

THE DISCREPANCIES BETWEEN HOUSEHOLD SOLID WASTE POLICIES AND HOUSEHOLD PRACTICES IN HANOI CITY, VIETNAM: CHALLENGES TO ACHIEVING SUSTAINABILITY DEVELOPMENT GOAL 11.6, 12.3 AND 12.5

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Thi Kim Nhung, NGUYEN

Faculty of Sociology and Social Work, University of Social Sciences and Humanities, Vietnam National University, Hanoi, e-mail: kimnhung86@gmail.com / nhungntk@vnu.edu.vn, <https://orcid.org/0000-0003-3200-5511>

Abstract

Objectives. Household solid waste management aligns with the Sustainable Development Goals, sharing similar approaches and implementation. In developing countries, managing household waste presents challenges related to both policy and practical considerations. This paper aims to identify gaps between household waste policies and actual behaviors, as well as the challenges in achieving the Sustainable Development Goals in Hanoi, Vietnam.

Material and Methods. This paper uses a case-study approach to examine household solid waste policies and practices in Hanoi, Vietnam. It analyzes 16 policies and 24 articles on waste management, focusing on household roles in waste separation, storage, collection, and recycling, from Google Scholar and ScienceDirect databases.

Results. The findings show that a policy-practice gap exists in household solid waste management, including gaps in technical guidance, knowledge, behavior, enforcement, and infrastructure. The limitation of policy design and residents' behaviors hinder Hanoi's progress in monitoring the Sustainable Development Goals related to Goal 11.6 (urban waste reduction), 12.3 (food waste reduction), and 12.5 (recycling and reuse).

Conclusion. This paper highlights gaps between legal regulations and household waste practices, including technical guidance, knowledge, behavior, enforcement, and infrastructure. These gaps may hinder the monitoring of the Sustainable Development Goals. The author proposes solutions to narrow those gaps and promote the achievement of the Sustainable Development Goals, such as developing comprehensive technical guidelines for waste storage, collection, and recycling, along with strict sanctions, enforcement, and monitoring. Policies should recognize the informal sector to improve recycling rates in low-participation areas. Regular reviews of legal frameworks are needed to prevent overlap and confusion. Local governments must enhance communication, raise awareness, and introduce economic incentives, such as pay-as-you-throw schemes, to boost household participation. This integrated approach is vital for improving waste management and advancing sustainability.

Keywords: household solid waste policy, household solid waste practice, sustainable development goals, Hanoi, Vietnam

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Introduction

Urbanization and industrialization in developing countries have improved living standards in urban areas. This transformation has resulted in increased employment opportunities with higher wages, as well as enhanced access to quality social services. Conversely, Aleluia and Ferrao (2016); Irene Voukkali et al. (2024) highlighted the negative impacts of urbanization on urban development, particularly rising municipal solid waste and pressure on social systems. Literature indicates a correlation between urbanization and effective municipal waste management (Chen, 2018; Sandhi & Rosenlund, 2024). Municipal solid waste management is a multifaceted process that involves several stages, including separation, collection, transportation, treatment, and disposal. This process is shaped by various factors, including socio-economic conditions, cultural aspects, environmental considerations, technological advancements, financial resources, institutional frameworks, and policies, all aimed at mitigating negative environmental impacts (Ye et al., 2023).

There are strong parallels between municipal solid waste management and sustainable development, as both require an integrated, multidimensional approach. The Sustainable Development Goals (SDGs) set specific targets and indicators, adopted in 2015 through the United Nations' 2030 Agenda for Sustainable Development, which comprises 17 goals. These aims safeguard human well-being and the environment, protect rights and health, and promote a prosperous, global community (Manzoor et al., 2024; United Nations, 2023). The SDGs encompass several targets and indicators closely linked to municipal solid waste management, including SDG 1, 8, 11, and 12 (Roy et al., 2023). The objectives of sustainable development include municipal solid waste management, particularly domestic solid waste management, with a focus on achieving Goals 11.6, 12.3, and 12.5. Additionally, the indicators associated with each goal are intricately interconnected. For instance, Indicator 11.6 shows a significant correlation with Indicators 12.3 (food waste) and 12.5 (waste reuse, recycling, and reduction).

