

Waste at the crossroads: Progress and challenges in Ho Chi Minh City's transition toward sustainable municipal waste management

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Abstract

Ho Chi Minh City, Vietnam's largest metropolitan area, faces increasing pressure from rapid growth in municipal solid waste generation alongside ongoing urban expansion. Although the city has achieved high collection coverage and introduced major policy reforms, including mandatory source separation and investments in waste-to-energy technologies, landfill disposal remains the dominant treatment pathway. This paper examines why visible progress in collection services and regulatory reform has not yet resulted in a fully integrated and sustainable waste management system. Using the Integrated Sustainable Waste Management (ISWM) framework, the study analyzes Ho Chi Minh City as an interconnected system structured around three dimensions: the physical waste system (What), the actors involved (Who), and the enabling environment (How). Based on secondary data and policy analysis, the findings show that improvements have largely taken place within individual system components rather than through coordinated transformation. Limited source separation constrains downstream treatment efficiency, coordination among state, private, and informal actors remain uneven, and technological upgrading has proceeded without full alignment with upstream material flows and financial conditions. The case demonstrates that the key challenge lies not only in infrastructure expansion or regulatory ambition, but in strengthening integration across system dimensions. A system-based approach is therefore essential for advancing sustainable municipal solid waste transitions in rapidly urbanizing cities.

Keywords: municipal solid waste management, integrated sustainable waste management, waste management transition, urban governance, Ho Chi Minh City

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1. Introduction

Ho Chi Minh City is Vietnam's largest municipal solid waste generator and represents the most critical stress point in the country's urban waste management system. Empirical data shows that daily municipal solid waste generation increased from approximately 6,200 tons in 2010 to between 9,200 and 9,800 tons by 2019-2020, with annual growth rates ranging from 6% to 8% depending on the period (P. G. Le, Le, Dinh, & Trinh, 2023; Nguyen, 2025). This rapid increase reflects the city's accelerated urbanization, population growth, and rising consumption levels, positioning Ho Chi Minh City as the epicenter of Vietnam's waste management challenge.

At the same time, Ho Chi Minh City has achieved relatively high waste collection coverage compared to other municipalities in Vietnam. By 2022, the overall collection rate reached approximately 90%, with full coverage in inner urban districts and lower but still substantial rates in suburban and rural areas (P. G. Le, Le, Dinh, & Trinh, 2023). Collection and transportation services are delivered through a combination of state-owned enterprises, public service companies, and community-based collection groups, resulting in a dense but unevenly regulated collection network (Schneider et al., 2017).

The composition of municipal solid waste in Ho Chi Minh City further highlights the unrealized potential of the existing system. Organic waste accounts for 61-65% of total municipal solid waste by weight, while recyclable materials such as plastics, paper, glass, and metals comprise roughly (Verma et al., 2016). In theory, this waste profile is well suited for composting, anaerobic digestion, and material recovery. In practice, however, insufficient separation at source results in contamination of waste streams, low-quality compost outputs, and limited efficiency of recycling and energy recovery processes (Fogarassy et al., 2022; Huynh et al., 2023; P. G. Le, Le, Dinh, & Trinh, 2023).

Recent policy developments have positioned Ho Chi Minh City at the center of Vietnam's municipal waste transition. The Environmental Protection Law 2020 introduced mandatory waste separation at source and established extended producer responsibility as a core policy instrument for improving recycling and waste reduction (National Assembly of the Socialist Republic of Vietnam, 2020). In parallel, the city has promoted alternative treatment technologies, including incineration and waste-to-energy (WtE), with the aim of reducing landfill dependence and modernizing the waste sector. Despite this reform momentum, landfill disposal remains the dominant pathway (D.Ngan, 2025).

