offer this service, the reality observed revealed that, in practice, recyclable materials were separated in environmentally inappropriate locations for final disposal. This finding highlights the inefficiency, incompetence, and lack of financial resources dedicated to addressing the issue. Contrary to what is established by the National Solid Waste Policy (PNRS)—which stipulated the end of open dumps—this goal is still far from being achieved (Andrade & Camuci, 2020), reaffirming Gouveia's observations previously mentioned in this text.

In other words, an integrated management and effective administration that truly overcome the fragile paradigm in terms of social inclusion, minimization of environmental impacts, and generation of economic gains is still far from being achieved—gains not for the large companies profiting from outsourced waste management, but rather for the vast majority of recyclable material pickers. As demonstrated by all the authors cited here, these workers remain marginalized and far from achieving decent living and working conditions. Given this worrying scenario—which is realistically still difficult to reverse—it becomes urgent to develop and implement sectoral public policies aimed at addressing not only this issue, but also other matters related to integrated management and solid waste administration. This is the point that will be discussed next.

Analyses on Public Policies and Solid Waste Management

Madeiros, Grigio, and Pessoa (2018), in the article "Inequalities and Environmental Justice: A Challenge in Building a Resilient City," published in the Journal of Geography and Spatial Planning (GOT), address the relationship between environmental inequality and the construction of resilient cities, focusing on the Brazilian context. It is based on the premise that

urban environmental problems result from accelerated and unplanned urbanization processes, characteristic of developing countries such as Brazil. These processes create socio-spatial and environmental inequalities, increasing the vulnerability of populations, especially low-income groups, to risks and natural disasters.

Madeiros, Grigio, and Pessoa (2018) begin by contextualizing the challenges faced by contemporary cities, highlighting the lack of basic infrastructure, such as sanitation and proper solid waste disposal, and the occupation of areas unsuitable for housing. These problems are exacerbated by the lack of effective urban planning, which exposes poorer populations to environmental and social risks. In a scenario of climate change and increasing frequency of extreme events, such as torrential rains and prolonged droughts, urban resilience becomes an urgent necessity, requiring not only governmental policies but also active public participation in decision-making.

The theoretical discussion in the article is divided into three main axes: the process of (re)production of cities, environmental justice and environmental inequality, and the concept of resilient cities. In the first axis, it explores how cities, since their origins as administrative and commercial centers, have undergone significant transformations with industrialization and accelerated urbanization. In the Brazilian context, urban development has been marked by an unequal dynamic, with a concentration of wealth and services in certain regions, while others have remained marginalized. This growth has contributed to the formation of a "risk society," in which environmental and social problems intensify, mainly affecting the most vulnerable populations.

The second axis focuses on environmental justice, a concept that emerged in the United States in the 1970s as a movement aimed at combating the unequal distribution of environmental impacts. In Brazil, the movement gained strength in the early 2000s with the creation of the Brazilian Network for Environmental Justice. Environmental inequality reflects social and economic inequalities, resulting in spatial segregation and the disproportionate exposure of certain groups to risks. The lack of access to information and political participation worsens this situation, perpetuating cycles of vulnerability and exclusion.

The third axis discusses the concept of resilience, originally applied to ecosystems, and its adaptation to the urban context. Urban resilience is defined as the ability of cities to cope with external disturbances and adapt to changes in order to maintain or recover their functionality. However, it should not be understood merely as the ability to "return to normal" after a disaster, but rather as an opportunity to transform cities into more just and sustainable systems. For this, public policies must be integrated with strategies to reduce social and environmental inequalities (Madeiros, Grigio & Pessoa, 2018).

Building resilient cities requires active participation from the population, especially from the most vulnerable communities, in the decision-making process. This includes the democratization of territory, combating socio-spatial segregation, and ensuring access to basic urban services. Furthermore, it is essential to invest in environmental education and risk awareness, empowering populations to prepare for adverse events. The United Nations (UN) proposes ten steps for building resilient cities, ranging from organizing and coordinating risk reduction actions to protecting ecosystems and implementing early warning systems (Madeiros, Grigio & Pessoa, 2018).

