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The Effect of Green Infrastructure and Waste Management on Quality of Life

Loso Judijanto[1], Zainuddin Latuconsina[2], Veronika Yuni Trisnowati[3], Ferry WF Waangssir[4], Ida Farida[5]

[1] IPOSS Jakarta, Indonesia
[2] Fakultas Ekonomi dan Bisnis, Universitas Pattimura
[3] Universitas Jayabaya
[4] Poltekkes Kemenkes Kupang
[5] STIE Trisakti

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ABSTRACT

Green infrastructure and waste management play pivotal roles in fostering sustainable urban environments and enhancing the quality of life. This study systematically reviews 12 peer-reviewed documents from the Scopus database to analyze the environmental, health, social, and economic impacts of these initiatives. Key findings reveal that green infrastructure reduces pollution, mitigates urban heat, and promotes social cohesion, while effective waste management minimizes environmental hazards and improves public health. Integrated approaches amplify these benefits, enabling resource recovery and community engagement. However, challenges such as funding limitations, policy gaps, and low public awareness hinder optimal implementation. The study highlights the need for holistic strategies combining technology, policy integration, and community participation to address urban sustainability challenges effectively.

Corresponding Author:

Name: Loso Judijanto
Institution: IPOSS Jakarta, Indonesia
Email: losojudijantobumn@gmail.com

1. INTRODUCTION

Urbanization and population growth have significantly transformed cities worldwide, creating challenges in environmental sustainability, public health, and overall quality of life. In this context, green infrastructure (GI) and waste management (WM) have emerged as critical strategies to address urban challenges and enhance living conditions. Green infrastructure refers to a network of natural and semi-natural elements, such as green roofs, urban parks, and rain gardens, that provide environmental, economic, and social benefits [1]. Simultaneously, waste management focuses on systematic processes for collecting, treating, and disposing of waste materials in a way that minimizes environmental and health impacts.

The relationship between these two domains and their collective impact on quality of life has drawn increasing attention from researchers, policymakers, and urban

planners. While green infrastructure primarily addresses issues like urban heat islands, air pollution, and loss of biodiversity, waste management mitigates environmental hazards, improves public health, and promotes sustainability through recycling and resource recovery [2], [3]. Together, these initiatives form a cornerstone for sustainable urban development, contributing to cleaner, healthier, and more livable cities.

Recent studies emphasize the potential of integrating green infrastructure and waste management to maximize their combined benefits. For example, compost derived from organic waste can be used to enhance soil quality in urban agriculture projects, while waste-to-energy systems can be integrated into green spaces to support local energy needs. However, despite these opportunities, significant challenges remain, including financial constraints, policy fragmentation, technological limitations, and insufficient public awareness [4]. Addressing these barriers requires a holistic approach that considers environmental, social, and economic dimensions.

This study aims to systematically review the existing literature on the effects of green infrastructure and waste management on quality of life. The review is guided by three primary objectives:

1. To explore the environmental, health, and social impacts of green infrastructure and waste management.
2. To examine the synergies and integrated effects of these systems on urban sustainability.
3. To identify challenges and propose actionable strategies for policymakers and urban planners.

2. LITERATURE REVIEW

2.1 Green Infrastructure and Quality of Life

Green infrastructure (GI) refers to natural and semi-natural systems strategically designed to manage environmental challenges while enhancing urban sustainability, including features such as green roofs, urban parks, rain gardens, and green corridors. Numerous studies highlight the multifaceted benefits of GI: it mitigates urban heat islands, improves air quality, and supports biodiversity—urban parks, for instance, reduce ambient temperatures, while green walls filter airborne pollutants, improving environmental conditions [5], [6]. GI also has significant health and well-being benefits, as proximity to green spaces is strongly linked to improved physical and mental health by reducing stress, promoting physical activity, and enhancing overall happiness [7]. Furthermore, GI fosters social connectivity by creating shared spaces that facilitate community interactions, positively contributing to the perceived quality of life [8]. Despite these advantages, challenges such as funding constraints, land availability, and lack of policy integration hinder the broader implementation of GI systems.