While Ho Chi Minh City's waste challenges have been examined in a growing body of academic and policy-oriented studies, existing analyses remain fragmented. Most research concentrates on specific components without situating them within the broader system. Although valuable, these studies assess reforms in isolation. Consequently, there is limited understanding of how improvements in individual components translate - or fail to translate - into overall system-level transition outcomes at the megacity scale. To address this gap, the study adopts the Integrated Sustainable Waste Management (ISWM) framework to examine Ho Chi Minh City. Developed by UN-Habitat and WASTE, ISWM conceptualizes waste management as an integrated system structured around three interrelated dimensions: the physical waste system (What), the actors and institutions involved (Who), and the enabling environment encompassing policy, finance, technology, and socio-cultural factors (United Nations Human Settlements Programme [UN-HABITAT], 2010). Focusing on the interactions among these dimensions, the paper analyzes how physical processes, institutional configurations, and enabling conditions jointly shape municipal solid waste management outcomes in one of Vietnam's largest cities.

2. Analytical Framework and Methodology

This study adopts ISWM framework to analyze municipal solid waste management as an integrated system rather than as a set of separate technical or policy actions. ISWM emphasizes that waste management outcomes depend on the interaction between physical waste processes, institutional arrangements, and broader enabling conditions. The framework is structured around three interconnected dimensions: the physical waste system (What), the actors and institutions involved (Who), and the enabling environment that shapes system performance (How). By linking these dimensions within a single analytical structure, ISWM provides a systematic way to examine how different parts of the waste system influence one another.

Previous studies show that ISWM has been widely used as an analytical framework to understand municipal waste systems beyond technical performance alone. Wilson et al. (2013) apply ISWM to demonstrate that effective waste management depends not only on collection and treatment infrastructure, but also on governance factors such as institutional coordination, financial sustainability, and stakeholder inclusion. Their work clearly distinguishes ISWM from narrower approaches to integrated waste management that focus mainly on technology, and positions ISWM as a framework for analyzing how physical and governance dimensions interact within a single system. Subsequent research has further developed ISWM by translating its core dimensions into practical analytical tools. Building on the ISWM logic, later studies introduce structured indicator-based approaches, such as the Wasteaware indicators, to assess both physical system performance and governance conditions across cities (Wilson et al., 2015). Applications of these indicators in different national contexts, including rapidly urbanizing cities in China (Whiteman et al., 2019), show how the ISWM framework can be adapted for comparative analysis while remaining sensitive to local institutional and socio-economic conditions. These studies illustrate that ISWM is flexible and can be applied at different scales without losing its system-based perspective. Other system-oriented studies reinforce the analytical assumptions underlying ISWM by highlighting the importance of integration and coordination. Research grounded in systems thinking shows that persistent problems in waste management often result from fragmented responsibilities, weak coordination among actors, and poor alignment between policies and implementation, rather than from a lack of technology alone (Marshall & Farahbakhsh, 2013). Although such studies do not always explicitly label their approach as ISWM, they support its core argument that waste management outcomes are shaped by the interaction between physical processes, institutional arrangements, and enabling conditions rather than by technological solutions alone.

In this study, ISWM is used as an analytical framework to structure and interpret secondary data and policy documents. Evidence is organized along the three dimensions What, Who, and How to examine physical system characteristics, stakeholder configurations, and enabling conditions. The analysis focuses on how interactions across these dimensions shape overall system outcomes, helping to explain why progress in specific areas has not yet translated into an integrated and sustainable municipal solid waste management system in Ho Chi Minh City.

3. The Physical Waste System (What)

Studies show that municipal solid waste generation in Ho Chi Minh City has increased significantly over the past decade and remains at a high level. Daily waste generation rose from approximately 6,241 tons in 2010 to around 9,200-9,800 tons in 2019-2020, equivalent to more than 3.3 million tons per year (P. G. Le, Le, Dinh, & Nguyen, 2023; Tran, 2020). At the household level, average per-capita waste generation is about 0.83 kg per person per day, with clear spatial variation across the city. Central districts tend to generate higher amounts, typically between 0.85 and 0.95 kg per capita per day, while suburban and peri-urban areas report lower levels, ranging from 0.78 to 0.83 kg (P. G. Le, Le, Dinh, & Trinh, 2023).