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In the Brazilian context, despite advances in social policies and poverty reduction over recent decades, social and environmental inequalities persist as a significant challenge. Income concentration and lack of access to basic services continue to expose poorer populations to risks such as floods, landslides, and contamination by toxic waste. To address these challenges, it is necessary to rethink the urban development model, prioritizing social inclusion and environmental sustainability (Madeiros, Grigio & Pessoa, 2018).

Madeiros, Grigio, and Pessoa (2018) conclude that building resilient cities is a complex and multifaceted process, involving not only infrastructure and technologies but also the transformation of social and political relations. Urban resilience should be understood as a management mechanism that considers scenarios of uncertainty and increasing risks, whether natural or anthropogenic. For this, public policies need to be integrated and participatory, involving all social actors, from public managers to local communities. Environmental education plays a crucial role in this process, empowering populations to face challenges and contribute to more just and sustainable cities. Urban resilience should not be seen only as a response to disasters, but as a continuous process of adaptation and transformation. This includes revising development models, promoting social and environmental equality, and protecting ecosystems. Reducing inequalities is a prerequisite for building truly resilient cities capable of facing the challenges of the twenty-first century.

In conclusion, by highlighting that building resilient cities requires inclusive public policies and the promotion of social and environmental justice, Madeiros, Grigio, and Pessoa (2018) broaden the perspective on urban management in Brazil. Meanwhile, Freitas, Pires, and Benincá (2024) delve deeper into this discussion by focusing specifically on urban solid waste management, analyzing the sector's weaknesses and strengths in light of the National Solid Waste Policy (PNRS) and proposing sustainable solutions adapted to local realities.

Freitas et al. (2024), in the article "Weaknesses and Strengths in Urban Solid Waste Management in Brazil," published in the Brazilian Journal of Urban Management, addresses the challenges and opportunities in Urban Solid Waste Management (USWM) in Brazil, focusing on the implementation of the National Solid Waste Policy (PNRS). The SWOT matrix (Strengths, Weaknesses, Opportunities, Threats) was used to analyze the strengths, weaknesses, opportunities, and threats related to USW management in the Brazilian context, aiming to propose sustainable solutions aligned with local realities.

The study assumes that despite the existence of environmentally sound management practices and models set out in the PNRS, many Brazilian municipalities face significant weaknesses in USWM. These weaknesses include lack of financial resources, absence of qualified personnel, lack of political will, and inadequate waste disposal, such as open dumps and controlled landfills. In 2022, for example, Brazil generated approximately 81.8 million tons of USW, of which only 61% was sent to sanitary landfills, while 39% was disposed of inadequately, despite the targets set by the PNRS.

The SWOT matrix was developed based on a systematic literature review, which identified 52 USWM practices in 148 Brazilian municipalities and 70 challenges related to waste management. The authors highlight that Brazil has great potential for sustainable USWM, but it faces structural problems that hinder the implementation of effective policies. Among the strengths identified are the existence of sanitary landfills, selective collection, participation of

waste pickers, and the presence of cooperatives and associations. However, weaknesses such as lack of adequate infrastructure, low recycling rates, and the absence of public policies focused on waste pickers represent significant obstacles (Freitas et al., 2024).

Among the opportunities highlighted are private sector support for selective collection actions, expansion of environmental education programs, biogas production from organic waste, and the possibility of accessing federal funds for USWM. However, these opportunities are often hampered by threats such as high costs associated with USWM, lack of public awareness, the high social and economic vulnerability of waste pickers, and dependence on state and federal resources. The lack of accurate data in the National Sanitation Information System (SNIS) is also identified as a threat, as it hampers the planning and implementation of effective public policies (Freitas et al., 2024).