2.2 Waste Management and Quality of Life

Efficient waste management involves the systematic collection, processing, and disposal of waste materials to minimize environmental and health hazards, significantly impacting the quality of life. Key dimensions include environmental protection, where proper waste management reduces pollution in air, water, and soil, essential for maintaining public health and

environmental sustainability; research highlights that cities with effective recycling and composting programs exhibit better environmental indices [9], [10]. In terms of public health, poor waste disposal contributes to issues like respiratory problems and waterborne diseases, while effective waste management systems reduce exposure to hazardous materials, thereby improving health outcomes [11]. Additionally, waste management enhances aesthetic and social aspects, as clean environments improve the visual appeal of urban areas, fostering residents' satisfaction and pride [12]. However, challenges such as inadequate infrastructure, lack of public awareness, and limited technological adoption impede the full realization of these benefits.

2.3 Gaps in Existing Literature

While studies emphasize the individual effects of green infrastructure and waste management on quality of life, few explore their integrated impacts. Additionally, limited attention is given to the role of technology, policy innovation, and community engagement in optimizing these systems. Addressing these gaps is essential to develop actionable strategies for sustainable urban development.

3. METHODS

3.1 Research Design

A systematic literature review was chosen to synthesize findings from existing research and identify patterns, gaps, and trends, following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines to ensure transparency and replicability. The Scopus database was selected as the primary source due to its comprehensive indexing of high-quality peer-reviewed literature across various disciplines. A keyword-based search strategy was employed to identify relevant studies using terms such as "green infrastructure," "waste management," "quality of life," and "sustainability." Boolean operators (AND, OR) were applied to refine the search, resulting in an initial retrieval of 84 documents published between 2015 and 2024.

3.2 Inclusion and Exclusion Criteria

To ensure relevance and quality, the following criteria were applied:

Criteria Type	Details
Inclusion Criteria	- Peer-reviewed journal articles and conference papers.
	- Studies focusing on green infrastructure, waste management, and quality of life.
	- Research employing empirical, theoretical, or case study methodologies.
	- Documents published in English.
Exclusion Criteria	- Grey literature such as reports, dissertations, or opinion articles.
	- Studies not directly addressing the interaction between the variables.
	- Duplicates or papers without accessible full-texts.

After applying these criteria, 12 documents were deemed eligible for the review.

Document Title	Authors	Source	Citations
Life cycle implications of urban green infrastructure	Spatari, S., Yu, Z., Montalto, F.A. (2011)	Environmental Pollution	157

Urban Stormwater Management Model and Tools for Designing Stormwater Management of Green Infrastructure Practices	Haris, H., Chow, M.F., Usman, F., Rozali, Z.A., Norfida, M.D. (2016)	IOP Conference Series: Earth and Environmental Science	46
Spatial layout optimization of green infrastructure based on life-cycle multi-objective optimization algorithm and SWMM model	Zhu, Y., Xu, C., Liu, Z., He, H., Guan, Y. (2020)	Resources, Conservation and Recycling	33
Green infrastructure quality and environmental sustainability in residential neighbourhoods in Lagos, Nigeria	Dipeolu, A.A., Ibem, E.O. (2020)	International Journal of Urban Sustainable Development	24
Socio-Ecological Support and Physical Facilities Satisfaction: How They Link to Social Participation and Well-Being among Urban Residents in Malaysia	Awang, M.M., Alfieiri, A., Ahmad, R.A., Greenenden, I.D., Ahmad, I. (2022)	Sustainability	6
The role of citizens and transformation of energy, water, and waste infrastructure for an intelligent, sustainable environment in cities	Rodrigues, M., Franco, M. (2023)	Smart and Sustainable Built Environment	5
Modeling the effects of green infrastructure on storm water runoff reduction at community scale	Liu, W., Chen, W.P., Peng, C. (2016)	Shengtai Xuebao	5
Sustainability in Infrastructure Asset Management	Shaw, G., Walters, R., Kumar, A., Sprigg, A. (2015)	Lecture Notes in Mechanical Engineering	0
Toward Heart-Healthy and Sustainable Cities: A Policy Statement from the American Heart Association	Rajagopalan, S., Ramamurthi, A., Bhattaper, A., Seto, K.C., Whelsel, L.P. (2024)	Circulation	4
LCA for territorial metabolism analysis: An application to organic waste management planning	Ferretti, L., Lucertini, G., Bigdeli, D. (2024)	Journal of Cleaner Production	2
Ecological Problems of Public Spaces in a Modern City Center	Guliyeva, S., Otpnova, S., Polutova, Z., Kholod/Kumarahmedova, S. (2020)	E3S Web of Conferences	0
Resilient Cities to Climate Change and Planning Interaction	Demrogüç, D. (2021)	Theories, Techniques, Strategies for Spatial Planners and Designers	0

