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Waste management gaps between urban and rural communities: a narrative review

Brechas en la gestión de residuos entre comunidades urbanas y rurales: revisión narrativa

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ABSTRACT

Population growth and changes in consumption habits have increased the generation of solid waste, posing challenges in its management and impacting public health and the environment. This study analyzed inequalities in solid waste management between urban and rural communities, identifying their main consequences. A qualitative approach was used with a documentary methodology based on a narrative review of the scientific literature. The results indicated that, although cities have greater infrastructure for waste collection and disposal, they face problems of overload and low efficiency in waste sorting. In contrast, in rural areas, collection is limited or nonexistent, with inadequate practices such as burning or dumping in waterways predominating. These inequalities are influenced by economic factors, poor planning, and a lack of environmental education.

Keywords: waste management, inequalities in environmental management, environmental impact of waste.

RESUMEN

El crecimiento poblacional y los cambios en los hábitos de consumo han incrementado la generación de residuos sólidos, lo que plantea desafíos en su manejo y efectos en la salud pública y el medioambiente. Este estudio analizó las desigualdades en la gestión de residuos sólidos entre comunidades urbanas y rurales, identificando sus principales consecuencias. Se empleó un enfoque cualitativo con una metodología documental basada en una revisión narrativa de la literatura científica. Los resultados indicaron que, aunque las ciudades cuentan con mayor infraestructura para la recolección y disposición de residuos, enfrentan problemas de sobrecarga y baja eficiencia en la clasificación de desechos. En contraste, en las zonas rurales, la recolección es limitada o inexistente, predominando prácticas inadecuadas como la quema o el vertido en cuerpos de agua. Estas desigualdades están influenciadas por factores económicos, planificación deficiente y falta de educación ambiental.

Palabras clave: gestión de residuos, desigualdades en la gestión ambiental, impacto ambiental de los residuos.

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INTRODUCTION

Inadequate solid waste management and the overexploitation of natural resources constitute a global environmental problem. Excessive waste accumulation and its poor management contribute significantly to soil, air, and water pollution, impacting both ecosystems and human health (Rico and Jiménez, 2018). In this context, large cities in Latin America and the Caribbean face a problem exacerbated by population growth and the increase in solid waste generation (Aguilar et al., 2018).

According to the World Bank, approximately 2.01 billion tons of solid waste were generated globally in 2018, with a projected increase to 3.4 billion tons by 2050; at least 33% of this is not managed in an environmentally safe manner (Kaza et al., 2018; Hernández et al., 2024). This problem has repercussions on environmental costs, climate change, and public health. The World Health Organization (2018) estimates that air pollution causes approximately 7 million deaths annually.

Waste management is influenced by economic, cultural, social, and political factors. Besana and Gutiérrez (2022) point out that in societies with low incomes and weak state structures, waste collection and treatment are often deficient or nonexistent, favoring the proliferation of open dumps. Similarly, Toledo and Quintero (2020) highlight that in developing countries, the lack of coordination between public administration and civil society hinders sustainable waste management.

In Latin America and the Caribbean, waste production reached 231 million tons in 2018, representing 10% of global waste (World Health Organization, n.d). Urban waste generation is growing in tandem with demographic and economic development, and it is estimated that by 2050 the region will produce 671,000 tons per day. However, waste management remains inadequate: one-third of waste ends up in uncontrolled dumps, impacting health and ecosystems.

In Ecuador, waste generation increased from 5.26 million tons in 2022 to 5.3 million tons in 2024 (INEC, 2023). Most waste originates in urban areas (66%), while gaps in collection and disposal persist in rural areas. Only 70.8% of the rural population has access to collection services, and even then, the frequency of collection is not guaranteed, forcing them to resort to alternative methods such as burning or dumping in open spaces (INEC, 2023).

These inequalities in waste management reflect the gaps in access to basic services, health, and education (United Nations, 2019; Moreno Avendaño et al., 2021). While cities face problems such as overloaded collection systems and low waste sorting rates (Portilla, 2022), in rural areas, a lack of infrastructure limits proper management. Urbanization and population growth saturate landfills, exacerbating pollution and increasing health risks (Sáez & Urdaneta, 2014).