Selective collection is one of the main strengths of the USWM system in Brazil, present in about 40.5% of the municipalities analyzed. However, incorrect waste segregation at the source and low public adherence to selective collection are weaknesses that limit the potential of this practice. To overcome these weaknesses, the authors suggest promoting awareness campaigns, improving selective collection infrastructure, and creating incentives for the population, such as discounts on water and electricity bills for those who correctly separate their waste (Freitas et al., 2024).

Another important strength is the participation of cooperatives and waste picker associations, which play a crucial role in recycling and the waste economy. However, many of these organizations operate under precarious conditions, without government support and with low remuneration. To strengthen them, Freitas et al. (2024) suggest creating public policies that provide financial support, technical training, and partnerships with companies, as well as tax incentives for companies that purchase recyclable materials from cooperatives.

Environmental education is identified as an essential tool to address the weaknesses and threats related to USWM. However, Freitas et al. (2024) point out that in many municipalities, environmental education is linked only to commemorative dates, such as World Environment Day, and is not integrated into the Municipal Integrated Solid Waste Management Plan (PMGIRS). To change this scenario, they suggest incorporating environmental education into school curricula, training educators, and promoting practical actions such as creating community gardens and implementing composting programs.

According to Crovador et al. (2024), the PMGIRS is highlighted as a fundamental instrument for sustainable USWM. However, many municipalities face difficulties in drafting and implementing it due to a lack of financial, technological, and qualified human resources. Additionally, the lack of political will to prioritize waste issues is a significant obstacle. To overcome these weaknesses, the authors suggest training public managers, setting clear and realistic goals, and implementing public policies that encourage sustainable USWM, such as community composting programs and tax incentives for companies that adopt sustainable practices.

Crovador et al. (2024) and Freitas et al. (2024) conclude that Brazil has great potential for sustainable USWM, thanks to the availability of existing technologies, adequate legislation, and educational institutions that promote environmental education projects. However, the lack of efficient enforcement and the absence of political will are obstacles that prevent achieving

the goals established by the PNRS, such as closing open dumps. To overcome these challenges, they suggest measures such as promoting awareness campaigns, improving waste collection and disposal infrastructure, and strengthening cooperatives and waste pickers' associations.

In summary, the article offers a detailed analysis of the weaknesses and strengths in USWM in Brazil, proposing concrete actions to leverage strengths and overcome weaknesses. It is expected that the results presented can assist public managers in identifying strategies appropriate to local realities, contributing to the construction of more sustainable and resilient cities. Efficient USWM not only promotes public health and environmental protection but also generates economic and social opportunities, especially for recyclable material pickers, who play a crucial role in the recycling chain.

Advancing along this line of reflection, and aiming to contribute not only theoretically but also practically to the discussions on public policies aimed at integrated management and solid waste management, the article “Solid Waste and Public Policies in Presidente Prudente – SP: Building Partnerships for Environmental Education” by Leal et al. (2006) stands out, presenting important reflections on the relevance of sectoral public policies focused on socio-environmental issues.

First, it is worth noting that the aforementioned article reports a real intervention proposal through the development and implementation of a public policy project funded by FAPESP, which resulted in the creation of a cooperative that, as of today (2025), remains active in the municipality of Presidente Prudente – SP. In this way, the authors emphasize the importance of environmental education processes, institutional integration, and concrete territorial intervention aimed at overcoming paradigms that are often detrimental from social, environmental, and economic perspectives. This is an initiative that effectively broke through academic barriers and materialized in the public sphere.

In the same vein, reflecting on the role of higher education institutions, Jr. and Kassardian (2015) analyze the USP Recicla program, created at the Polytechnic School of the University of São Paulo in 2006. The program promoted a transformation in solid waste management on the university's campuses, highlighting the collection of highly polluting waste such as batteries, fluorescent lamps, and laboratory waste. This experience reinforces the importance of formulating public policies that go beyond the state sphere.