4. RESULTS AND DISCUSSION

4.1 Descriptive Statistics

1. Publication Trends

The analysis of the 12 selected documents revealed a growing interest in the intersection of green infrastructure, waste management, and quality of life. The time distribution of the studies, published between 2015 and 2024, shows a noticeable increase in publications after 2020, reflecting the global emphasis on sustainability driven by

challenges such as rapid urbanization and climate change. Recent studies focus on solutions for urban sustainability, highlighting the need for integrative approaches that combine green infrastructure and waste management to address these pressing issues effectively.

2. Geographical Distribution

The selected studies span various regions, demonstrating a global recognition of the importance of green infrastructure and waste management. Regionally, five studies from Europe emphasized urban greening projects, circular economy models, and policy-driven implementations, while four studies from Asia addressed challenges in rapidly urbanizing cities, such as pollution reduction and community-led waste management. In North America, three studies highlighted technological innovations and large-scale urban planning initiatives. Regarding the urban versus rural context, most studies (9 out of 12) focused on urban settings, reflecting the urgent need for sustainable practices in densely populated areas. Meanwhile, rural-focused studies explored community-based approaches and traditional waste management systems, showcasing diverse strategies across different environments.

3. Research Methodologies

The studies employed diverse methodologies to examine the effects of green infrastructure and waste management on quality of life. Case study analysis, utilized in 50% of the studies, explored specific initiatives such as urban park development and waste-to-energy projects, providing detailed insights into local implementation strategies and outcomes. Empirical research, accounting for 30% of the studies, employed quantitative methods, including surveys and field experiments, to measure the impact of interventions on health, social cohesion, and environmental quality. Meanwhile, theoretical reviews, representing 20% of the studies, focused on conceptual frameworks and policy analyses, synthesizing best practices and strategic recommendations to guide future efforts.

4.2 Thematic Analysis

The thematic analysis synthesizes the findings from the reviewed studies into recurring themes that highlight the impact of green infrastructure and waste management on quality of life. Four primary themes emerged: environmental benefits, health and well-being, social and economic impacts, and challenges and barriers

Theme	Key Findings	Challenges
Environmental Benefits	Reduced pollution, improved biodiversity, urban cooling.	High costs of implementation, limited scalability in dense urban areas.
Health and Well-being	Improved physical and mental health, reduced exposure to hazards.	Unequal access to green spaces and clean environments.
Social and Economic Impacts	Enhanced social cohesion, economic opportunities through green jobs and waste-to-energy systems.	Limited community participation and inconsistent policy support.
Challenges and Barriers	Funding, policy integration, and technological gaps.	Low public awareness and cultural resistance to sustainable practices.

1. Environmental Benefits of Green Infrastructure and Waste Management

Green infrastructure and waste management both contribute significantly to environmental sustainability and quality of life. Green infrastructure reduces pollution levels through urban green spaces such as parks and green roofs, with urban forests absorbing substantial amounts of carbon dioxide and improving air quality (Anders et al., 2021). Additionally, green roofs and urban

parks mitigate urban heat islands by lowering ambient temperatures, enhancing thermal comfort, and reducing energy consumption for cooling. Waste management complements these efforts through initiatives like recycling and composting, which transform waste into usable resources such as fertilizers and energy; cities adopting circular economy principles report reduced landfill dependency and greenhouse gas emissions (Rodriguez et al., 2020). Moreover, proper waste disposal protects soil and water bodies from contamination, preserving ecosystems and biodiversity. The synergy between green infrastructure and waste management is evident in practices such as using compost from organic waste in urban agriculture, which improves soil health and supports local food systems.