In terms of composition, municipal solid waste in Ho Chi Minh City is dominated by biodegradable organic waste. Multiple waste characterization studies consistently report that organic materials account for 61-65% of

total waste by weight, while recyclable materials, including plastics, paper and cardboard, glass, and metals, represent about 30-32% (P. G. Le, Le, Dinh, & Nguyen, 2023). The remaining fraction consists of residual waste that is difficult to recycle, such as textiles, composite materials, and sanitary waste. Household hazardous waste constitutes only a very small share of the total stream but is often mixed with general municipal solid waste due to limited separation practices (Vo, 2020). This composition theoretically provides favorable conditions for composting, recycling, and biological treatment. However, empirical evidence from Ho Chi Minh City shows that limited separation at source leads to contamination of organic and recyclable fractions, reducing treatment efficiency and the quality of recovered (Tran, 2020). In addition, the high moisture content of the organic fraction poses technical constraints for thermal treatment options such as incineration and reinforces the importance of upstream separation for effective downstream processing.

Source separation at source in Ho Chi Minh City remains at an early and transitional stage, characterized by partial implementation and uneven operational outcomes. Following the Environmental Protection Law 2020, the city introduced regulations requiring household waste separation, with initial guidance focusing on two waste streams - recyclable waste and residual waste - before moving toward the nationally mandated three-category system (Ho Chi Minh City People's Committee, 2025; National Assembly of the Socialist Republic of Vietnam, 2020). In practice, implementation has largely taken the form of pilot programs and phased rollouts at the district and ward levels, with local authorities responsible for organization and supervision, while the Department of Agriculture and Environment provides technical guidance and monitoring. Reports indicate that most efforts to date have concentrated on awareness-raising and community communication, such as public announcements, neighborhood meetings, and household guidance, rather than strict enforcement (Environment & Life Online Magazine (Environment & Life Online Magazine, n.d.). As of 2025, administrative sanctions for non-compliance have rarely been applied, and participation levels vary significantly across districts. Operationally, source separation outcomes remain inconsistent, as collection and transport systems are not yet fully adapted to handle separated waste streams, resulting in frequent recombination during collection (Tran, 2020).

Collection and transportation form the backbone of Ho Chi Minh City's physical municipal solid waste system. Waste collection coverage is relatively high in urban areas, reaching about 95%, while lower rates of 70-80% are reported in peri-urban and rural districts. Uncollected waste in these areas is often managed informally through open dumping, small-scale burning, or burial by households. The collection system operates through a dual structure. Formal public services, led by the Ho Chi Minh City Urban Environment Company (CITENCO) and district public service companies, handle street sweeping, public spaces, and roughly one-third of household waste along main roads. Informal and semi-formal collectors play a key role at the neighborhood level, collecting an estimated 60-70% of household waste, particularly in narrow alleys inaccessible to large vehicles (Schneider et al., 2017). Collected waste is then transported via transfer stations to centralized treatment and disposal facilities located outside the urban core. Despite its extensive coverage, the collection and transport system face several structural limitations. A large share of primary collection relies on small, manually operated vehicles, which are labor-intensive and prone to leakage, odor, and hygiene problems, particularly at transfer points (Verma et al., 2016).

At present, municipal solid waste in Ho Chi Minh City is treated mainly through a combination of landfill disposal, composting and emerging thermal treatment technologies. The largest share of waste continues to be transported to centralized treatment complexes located outside the urban core. Da Phuoc Integrated Wasted Treatment Facility, operated by Vietnam Waste Solutions Co., Ltd., currently receives approximately 5,000 tons of municipal solid waste per day, making it the city's primary disposal site. In addition, around 2,000 tons per day are delivered to the Northwest Solid Waste Treatment Complex, where VietStar Joint Stock Company is a major operator. The remaining waste stream is treated by facilities operated by Tam Sinh Nghia Company and the Ho Chi Minh City Urban Environment One Member Limited Company. Across these facilities, landfill disposal remains the dominant treatment method, accounting for the majority of municipal solid waste processed in the city. However, Ho Chi Minh City has begun to diversify its treatment portfolio through the gradual

introduction of incineration and WtE technologies. Several large-scale WtE projects, including those developed by VietStar and Tam Sinh Nghia, have been approved or are under construction, each designed to treat approximately 2,000 tons of waste per day (Thanh Hai, 2025). These facilities aim to reduce landfill volumes by thermally treating residual waste while recovering energy in the form of electricity. Composting and material recycling facilities are also present within the treatment system, although their overall throughput remains smaller than landfill capacity.