The analysis of these examples highlights the need to expand the concept of public policies and, above all, points to the possibility, urgency, and legitimacy of developing policies originating from other sectors of society, not exclusively from the state. This is a movement that transcends mere theoretical reflection or the exhaustive repetition of academic references—which at times borders on what could be called "theoretical masturbation"—and directly collides with concrete reality, marked by institutional weaknesses, social vulnerabilities, and a lack of political will.

As highlighted by the aforementioned authors, especially Jr. and Kassardian (2015), it is imperative to propose practical and effective actions capable of reversing scenarios of exclusion and social neglect, particularly regarding urban solid waste management.

Reflections on the Implementation of the National Solid Waste Policy (PNRS)

The article "Implementation of the National Solid Waste Policy" by Maiello, Britto, and Valle (2018) analyzes the challenges and the degree of implementation of the PNRS in the Metropolitan Region of Rio de Janeiro (RMRJ), based on data from the National Sanitation Information System (SNIS). The PNRS, established by Federal Law No. 12,305/2010, sets guidelines for integrated urban solid waste management (USWM), aiming at environmental sustainability, public health protection, and the social inclusion of recyclable material pickers. However, despite advances in the universalization of waste collection services, most PNRS objectives have not been fully achieved, especially regarding recycling, environmentally appropriate final disposal, and the integration of waste pickers (Maiello, Britto, & Valle, 2018).

The study uses a methodology based on gap analysis, which compares the current performance of RMRJ municipalities with the targets established by the PNRS. The results show that although there has been an increase in waste collection service coverage, integrated and sustainable USWM is still incipient. The research highlights the lack of local policy guidelines for monitoring and implementing PNRS targets, as well as the limited institutional and budgetary capacity of municipalities, especially smaller ones, to meet the law's requirements.

The analysis is based on the theoretical framework of institutionalism, which allows interpreting the difficulties in implementing the PNRS as resulting from failures in coordination among different levels of government (federal, state, and municipal) and the absence of a political and administrative culture that fosters intermunicipal cooperation and active civil society participation. The study also points to the need for greater integration between public policies on sanitation, environment, and urban development, as well as the importance of strengthening intermunicipal consortia as tools for regionalized solid waste management (Maiello, Britto, & Valle, 2018).

In the RMRJ, selective collection and solid waste recycling are still underdeveloped practices, with only 1% of waste being recycled, below the national average of 1.4%. Although the PNRS emphasizes the importance of selective collection and the inclusion of recyclable material pickers, SNIS data show that only seven of the fifteen municipalities analyzed have selective collection programs, and the participation of organized waste pickers is minimal. Furthermore, the environmentally appropriate final disposal of waste, which includes sanitary landfills and other forms of treatment, is still insufficient, with only 39% of waste being properly disposed of. The research warns about the overestimation of this percentage, as many controlled landfills have characteristics similar to open dumps, which compromises environmental quality and public health (Maiello, Britto, & Valle, 2018).

Another critical aspect highlighted in the study is the low incidence of municipal investments in solid waste management, with only 6% of total municipal expenditures allocated to this area. This low investment reflects the lack of prioritization of waste management in local public policies, in addition to the absence of specific resources to finance the necessary actions. Despite this, most RMRJ municipalities charge for waste collection services, although the method of charging is not always transparent or efficient. The research also points to the need for greater integration among municipalities through intermunicipal consortia, which could optimize resources and improve regionalized solid waste management. However, only 13% of the municipalities analyzed participate in consortia, indicating a significant gap in the implementation of this strategy (Maiello, Britto, & Valle, 2018).

In summary, the PNRS in the RMRJ faces structural challenges, such as a lack of coordination among different levels of government, limited institutional capacity in municipalities, and the absence of a political culture that fosters cooperation and social participation. The study suggests that adopting a more integrated and participatory approach, involving local and regional actors, could help overcome these challenges. Additionally, it highlights the importance of improving monitoring and evaluation systems for solid waste public policies, based on more precise and comprehensive indicators that allow tracking progress toward PNRS targets.