Sustainable solid waste management is key to achieving the Sustainable Development Goals (SDGs), especially SDG 11 (Sustainable Cities and Communities), SDG 12 (Responsible Consumption and Production), and SDG 3 (Good Health and Well-being). Inefficient waste management worsens pollution, affects public health, and deepens social and environmental

inequalities, particularly in vulnerable communities. Lack of equitable access to collection and treatment services perpetuates these problems, highlighting the urgent need for inclusive and sustainable policies to mitigate their impact and improve quality of life.

Given that deficiencies in waste management directly affect public health and the environment, it is crucial to analyze how these inequalities impact urban and rural communities. This research seeks to highlight the differences in waste management and their consequences, providing information that contributes to the formulation of more equitable and sustainable public policies. This leads to the following question: What are the main inequalities in solid waste management, and how do they affect the health of urban and rural populations? Therefore, this study aimed to analyze these inequalities in solid waste management and their effects on the health of urban and rural communities.

METHODOLOGY

This study adopts a qualitative and documentary approach based on a narrative review of the scientific literature to analyze inequalities in solid waste management and their effects on the health of urban and rural communities. An interpretive design was used, combining the description of key concepts with a critical analysis of the selected sources.

Data collection was carried out in recognized scientific databases, such as SciELO, Dialnet, and Google Scholar. To ensure a comprehensive search, keywords in Spanish were used, including: "solid waste management", "waste inequalities", "environmental impact of waste", "urban and rural solid waste", and "public health and solid waste", Combining these terms with Boolean operators (AND, OR) allowed for the identification of relevant studies that analyze the relationship between unequal waste management and its repercussions on health and the environment.

Specific selection criteria were established, prioritizing original and review articles, while excluding letters to the editor, commentaries, reports without peer review, and other opinion-based documents. To ensure data accuracy, only publications from 2019 to 2024 were included. While studies from Ecuador were prioritized, the analysis was not limited to this country. Regional research across the Americas, with an emphasis on Latin America, was included to provide a broader and more comparative context for solid waste management.

Undergraduate and graduate theses were excluded due to their limited peer review, which could compromise the reliability of the findings. A total of 24 studies were reviewed, selecting only those that met the established criteria. A database was created for data analysis, organizing the selected studies according to key aspects such as author(s), year, title, article type, methodology, and main findings. This structure facilitated the identification of trends and patterns in the reviewed literature. The results of this analysis are presented in Table 1 in the Results section, providing a structured and concise overview of the information obtained. As this was a literature review, it was not necessary to obtain ethical approvals or informed consent from human participants. However, the principles of academic integrity were respected, ensuring accurate reproduction of information and proper citation of the sources.

RESULTS AND DISCUSSION

For the analysis of the results, a database was created that included 23 articles, for which a table was generated. Table No. 1 identifies: authors, year, title, type of article, methodology, and main findings.

This research highlights inequalities in solid waste management between urban and rural communities, which directly impact public health and the environment. While urban areas have greater infrastructure for waste collection and disposal, problems persist, such as overloaded collection systems, inefficient source separation of waste, and a lack of effective strategies for utilizing recyclable waste (Segura et al., 2020; Rodríguez-Guerra & Baca-Cajas, 2021). In contrast, waste management in rural areas is even more precarious, characterized by low collection service coverage, frequent use of inadequate disposal methods such as burning or dumping into water bodies, and limited implementation of recycling programs (Vélez et al., 2019; Chamorro et al., 2023).

The reviewed studies confirm that disparities in waste management are largely due to economic and urban planning factors. In developing countries, such as those in Latin America, the lack of investment in adequate infrastructure, institutional weaknesses, and poor coordination between different levels of government hinder the implementation of sustainable waste management strategies (Toledo & Quintero, 2020; Nájar, 2024). Furthermore, the population's limited environmental education contributes to inadequate source separation, which restricts the potential for recycling and reusing materials (Sánchez-Muñoz et al., 2019).