Developing countries face greater challenges in municipal waste management than developed nations. Although they implement various strategies and policies, obstacles such as limited funding, low public awareness, challenges with civic engagement, inadequate infrastructure, and technological limitations hinder effective implementation (Zhang et al., 2024). As a lower-middle-income country in the developing world, Vietnam confronts substantial environmental challenges arising from urbanization and industrial growth, resulting in increased volumes and complexity of waste. Furthermore, several obstacles—such as limited waste collection coverage in rural areas, inadequate waste sourcing practices, insufficient recycling, and deficient waste treatment and disposal methods—exacerbate this issue. In terms of waste generators, municipal solid waste encompasses waste generated by households, commercial establishments, small enterprises, office complexes, and institutions (Ministry of Natural Resource and Environment, 2019). Vietnam lacks a clear definition of municipal solid waste or of its management. Nevertheless, the definitions of municipal solid waste and domestic solid waste exhibit substantial similarities. As stipulated by the 2020 Law on Environmental Protection, domestic solid waste management refers to the solid waste generated through the daily activities of waste generators, such as households, individuals, and various service providers and organizations (Vietnam National Assembly, 2020). This paper examines a specific waste generator in Hanoi, acknowledged for its substantial production of domestic solid waste, specifically households. The paper highlights the initial stages of the management process: waste separation at the source, waste storage and collection, and waste recycling, as these stages most explicitly depict the roles of households in managing their domestic solid waste.

Hanoi, the capital of Vietnam, covers an area of 3,359.84 km² and has a population of 8,435,650 residents, comprising 4,138,510 urban inhabitants and 4,297,140 suburban inhabitants. The

city consists of 30 districts, comprising 12 urban districts, one town, and 17 suburban districts (General Statistics Office, 2021). According to data from the Hanoi Urban Environment Company, household waste generation has increased from 5,000 tons per day in 2010 to between 6,500 and 7,000 tons per day in 2023. Furthermore, it is projected to rise to 11,305 tons per day by 2030 and 15,805 tons per day by 2050 (Ministry of Natural Resource and Environment, 2019; Prime Minister, 2014). Hanoi's economic development has driven rapid urbanization and elevated consumption, leading to increased waste production. Moreover, the inadequacy of waste treatment and disposal systems has placed significant strain on municipal waste management capacity, both currently and under projected future conditions (Schneider et al., 2016).

Hanoi's economic and urban lifestyle changes have challenged waste management since the early 2000s. Pilot programs for waste reduction, recycling, and segregation highlight rising waste and limited landfill space, drawing attention from developers and authorities. Discussions focus on waste types, management, influencing factors, and strategies for improvement. Firstly, previous studies have highlighted significant findings regarding solid waste generation, including the total amount of household solid waste produced, and the components and generators of waste (Anh Kiet, 2023; Kawai et al., 2016; Ngo et al., 2021; Nguyen & Aramaki, 2022). Moreover, others have focused on the phases of solid waste management, including waste separation at the source (Le, 2015; Nguyen et al., 2023; Nguyen & Aramaki, 2022; T. K. N. Nguyen, 2021; Nguyen, 2023; Nguyen et al., 2015), waste collection (Hoang et al., 2023), waste disposal, and treatment (Le et al., 2018; Nguyen & Fogarassy, 2020; Nguyen & Nguyen, 2019; Nguyen & Nguyen, 2020; T. Nguyen et al., 2021). Several scholars have raised concerns about specific types of waste, with a focus on food waste and organic waste (Kawai & Huong, 2017; Liu & Nguyen, 2020); plastic waste (Liu et al., 2021), and recyclable waste (Hoang et al., 2015; Liu & Nguyen, 2020; Nguyen et al., 2017; Yokoo et al., 2018). Additionally, prior studies have concentrated on factors influencing solid waste management, such as climate change and landfill management (Schneider et al., 2016), and legal, financial, technological, environmental, and social acceptance factors (T. Nguyen et al., 2021). Meanwhile, others have discussed stakeholders, particularly formal and informal waste collectors (Mitchell, 2008; Q. T. Nguyen et al., 2021; Pham et al., 2020; Tong et al., 2021), who play a significant role in household solid waste management, especially in waste collection and recycling. Regarding household solid waste policies, several studies indicated a progressive trend, particularly in the latest version of the Law on Environmental Protection in 2020, and the national strategies specifying the role of households in waste separation, disposal, and recycling (Hoang, Nguyen, et al., 2024; Nguyen et al., 2020). However, a lack of clear guidance and mechanisms leads to ineffective implementation and hinders the achievement of the Sustainable Development Goals (Tsai et al., 2020). Furthermore, as one of the main types of waste generated, food waste has not been adequately addressed in these policies (Nguyen et al., 2020).