The study by Maiello, Britto, and Valle (2018) also offers relevant theoretical reflections, using an institutionalist framework to interpret the challenges in implementing the National Solid Waste Policy (PNRS). The institutionalization of a public policy such as the PNRS depends not only on the creation of rules and guidelines but also on the development of habits and practices that legitimize these norms among the actors involved. In this sense, the lack of integration between national, state, and municipal policies, as well as the absence of a culture of cooperation and social participation, are identified as factors that hinder the effective implementation of the PNRS. Overcoming these challenges requires a more holistic approach that considers the political, cultural, and organizational dimensions of solid waste management.

Furthermore, an innovative methodology can be used for public policy monitoring, based on gap analysis, which can be applied in other contexts and areas of public policy. The research also contributes to the academic debate on solid waste management in Brazil, highlighting the need for more in-depth studies on regional and local political-administrative culture, as well as on the processes of public policy institutionalization. The study offers practical recommendations for solid waste management in the RMRJ, such as strengthening intermunicipal consortia, increasing investments in selective collection and recycling, and promoting greater social participation in waste management.

Continuing from this perspective of assessing impacts and management practices, Fonseca, Oliveira, and Leite (2024) focus on the environmental effects caused by poor waste management, with a study focused on the reality of Belo Horizonte, expanding the understanding of the damages caused by improper disposal and the strategies necessary for their mitigation.

The article “Environmental Impacts of Urban Solid Waste” by Jordânia Passos Fonseca, Larissa Pereira de Oliveira, and Mariana Vieira Leite addresses the negative effects of inadequate Urban Solid Waste Management (USWM) on the environment, focusing on the city of Belo Horizonte, Minas Gerais. The study aims to analyze the environmental impacts resulting from improper USW disposal, such as soil, water, and air contamination, and to propose sustainable solutions to mitigate these effects. The methodology used includes literature review, statistical data analysis, and case studies on waste management practices.

USW, commonly referred to as urban waste, results from human activities and reflects the lifestyle and consumerism of modern society. The composition of this waste varies according to each individual’s habits and socioeconomic status, but generally includes organic materials, plastics, metals, and hazardous waste. The improper disposal of these materials causes significant environmental impacts, such as soil, water, and air pollution, in addition to contributing to ecosystem degradation and the spread of diseases (Fonseca et al., 2024).

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In Brazil, inadequate USWM is a serious problem. According to data from the Brazilian Association of Waste and Environment (ABREMA, 2024), about 40% of the waste produced in the country is disposed of in an environmentally inappropriate manner, mainly in open dumps. In Belo Horizonte, the situation is no different. With a population of almost 2.4 million inhabitants, the city faces significant waste management challenges, including a lack of adequate infrastructure, low adherence to selective collection, and irregular waste disposal in urban and environmental preservation areas.

To complement this situation, and to corroborate these difficulties in USWM in urban areas, Alípio and Bruna (2013) report similar challenges on the coast of São Paulo state. As they point out, the coastal region lacks adequate sites for final waste disposal due to its morphological characteristics.

Inadequate USWM in Belo Horizonte has direct impacts on both the population's quality of life and the environment. Soil and water contamination by leachate, emissions of toxic gases such as methane, and the proliferation of disease vectors are among the main problems identified. Additionally, the improper burning of waste contributes to air pollution and the worsening of climate change. Therefore, the lack of effective public policies and cultural resistance to recycling are significant obstacles to implementing sustainable waste management practices.

The research conducted by Fonseca et al. (2024) indicates that USWM in Belo Horizonte is marked by structural and cultural challenges. Despite the existence of public policies, such as the Municipal Integrated Solid Waste Management Plan (PMGIRS), aligned with the National Solid Waste Policy (PNRS), the implementation of these guidelines still faces difficulties. Selective collection, for example, although expanded in recent years, has low public adherence, resulting in a recycling rate of only 1.1% of the material collected in the city, below the national average of 2.3%. This scenario reflects the need for greater environmental awareness and adequate infrastructure for the segregation and collection of recyclable materials.