4. Actor Structure and Institutional Arrangements (Who)

Municipal solid waste management in Ho Chi Minh City involves multiple administrative levels and sectoral departments. At the administrative level, waste management functions at the city level extend beyond a single lead agency. At the city level, the Department of Agriculture and Environment (formerly the Department of Natural Resources and Environment) is formally assigned responsibility for waste management. In addition, several other departments which included planning, finance, science and technology, construction, and transport, exercise parallel authority over investment approval, pricing mechanisms, technology selection, and infrastructure planning. Spatial planning for waste facilities involves both environmental regulatory agencies and urban planning bodies under the construction sector (Le et al., 2009). Studies on waste governance in Ho Chi Minh City suggest that, despite increasingly detailed legal frameworks, the absence of clearly defined lead authority and effective inter-agency coordination mechanisms undermines accountability and enforcement in practice (Schneider et al., 2017).

Private sector actors have assumed an increasingly important role in municipal solid waste management in Ho Chi Minh City. A significant share of the city's municipal solid waste is currently transported to large-scale treatment facilities operated by private companies, most notably the Da Phuoc Integrated Waste Treatment Facility. By early 2024, this facility had received more than twenty-eight million tons of waste, exceeding its original design capacity (Bui Nhi, 2025). Other private firms, including Vietstar and Tam Sinh Nghia, are involved in composting, recycling, and the development of incineration and WtE facilities (Thanh Hai, 2025), while private companies and community-based collection groups are estimated to collect approximately 60- 70% of municipal solid waste in Ho Chi Minh City and surrounding areas (Schneider et al., 2017). Public-private partnership (PPP) arrangements have therefore been promoted by city authorities as a mechanism to mobilize private finance and technical expertise for waste treatment infrastructure, particularly for advanced technologies such as WtE, in order to reduce pressure on public budgets (National Assembly of the Socialist Republic of Vietnam, 2023). At the same time, available evidence indicates that private sector involvement has primarily taken the form of facility-specific investments and service contracts(Thanh Hai, 2025).

Informal actors, including waste pickers and junk buyers, play a central role in material recovery within Ho Chi Minh City's municipal solid waste system, particularly at the source and pre-collection stages. These actors typically recover high-value materials such as aluminum cans, PET bottles, paper, and electronic waste directly from households, small businesses, and public waste bins before formal municipal collection occurs, enabling early diversion of recyclables from the residual waste stream (Tong et al., 2021). Empirical studies estimate that informal recycling activities contribute to the recovery of approximately 15-20% of municipal solid waste, with monthly recycling flows exceeding 3,000 tons of paper and nearly 4,000 tons of plastic through networks of scrap dealers and small recycling facilities (Verma et al., 2016). These activities are supported by a dense informal infrastructure consisting of several hundred small-scale recycling workshops and scrap trading points embedded within residential areas, forming an extensive material recovery network that operates alongside the formal system. In parallel, informal and semi-formal collection groups are estimated to collect 60- 70% of municipal solid waste in Ho Chi Minh City, largely because formal collection vehicles operated by CITENCO face physical constraints in accessing narrow alleys and high-density neighborhoods (Schneider et al., 2017). By recovering materials based on market value, informal actors reduce the volume of waste requiring transport, treatment, and landfill disposal, thereby lowering system-wide management costs and supplying secondary materials to downstream industrial recycling chains (Salhofer et al., 2021). However, while these actors are

deeply embedded in the physical functioning of waste and recycling flows, they remain largely outside formal policy frameworks, planning processes, and contractual arrangements.