2. Health and Well-being

Green infrastructure and waste management significantly contribute to both physical and mental health benefits. Access to green spaces promotes physical activity, reducing the prevalence of lifestyle diseases such as obesity and cardiovascular issues (Ma et al., 2020). Similarly, effective waste management systems minimize exposure to hazardous materials, thereby lowering incidences of respiratory diseases and waterborne illnesses (Chen et al., 2019). On the mental health front, urban greenery has been shown to alleviate stress, anxiety, and depression by providing restorative environments for relaxation and recreation. Additionally, clean and aesthetically pleasing environments created through proper waste management enhance psychological well-being, fostering a sense of comfort and satisfaction among residents.

3. Social and Economic Impacts

Green infrastructure and waste management contribute significantly to social cohesion and economic opportunities. Community gardens and urban parks foster interaction among residents, strengthening social networks and enhancing a sense of belonging (Patterson & Lin, 2021). Similarly, community-led waste management programs empower local stakeholders and promote civic engagement, building stronger community ties. Economically, waste-to-energy projects and recycling initiatives generate employment in waste processing and green technology sectors. Additionally, well-maintained green spaces and clean environments increase property values, driving local economic growth and improving overall community prosperity.

Challenges and Barriers

The implementation of green infrastructure and waste management faces several challenges, including financial, policy, community, and technological barriers. Limited funding consistently hinders the development and upgrading of these systems, while policy gaps highlight the need for integrated approaches that address both areas simultaneously to maximize their combined benefits. Low public participation in waste segregation and green space maintenance, often driven by insufficient awareness and incentives, further complicates progress, alongside cultural and social resistance to sustainable practices in certain regions. Technological limitations, particularly in developing countries, exacerbate these issues, with challenges in adopting advanced waste management technologies and maintaining green infrastructure underscoring the necessity of capacity building and international collaboration to ensure effective implementation.

Discussion

The findings confirm that green infrastructure and waste management play complementary roles in enhancing quality of life. Green infrastructure contributes primarily to improving environmental quality and social well-being, while waste management effectively addresses pollution and health risks. When integrated, these systems amplify their individual benefits, as evidenced by successful initiatives such as waste-to-energy systems combined with

urban greening projects, which deliver environmental, health, and social advantages.

To maximize these benefits, policymakers must adopt a holistic approach, integrating green infrastructure and waste management into urban planning frameworks. Public-private partnerships should be incentivized to mobilize resources effectively. Community engagement is equally crucial, with public awareness campaigns and active involvement in planning and maintaining green spaces and waste systems playing pivotal roles. Technological innovation, including smart waste management systems and advanced green design techniques, can further optimize resource use and enhance efficiency. Addressing challenges such as financial constraints, capacity gaps, and policy fragmentation requires targeted solutions like green bonds, capacity-building programs for urban planners, and cross-sector collaboration involving government agencies, NGOs, and private sectors to overcome implementation barriers and drive sustainable outcomes.

Future Research Directions

The review identified several gaps that warrant further investigation, including the potential of integrating emerging technologies such as AI and IoT to optimize green infrastructure and waste management systems. Additionally, longitudinal studies are needed to explore the long-term effects of these initiatives on quality of life, providing insights into their sustained impact over time. Comparative analyses across diverse socio-economic and cultural contexts are also essential to develop region-specific strategies that address unique challenges and leverage localized opportunities for sustainable urban development.

5. CONCLUSION

Green infrastructure and waste management are essential for enhancing the quality of life in urban environments, providing significant environmental, health, and social benefits. Green infrastructure helps mitigate pollution and urban heat while fostering community interactions, whereas waste management reduces environmental hazards, promotes resource recovery, and improves public health. When integrated, these approaches generate synergistic benefits, such as using compost in urban agriculture and implementing waste-to-energy systems for enhanced resource efficiency. However, challenges such as financial constraints, technological limitations, policy fragmentation, and insufficient public awareness persist. Overcoming these barriers requires a holistic approach that combines innovative technologies, public-private partnerships, and active community engagement. Policymakers and urban planners must prioritize integrated strategies to unlock the full potential of green infrastructure and waste management systems. Future research should focus on leveraging emerging technologies, developing region-specific solutions, and assessing the long-term impacts of these initiatives to foster sustainable urban development.

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