Table 1. Characteristics and findings of the reviewed studies on waste management

Reference	Article type	Methodology	Key findings
Sánchez-Muñoz et al. (2019)	*Original article*	Descriptive and correlational statistics. Kolmogorov-Smirnov normality test and Pearson coefficient. Data from official bodies (2007-2014) of 9 Latin American cities.	A significant correlation exists between waste generation and per capita income in some cities. There is a lack of effective implementation of regulations. Environmental education and effective local management are key to reducing waste. More robust policies and improved logistics are needed for reintegrating waste into the production cycle.
Vélez et al. (2019)	*Original article*	The study surveyed 32 families and followed the PAHO methodology. An integrated management system was proposed.	In the Waorani community in Gareno, there is no comprehensive solid waste management system in the community. Burning waste is the most common practice (66%), followed by unlined burial (31%) and dumping into the river (3%), causing air, soil, and water pollution. There is no municipal collection service or adequate containers for waste disposal.
Alcocer et al. (2019)	*Original article*	Design of a mathematical model with a multi-objective approach to optimize the comprehensive management of urban solid waste in the canton of Quevedo, Ecuador.	Planning based on mathematical models allows for improved efficiency in waste collection and disposal, reducing operating costs and minimizing environmental impacts. It highlights the importance of a comprehensive approach to waste management, where optimizing routes and resources can improve the system's sustainability.
Mendieta-Vivas et al. (2020)	*Original article*	Mixed approach, combining the collection, interpretation, and evaluation of quantitative and qualitative information.	The study reveals deficiencies in waste management in the Membrillo parish, with irregular collection and inadequate disposal in rural areas, while coverage is more stable in urban areas. In rural areas, 42% of residents burn waste. Furthermore, 73% of the population recognizes health impacts due to poor waste management, highlighting the need for adequate infrastructure and environmental education in both rural and urban areas.
Segura et al. (2020)	*Review article*	Qualitative and descriptive approach, using documentary analysis.	In Latin America, waste management remains deficient, with a system based on models from the last century, where disposal in landfills and a lack of waste utilization predominates. 52% of waste in Latin America ends up in landfills, while in leading countries this figure is only 0.9%.

Reference	Article type	Methodology	Key findings
Toledo & Quintero (2020)	*Original article*	Holistic organizational analysis methodology based on Scott's model (2003) and the Critical Path Methodological Strategy for Strategic Organizational Analysis (RC-AEO).	Lack of integration of informal recyclers, especially in peripheral areas, where the existence of urban recyclers (scavengers) is mentioned, operating on the margins of the management system, often in less centralized areas.
Huamaní et al. (2020)	*Original article*	Questionnaire to 267 heads of household; processing through descriptive statistics.	Garbage collection is a more critical situation in urban-marginal neighborhoods. 68.2% dispose of waste outside the home every day, 22.8% do so every two days. There is no classification or separation by type of waste.
Jaime-Huaman et al. (2021)	*Original article*	The study employed a descriptive approach with fieldwork in the rural community of Vitis, Lima, Peru. Sampling was conducted over seven days to quantify and characterize the solid waste generated.	The study conducted in the rural community of Vitis, Lima, Peru, identified key differences in the generation and composition of household and non-household solid waste. It was determined that per capita generation of household solid waste is 0.39 kg/ person /day and 0.29 kg/ person /day for non-household waste, figures lower than those reported in urban areas. Organic waste predominates in both categories (69% in household waste and 44% in non-household waste), reflecting the influence of agricultural activities in the community. The lower production and density of waste in rural areas highlight the need for differentiated waste management strategies, prioritizing the use of organic waste for compost production and promoting source separation.
Moreno et al. (2021)	*Original article*	Quantitative, statistical method, and correlational scope.	100% optimal collection level is not reached, with the greatest deficit on Saturday. The minimum efficiency indicators are not being met; the collection trucks are obsolete or not very functional, affecting the efficiency of the system; causing accumulation of waste in the streets, generating contamination of water sources in the Pelileo canton.
Dávila et al. (2021)	*Original article*	Leopold matrix to evaluate the environmental impact of municipal solid waste on air, water and soil at the Zinacantepec landfill – Mexico.	Direct management by municipalities is less efficient than private concession, which has a negative impact; since the lack of data on leachate and gases in landfills increases the risks of contamination in nearby communities. The lack of infrastructure in rural areas exacerbates the improper