In a word, the stakeholder landscape of municipal solid waste management in Ho Chi Minh City reflects a system in which responsibilities and contributions are distributed across state, private, and informal actors, each performing distinct yet only partially connected roles. State agencies provide the legal and administrative framework for waste management and retain authority over policy approval and regulation but operate within a fragmented institutional structure spanning multiple departments and administrative levels. Private sector actors contribute primarily through investment in collection services and large-scale treatment facilities, helping to address immediate infrastructure and capacity needs, particularly in downstream processing. Informal actors, by contrast, are deeply embedded in upstream collection and recycling activities, recovering significant volumes of recyclable materials through market-based practices that function largely outside formal governance arrangements.

5. The Enabling Environment: Policy, Finance, and Social Conditions (How)

The national policy framework for municipal solid waste management in Vietnam is implemented in Ho Chi Minh City through local regulatory instruments, most notably Decision No. 73/2025/QĐ-UBND. This decision specifies responsibilities for waste separation, collection, transport, and treatment across urban and residential areas, and assigns implementation roles to city departments, district authorities, service providers, and waste generators (Ho Chi Minh City People's Committee, 2025). The city's institutional context has also been subject to national-level oversight. During the National Assembly's explanatory hearing on the implementation of municipal solid waste management policies in October 2025, Ho Chi Minh City was among the surveyed localities. The review acknowledged improvements in legal clarity, service coverage, and infrastructure investment following the adoption of the 2020 Environmental Protection Law, while also identifying ongoing challenges related to economic–technical norms, service pricing mechanisms, and coordination across administrative levels (An Binh, 2025). Taken together, these developments indicate that Ho Chi Minh City operates within a relatively comprehensive legal and regulatory environment, with continued adjustments and oversight shaping how national policies are translated into local practice.

At the same time, Ho Chi Minh City is pursuing a technology-oriented transition in municipal solid waste treatment. The city has set an official target that by 2030, approximately 90% of household waste will be treated using advanced technologies rather than landfilling. WtE incineration has been prioritized as a key technological pathway. Several large-scale facilities, including the VietStar integrated waste treatment plant and the Tam Sinh Nghia WtE project, have been approved or are under construction, each designed to process approximately 2,000 tons of waste per day (Thanh Hien, 2025). These projects are supported through PPP arrangements and special policy mechanisms under Resolution No. 98/2023/QH15, which aims to attract private investment and accelerate technology conversion in waste treatment (National Assembly of the Socialist Republic of Vietnam, 2023). Nevertheless, financial and regulatory conditions continue to influence the pace of technological deployment. In particular, the absence of clearly defined economic - technical norms and standardized pricing frameworks for waste treatment services has complicated cost appraisal and contract approval, especially for capital-intensive WtE projects (An Binh, 2025).

Social and cultural factors further shape how municipal solid waste is managed in Ho Chi Minh City, particularly at the household and community levels. Empirical studies consistently show that public awareness of environmental issues has increased over time. However, this awareness has not yet translated into stable and widespread waste separation practices at source (Vo, 2020). While many households are familiar with the concept of waste sorting, daily practices remain strongly influenced by convenience, time constraints, and limited living space in dense urban housing, especially in alley-based neighborhoods. As a result, waste is often mixed before collection, even in areas where pilot source-separation programs have been implemented. Another defining social feature of the city's waste system is its long-standing reliance on informal and semi-formal

collection arrangements. Residents are accustomed to flexible, door-to-door services provided by informal collectors, which reinforces expectations of frequent collection rather than behavioral change at the household level. While this arrangement helps reduce visible waste accumulation, it also weakens incentives for households to actively engage in waste separation and reduction (Tran, 2020). Overall, the social and cultural context in Ho Chi Minh City supports high participation in waste disposal, but not yet consistent participation in waste separation, helping to explain why technological and policy interventions often face difficulties when implemented without parallel community-level engagement.

6. Discussion: Ho Chi Minh City at the Crossroads

The ISWM analysis shows that improvements in Ho Chi Minh City's waste management have taken place in separate parts of the system, but the links between these parts remain limited. The first issue concerns the interaction between the physical waste system (What) and the enabling conditions (How). The waste composition of the city provides substantial potential for composting, recycling, and energy recovery. Regulatory instruments formally require source separation and promote advanced treatment technologies. However, separation at source remains inconsistent, and waste frequently enters treatment facilities as mixed streams. This weak linkage between upstream waste handling and downstream processing reduces the efficiency of material recovery and thermal treatment. This suggests that system performance depends not only on improving individual components, but also on strengthening coordination between material flows and the conditions that regulate them.