Previous studies have examined various dimensions of household solid waste management in Hanoi, with a focus on public participation. Other research has examined institutional arrangements and the legal framework governing urban solid waste management. However, there remains a lack of studies that systematically link and compare policy requirements with actual implementation practices, particularly in the context of Hanoi's efforts to advance the achievement of the SDGs. In the context of Hanoi, Vietnam, this paper addresses two research questions:

1. What are the discrepancies between household solid waste policies and household practices in Hanoi City?
2. What are the challenges associated with household solid waste policies and practices in achieving sustainable development goals?

The findings are organized into five sections. The first section introduces the topic and reviews prior studies on household solid waste management in Hanoi. The second section describes the methods used to collect data for this paper. The third section identifies discrepancies between household solid waste policies and household practices. The fourth section discusses the challenges posed by the legal system and household practices in relation to the Sustainable Development Goals, and the final section concludes and addresses the paper's limitations.

Material and Methods

This research utilized a case-study methodology, selecting Hanoi as the focal site to investigate two research questions. This choice was motivated by Hanoi's status as one of the two largest cities in the country, generating the highest waste volume and exhibiting substantial diversity in waste composition (Ministry of Natural Resource and Environment, 2019). Furthermore, as the capital and the country's political-administrative center, Hanoi frequently serves as a pilot site for implementing national policies, including those related to household solid waste management. The research methodologies incorporated document analysis, which included identifying, collecting, reviewing, and analyzing prior studies and policies related to household solid waste management.

A comprehensive literature review was conducted utilizing databases such as Google Scholar and ScienceDirect. The selection criteria for documents were applied as follows:

- Policy documents were included at the national level, encompassing laws, government decrees, decisions, and other policy instruments issued by ministries and ministerial agencies. Additionally, policies issued by the Hanoi municipal government were taken into account. The Law on Environmental Protection was identified as the highest-level legal framework and underpins municipal solid waste management activities. It also provides the legal foundation for subsequent decrees, decisions, and related policies. Documents were retrieved from official digital repositories and the Ministry of Natural Resources and Environment's website (<https://www.monre.gov.vn/>). It should be noted that policy searching was conducted before the merging of the Ministry of Natural Resources and Environment with the Ministry of Agriculture and Rural Development, forming the Ministry of Agriculture and Environment in March 2025. Other relevant reports and legal documents pertaining to solid waste management were accessed through the Vietnamese Government's official portal (<https://vanban.chinhphu.vn/>).
- Content scope: The review focused on municipal solid waste management activities and the specific dimensions that define the roles, responsibilities, and obligations of households and individuals. These include waste separation at the source, waste collection, and recycling practices.
- Articles selected for the research include: (1) those based on empirical evidence derived from quantitative and/or qualitative studies, (2) those specifically addressing household solid waste management concerning waste separation, waste collection, waste recycling, and/or household solid waste policies in Hanoi, Vietnam, and (3) those published in English or Vietnamese with accessible full texts.
- Time scope: Given the prevailing conditions of household solid waste management in Vietnam, recent years have seen heightened interest from policymakers and the government, particularly following the enactment of the 2005 Law on Environmental Protection. Accordingly, the literature review was confined to articles published between 2005 and 2024.

The following keywords were employed to search for relevant documents: “household solid waste management,” “household solid waste practices in Hanoi,” “household solid waste policy in

Vietnam,” and “household solid waste policy in Hanoi.” All retrieved records were screened by titles, abstracts, and full texts to ascertain their compliance with the inclusion criteria. Duplicates were systematically excluded from the selection. Subsequently, publications lacking direct relevance to the specified focus—namely, policies and practices of household solid waste management in Hanoi—were excluded. As a result of the screening and review process, a total of 16 policy documents at the national and Hanoi municipal levels, together with 24 scholarly articles, were selected for in-depth analysis.

Data extraction was conducted utilizing Microsoft Excel to systematically record relevant information, including the author(s), title, publication year, research focus, scope, methodology, and key findings. The selected academic articles were organized into thematic groups: waste separation at the source; factors affecting individual waste-separation behavior; waste storage and collection practices; and waste recycling activities. Additionally, policy documents were classified according to key content areas related to household solid waste management. Within legal provisions and chapter contents, the analysis focused on the following themes: “waste separation,” “waste collection,” “waste recycling,” and the “role of households and individuals in household solid waste management.”