Irregular waste disposal in urban and environmental preservation areas is another significant problem. In Belo Horizonte, it is common to find solid waste such as PET bottles, discarded furniture, and plastic bags in places like Pampulha Lagoon, one of the city's main tourist attractions. Pollution caused by this waste, combined with inadequate sewage treatment, directly affects the local ecosystem, compromising water quality and biodiversity. The presence of microorganisms that consume water oxygen and contamination by domestic and industrial waste make the environment inhospitable for fauna and flora, endangering species such as alligators, capybaras, and fish (Fonseca et al., 2024).

In addition to environmental impacts, inadequate USWM has social and economic consequences. The accumulation of waste in urban areas causes problems such as flooding, especially during periods of heavy rain. These events can damage homes, lead to the loss of material goods, and even cause loss of human life. The proliferation of disease vectors such as rats and mosquitoes is also a serious problem, increasing the risk of epidemics and affecting public health. Visual pollution and foul odors resulting from irregular waste disposal also contribute to property devaluation and urban landscape degradation (Fonseca et al., 2024).

In this sense, environmental education is a crucial factor for improving solid waste management. The lack of public awareness about the importance of waste segregation and proper disposal is one of the main obstacles to the effectiveness of selective collection programs. Research indicates that 90% of Belo Horizonte's population blames the municipal administration for negligence in selective collection, while 51% justify their lack of participation due to the absence of accessible drop-off points near their homes. Additionally, 37% of respondents attribute the failure to the lack of door-to-door collection services (Fonseca et al., 2024).

To address the challenges of USWM, Fonseca et al. (2024) propose adopting sustainable practices such as recycling, composting, and waste-to-energy recovery. Recycling, in particular, is highlighted as an effective solution to reduce the volume of waste sent to sanitary landfills and dumps, while generating economic and social benefits such as job creation and income generation for waste pickers. Composting, in turn, is a viable alternative for treating organic waste, which accounts for about 50% of total USW in Brazil. Waste-to-energy recovery, through the capture of gases such as methane in sanitary landfills, is also an important strategy to reduce greenhouse gas emissions and help mitigate climate change.

A successful example of USWM is Germany, where the implementation of effective policies led to a significant reduction in the amount of urban waste produced. Between 1992 and 2012, the country reduced its waste production by 43%, thanks to the adoption of practices such as recycling and material reuse. The German experience can serve as a model for Belo Horizonte and other Brazilian cities, demonstrating that it is possible to turn the waste problem into an opportunity for sustainable development (Fonseca et al., 2024).

In conclusion, the article highlights the importance of integrated and sustainable USWM, involving the active participation of the government, companies, and the population. Implementing effective public policies, investing in adequate infrastructure, and promoting environmental education are essential steps to minimize the negative impacts of USW and improve quality of life in cities. Fonseca et al. (2024) argue that only through collaborative efforts and a commitment to good environmental practices will it be possible to ensure a cleaner and more sustainable future for generations to come.

Ultimately, it is worth presenting a brief critique of the limitations that go beyond the legal-formal framework and highlight a recurring fallacy in debates on integrated waste management— a fallacy present in most academic works produced by researchers across the country. It cannot be stated, under any circumstances, that the National Solid Waste Policy (PNRS) is fully feasible, given how integrated waste management and disposal are actually carried out nationwide. The current scenario is marked by setbacks, such as the publication of decrees authorizing the import of recyclable materials— in blatant violation of international conventions; by the technical shortcomings of most municipalities, which lack the minimum structural, financial, or operational capacity to manage their waste; and by the persistence of environmentally inadequate sites for final waste disposal. All these elements were corroborated by the authors analyzed here. In light of this, the question arises: after all, what has been proposed to address these challenges? What possible paths could lead to a fairer, more efficient, and more sustainable scenario in terms of solid waste management?