Reference	Article type	Methodology	Key findings
			disposal of waste, increasing soil and water pollution. In urban environments, overcrowded landfills cause leaks and polluting emissions.
Rodríguez-Guerra & Baca-Cajas (2021)	Review article	A qualitative method was used, employing documentary analysis within a non-experimental context. Electronic and physical bibliographic sources were analyzed. Statistics from 25 articles, reports, and official documents from environmental control agencies in cities were reviewed.	The average waste collection rate in Latin America exceeds 90%, but it drops significantly in peripheral and rural areas. The lack of treatment plants for special and hazardous waste poses risks to public health in Latin American cities.
Quispe (2022)	*Original article*	Data Envelopment Analysis (DEA) to evaluate the relative efficiency of municipalities in solid waste management.	The study reveals a significant disparity in the efficiency of solid waste management among the municipalities of the Puno region. Rural areas are particularly neglected, with public cleaning coverage notably lower than in urban areas.
Besana & Gutiérrez (2022)	*Original article*	Qualitative analysis based on interviews and participant observation in popular neighborhoods of the Buenos Aires Metropolitan Region.	Waste management in low-income neighborhoods is characterized by co-production practices between state and community actors. However, these practices also reflect and reproduce social and spatial inequalities, affecting residents' quality of life and the efficiency of waste collection.
Tagle & Carrillo (2022)	*Original article*	The study used a qualitative approach, based on in-depth interviews in León, Guanajuato, Mexico. It was supplemented with public information and analysis of official documents. The unit of analysis was the Comprehensive Public Cleaning System (SIAP), the agency responsible for waste management in the municipality.	In urban areas, waste management is more structured, with three-day household collection and waste separation in certain sectors. In rural areas, collection is limited and occurs one to three times per week, depending on the distance. Coverage reaches only 98% of the rural population, leaving some areas without regular service. Furthermore, waste management in León is outsourced to private companies.
Rodríguez-Díaz et al. (2022)	Review article	Bibliographic review in databases, and documents corresponding to the legislation of each country, comparing aspects such as population, waste generation.	Although cities like Bogotá and Mexico City have made progress in solid waste management through recycling plans and collection coverage, they still face challenges in source separation, transportation modernization, and marketing of recyclable waste.
Carvajal et al. (2022)	Original article	The research is cross-sectional with a quantitative approach, in which a questionnaire applied by ECLAC and the	Waste management in El Oro shows deficiencies despite the existence of plans and sanitary landfills. There is no correlation between these plans and their impact on final disposal, training, or

Reference	Article type	Methodology	Key findings
		Ministry of the Environment in Chile in 2019 was used.	the treatment of hazardous waste. While waste sorting is encouraged in urban areas, in rural areas, intermunicipal associations are formed to improve management. Greater and more effective implementation of public policies is needed to optimize waste management.
Velásquez-Pita et al. (2023)	*Review article*	Descriptive research based on the documentary analysis of indexed publications (2018-2021), international, national, and regional legislation.	There is evidence of limited knowledge, non-compliance with environmental regulations and a lack of work plans by municipal authorities regarding the management of urban and non-hazardous solid waste, affecting its management in rural and dispersed areas. Entrepreneurial opportunities were identified in rural communities, through the transformation of waste into usable products.
Herrera-Uchalin et al. (2023)	Review article	Quantitative approach, of an exploratory-bibliometric type.	In urban areas, urbanization and population growth are increasing rapidly, generating a greater amount of waste, emphasizing the importance of local authorities including objectives oriented towards sustainable development in their government plans.
Guevara & Salazar (2023)	Original article	Use of an ordinal logit model to analyze individual and cantonal data in Ecuador.	In larger cities, the perception of poor environmental management negatively impacts life satisfaction. Factors such as pollution, traffic congestion, and a lack of green spaces affect urban residents more. Despite having less infrastructure and fewer resources for environmental management, rural residents report higher levels of life satisfaction compared to urban residents. It is suggested that lower pollution, contact with nature, and social cohesion contribute to this difference.
Niezwida et al. (2023)	Review article	Bibliographic reviews using data from the year 2000 onwards, such that, for the article, the most relevant study documents on general information and MSW models were selected.	Although separate collection and recycling initiatives exist, their impact is limited due to a lack of incentives and effective policies. In conclusion, it is emphasized that urban population growth exacerbates waste generation, and while there are management models applicable to large cities, a comprehensive approach for small municipalities is lacking.
Chamorro et al. (2023)	Original article	The study used random sampling and followed the guidelines of the Pan American Health Organization. Waste from 51 households in a rural parish in the	Waste management in the Fátima rural parish faces serious limitations in coverage and treatment. The majority of waste (66%) is organic matter, indicating an opportunity to implement composting. Waste accumulation was identified on riverbanks and