Results on discrepancies between household solid waste management policies and household practices in the context of Hanoi, Vietnam

The search results identified 24 articles, three of which were published in Vietnamese journals. A review of these selected papers revealed several key points, as follows:

Firstly, the majority of the selected articles employed quantitative research methodologies ($n = 14$), followed by a subset that utilized a combination of quantitative and qualitative approaches ($n = 6$), while the remaining studies employed qualitative methodologies ($n = 4$). Secondly, regarding the research topics, most of the reviewed articles focused on household solid waste separation ($n = 7$), followed by those addressing general household solid waste management ($n = 5$). The number of articles examining waste recycling equaled those focusing on waste collection and collectors ($n = 4$). Additionally, two articles investigated willingness to pay for waste collection, transportation, and treatment, while another two ($n = 2$) examined specific categories of solid waste, including food and plastic waste. The majority of articles on household solid waste separation employed the theory of planned behavior to identify factors influencing residents’ waste separation practices. These studies, conducted with diverse methodologies and sample populations, consistently identified certain determinants: notably, low adoption rates of waste separation practices within the city; and factors such as trust, duration of residence, subjective and moral norms, attitudes, and behavioral intentions. Half of the studies on waste recycling highlighted the significant role of the informal sector in the recycling process. The remaining studies concentrated on household recycling practices and the factors that influence them. Regarding solid waste collection, three out of four studies primarily examined the activities of waste collectors across both formal and informal sectors. An important issue identified is the inefficiency of waste collection, attributable to current routing and methodological approaches. Thirdly, out of 16 articles specifying a research scope, 11 focused on urban areas within Hanoi, whereas five explored both rural and urban regions. One study, reported in two articles, was conducted in a rural district of Hanoi. Consequently, there is a compelling need for further research on household solid waste management in rural and peri-urban areas, as most recent studies have focused on urban and inner regions of Hanoi.

The following section will identify discrepancies between the household practices documented in the 24 reviewed articles and the established national and local policies (see Table 1). An examination of the articles and policies reveals that the guidelines and requirements for the three

dimensions—namely, waste separation at the source, waste storage and collection, and waste recycling—are insufficiently specified within the legal documentation. The subsequent sections will analyze policy development and revisions, followed by household practices, and finally the gaps between policy and practice in household solid waste management.

Table 1

The discrepancies between household solid waste policies and households' practices

| Aspects of household solid waste management | Household solid waste policies | Household solid waste practice |
|--|---|--|
| Waste separation at source | Households are required to separate waste at the source; however, there is no clearly established mechanism for enforcing this regulation or imposing penalties for non-compliance. | Separation rate is low |
| | Legal documents require waste to be sorted as recyclable, organic, and inorganic categories. | Households typically separate solid waste into recyclable materials, organic food waste, and other types, based on established routines |
| Waste storage and collection | The absence of technical guidance regarding household waste storage and collection, and a lack of specialized waste collection vehicles. | Households typically store solid waste in plastic bags, predominantly utilizing non-biodegradable materials. Formal waste collectors mixed types of waste when they collect waste from households. |
| Waste recycling | Waste recycling is regarded as a voluntary activity, with the absence of formal penalties for non-compliance. | The proportion of residents engaged in household waste recycling remains low. Recyclable materials were either sorted for sale to informal waste recyclers or provided to them without financial compensation. Food waste is frequently reused or recycled by being fed to livestock or other animals. |
| | There is a lack of formal regulations to support informal waste recyclers, despite their significant role in household solid waste recycling. | The informal sector serves as the main driver of waste recycling in the city |