Perhaps — and this is indeed the appropriate word — a textual and structural revision of the PNRS is needed, considering the limited progress observed in its practical implementation since its enactment. Therefore, there is an evident question regarding the effectiveness of the PNRS implementation, especially given the concrete realities of Brazilian municipalities and the vulnerable populations directly involved in this production chain.

CONCLUSION

Based on the analysis of the selected studies, it is clear that the issue of urban solid waste goes beyond the purely technical or operational sphere, representing a challenge that involves deep social, cultural, environmental, and political issues. Inadequate waste management reflects unsustainable production and consumption models that not only generate severe environmental impacts but also perpetuate dynamics of social exclusion, especially affecting waste pickers and vulnerable populations.

The studies reveal an understanding that building sustainable alternatives necessarily involves incorporating management practices that prioritize waste reduction, reuse, and recycling, while ensuring the social inclusion of workers in the recycling chain. This perspective reinforces the importance of adopting public policies that, in addition to being technical and regulatory, are inclusive, participatory, and sensitive to the socio-environmental inequalities present in cities, promoting not only waste management efficiency but also social justice and territorial equity.

Furthermore, it becomes evident that there is a need to go beyond the economicist and purely functional view of waste, recognizing it as a sociocultural phenomenon that expresses the habits, representations, and daily practices of contemporary societies. Overcoming this paradigm requires profound cultural changes, involving raising society's awareness about the impacts of consumption and promoting shared responsibility in waste management.

The studies also indicate that although there have been important institutional and regulatory advances, such as the creation of the National Solid Waste Policy, the effective implementation of these guidelines still faces significant obstacles. These include the lack of integration among different levels of government, scarcity of resources, low social participation, and resistance to structural changes. Thus, efficient solid waste management depends not only on legal instruments but also on coordinated and long-term actions that take local specificities into account and promote the strengthening of environmental governance.

Finally, the analyses reinforce that inadequate urban solid waste management leads to severe environmental impacts, such as soil, water, and air contamination, directly affecting quality of life in cities. Therefore, mitigating these impacts requires investments in appropriate technologies, environmental education, the strengthening of waste picker networks, and the promotion of sustainable practices that engage society as a whole. Therefore, the literature review confirms that addressing the challenge of urban solid waste is, above all, about rethinking the current development model in pursuit of more inclusive, resilient, and environmentally responsible cities.

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DECLARATIONS

In describing each author's participation in this manuscript, the following criteria were used:

- **Conceptualization and Study Design:** Uilmer Rodrigues Xavier da Cruz, Eduardo Rodrigues Ferreira, Ricardo Alexandrino Garcia, and Martín Andrés Díaz
- **Data Curation:** Uilmer Rodrigues Xavier da Cruz, Eduardo Rodrigues Ferreira, Ricardo Alexandrino Garcia, and Martín Andrés Díaz
- **Formal Analysis:** Uilmer Rodrigues Xavier da Cruz, Eduardo Rodrigues Ferreira, Ricardo Alexandrino Garcia, and Martín Andrés Díaz
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- **Supervision:** Ricardo Alexandrino Garcia and Martín Andrés Díaz

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Conflict of Interest Declaration

We, **Uilmer Rodrigues Xavier da Cruz, Eduardo Rodrigues Ferreira, Ricardo Alexandrino Garcia, and Martín Andrés Díaz**, hereby declare that the manuscript entitled "**Urban Solid Waste Management in Brazil: Challenges, Public Policies, and Social Inclusion**":

1. **Financial Relationships:** We have no financial relationships that could influence the results or interpretation of this work.
2. **Professional Relationships:** We have no professional relationships that could impact the analysis, interpretation, or presentation of the results.
3. **Personal Conflicts:** We have no personal conflicts of interest related to the content of this manuscript.