Reference	Article type	Methodology	Key findings
		Ecuadorian Amazon was analyzed.	in public spaces, negatively impacting aesthetics and tourism. Collection is insufficient, and recycling strategies are inefficient, highlighting the need to improve waste management with source separation programs and the recovery of recyclable materials.
Cruzado (2023)	Original article	Descriptive research, correlational, transversal, phenomenological, and grounded theory in rural population centers.	Although waste management is an important factor, it is not directly related to community health in this specific context. Improved management practices and community participation are essential to promoting a healthier environment.
Najar (2024)	Review article	The study was conducted through a literature review in databases such as Scielo, Dialnet, and Scopus, selecting 30 relevant articles on solid waste management in Latin America. Inclusion and exclusion criteria were applied to analyze policies, action plans, and innovations in waste management.	In Latin America, solid waste management suffers from widespread administrative deficiencies, especially in urban areas, where a lack of planning and coordination among stakeholders (government, private sector, and population) limits the system's efficiency. In rural areas, waste collection and treatment are even more precarious, with limited coverage and a lack of adequate infrastructure.

One of the most significant aspects is the direct impact of these inequalities on public health. In communities with deficient waste collection and treatment systems, an increase in respiratory, gastrointestinal, and skin diseases is observed, associated with exposure to decomposing waste, leachate, and polluting emissions (Huamaní et al., 2020; Dávila et al., 2021). Furthermore, inadequate waste management in rural areas contributes to water pollution, affecting not only human health but also the quality of local ecosystems (Mendieta-Vivas et al., 2020).

Another key factor identified in the review is the difference in community perception and management of waste between urban and rural areas. While in larger cities dissatisfaction with environmental management is linked to problems such as pollution and traffic congestion (Guevara & Salazar, 2023), in rural areas there is greater tolerance for inadequate waste collection, possibly due to proximity to natural environments and lower population density (Chamorro et al., 2023). However, this lower perception of risk does not imply better conditions, but rather reflects the normalization of inadequate waste management practices.

From a sustainability perspective, the results suggest that waste management strategies should be adapted to the needs and capacities of each context, prioritizing infrastructure investment in rural areas and promoting circular economy models in urban environments (Tagle & Carrillo, 2022). Furthermore, the implementation of more equitable public policies for waste collection and treatment is crucial to reducing existing gaps and improving the quality of life of affected populations (Rodríguez-Díaz et al., 2022).

CONCLUSIONS

The study revealed inequalities in solid waste management between urban and rural communities. While urban areas face overloaded collection systems and low waste sorting rates, rural areas continue to suffer from low coverage and inadequate disposal practices. Economic factors, poor planning, and a lack of environmental education exacerbate these inequalities. Furthermore, a link was identified between poor waste management and increased disease rates in vulnerable communities. Strengthening infrastructure in rural areas and promoting sustainable models in urban areas through equitable public policies are crucial. However, a lack of specific studies in Ecuador was identified, highlighting the need for future research that delves deeper into the national context and provides data to improve waste management in the country.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

AUTHOR CONTRIBUTIONS

Conceptualization: Yaniset Rodríguez. **Data curation:** Ariana L. Álvarez. **Formal analysis:** Josselyn J. Iriarte and Ariana L. Álvarez. **Investigation:** JYaniset Rodríguez, Josselyn J. Iriarte, and Ariana L. Álvarez. **Methodology:** Ariana L. Álvarez. **Supervision:** Josselyn J. Iriarte. **Writing – original draft:** Yaniset Rodríguez, Josselyn J. Iriarte, and Ariana L. Álvarez. **Writing – review & editing:** Ariana L. Álvarez.

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