A second issue relates to how different actors work together in the waste management system. Responsibilities for waste management are distributed across multiple departments, public enterprises, private firms, and informal actors, each operating at different stages of the waste chain. Although this structure allows a wide range of actors to participate in collection, treatment, and recycling activities, coordination across planning, pricing, infrastructure development, and daily service delivery remains uneven. Regulatory objectives established at the national and city levels require consistent implementation across these stages, yet alignment between policy design and operational practice is not always stable. As a result, the system includes many active participants, but the connections between their roles are not fully structured to support coherent management across the entire waste chain.

A third issue concerns the introduction of advanced treatment technologies and their connection to the broader system. Ho Chi Minh City has prioritized WtE and other modern treatment options as part of its effort to reduce landfill dependence. These projects represent significant investment in infrastructure and reflect a clear policy direction. However, technological expansion alone does not automatically change how the system functions. When waste continues to enter facilities as mixed streams and pricing mechanisms remain under adjustment, advanced technologies operate within existing constraints. In this situation, new treatment capacity increases processing volume, but it does not necessarily lead to a fundamental shift in how materials are managed across the waste chain. Effective technological upgrading therefore depends on stronger alignment between infrastructure, financial arrangements, and upstream waste practices.

A fourth issue concerns the relationship between formal and informal actors within the waste system. Informal collectors and recyclers play a significant role in recovering recyclable materials and supporting daily waste flows. Their activities contribute significantly to material recovery, especially at the household and neighborhood levels. However, these activities largely operate outside formal planning, regulation, and contractual arrangements. As a result, recycling and recovery processes are influenced more by market incentives than by coordinated policy design. While this dual structure allows the system to function and maintain service continuity, it also means that formal and informal activities are not fully integrated within a common management framework.

Taken together, these issues indicate that Ho Chi Minh City is at a structural turning point in its municipal

solid waste transition. Progress in Ho Chi Minh City's waste management has occurred in multiple areas, including collection coverage, policy reform, and technological investment. However, these improvements have developed largely in parallel rather than through coordinated system integration. Physical processes, institutional arrangements, technological infrastructure, and social practices are present, but their interaction remains only partially aligned. This helps explain why the city has achieved visible improvements in service provision while broader structural transformation toward an integrated and sustainable system remains gradual. In this sense, Ho Chi Minh City stands at a crossroads where future outcomes depend less on additional infrastructure and more on the coherence of system-wide governance and coordination.

7. Conclusion

This study set out to explain why significant progress in waste collection coverage and policy reform in Ho Chi Minh City has not yet resulted in a fully integrated and sustainable municipal solid waste management system. Applying the ISWM framework, the analysis shows that although the city has achieved high collection rates, strengthened its legal foundation under the Environmental Protection Law 2020, and promoted WtE investments to reduce landfill dependence, integration across the What, Who, and How dimensions remain incomplete. Waste flows are still insufficiently differentiated, coordination among state, private, and informal actors is uneven, and participation in source separation remains inconsistent. As a result, improvements within individual components have not yet produced system-wide transformation. The study therefore highlights alignment- between material flows, institutional arrangements, and enabling conditions- as the central challenge, shifting attention from purely technological solutions toward governance and coordination.

From a policy perspective, future reforms should prioritize stronger integration across system dimensions rather than relying primarily on infrastructure expansion. This task becomes more complex in the context of recent administrative boundary expansions, which incorporate areas with different service levels and institutional capacities into the city's governance structure. Ensuring coherent coordination across these territories will be essential for long-term sustainability. Finally, this study is limited by its reliance on secondary data and policy documents; future research should incorporate empirical fieldwork, longitudinal analysis, and comparative studies across Southeast Asian cities to further examine how urban growth and governance restructuring shape municipal solid waste transitions over time.

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