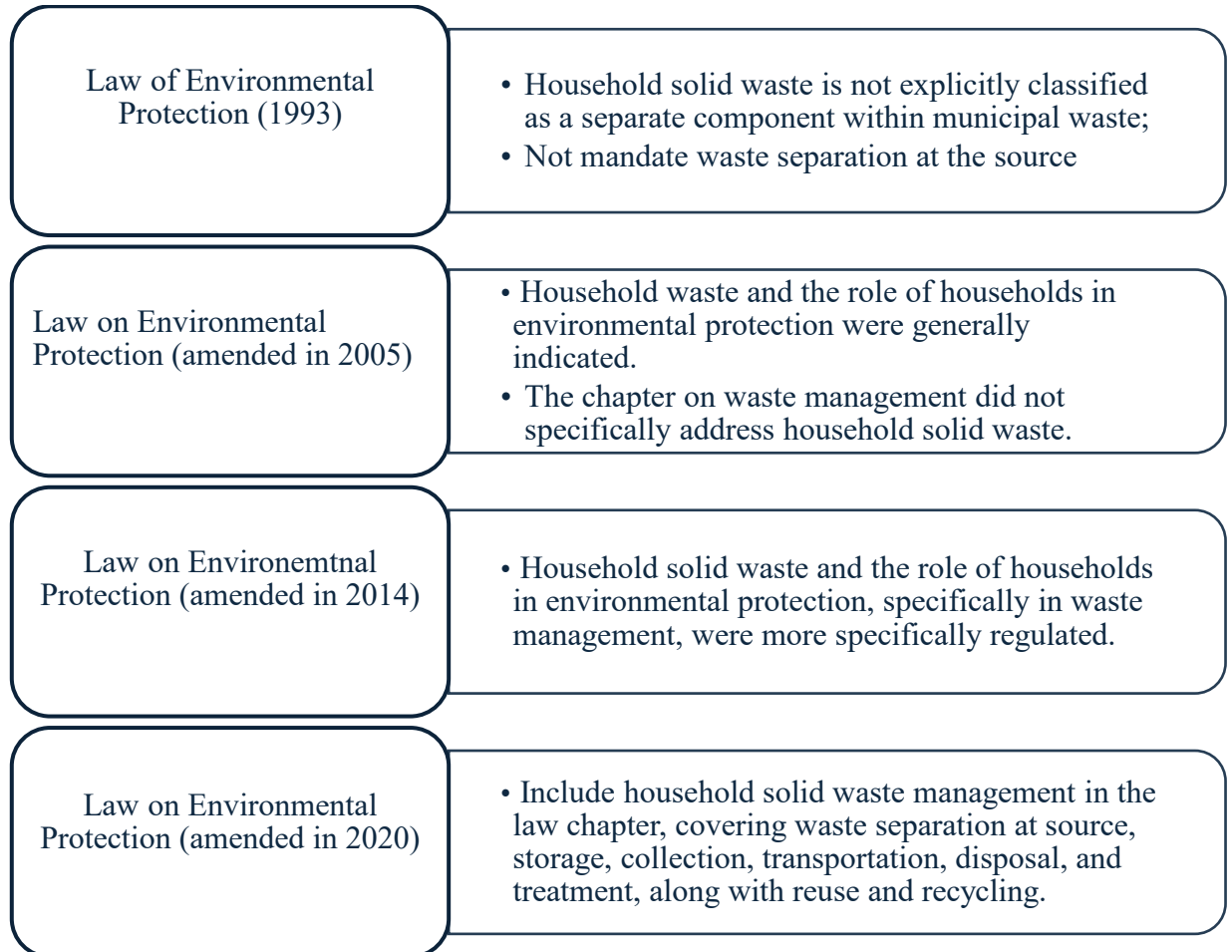
Note: This table highlights the disparities between policy frameworks governing household solid waste management and their actual implementation. These differences are presented through three pivotal operational dimensions: waste separation at the source, waste storage and collection, and waste recycling. A more in-depth interpretation of these discrepancies is provided in subsections 3.1, 3.2, and 3.3.

1. Household solid waste separation

The solid waste management system was first established pursuant to the Law on Environmental Protection, enacted in 1993. This framework was amended and supplemented in 2005, 2014, and 2020. In alignment with these legislative revisions, the government has promulgated decrees that provide detailed implementation guidelines.

Figure 1

The progress of household solid waste management through the Law on Environmental Protection and its revised versions



Note. This chart depicts the shifting governmental perception of household solid waste management, evidenced through various Environmental Protection Laws enacted during specific timeframes (1993, 2005, 2014, and 2020).

Figure 1 illustrates the laws on environmental protection and their corresponding guiding documents for effective implementation. Notably, the management of household solid waste and the active participation of households have been articulated with greater clarity. While the 2005 and 2014 laws did not explicitly categorize household solid waste as a distinct component within the broader waste management framework, the 2020 legislation has designated a specific chapter to address this issue explicitly. Furthermore, this comprehensive legal instrument emphasizes source separation of waste and prescribes methodologies for its storage and transfer applicable to both rural and urban contexts. The legislation also thoroughly covers key aspects, including the collection, transportation, disposal, and treatment of household solid waste. As the primary legal framework, the Law on Environmental Protection stipulates the rights and obligations of households and individuals in the management of urban solid waste. The information conveyed in Figure 1 suggests an increasing

government focus on municipal solid waste management, as reflected in recent amendments and revisions to the law.

Regarding waste separation at the source, policies on household solid waste separation were first introduced in the Law on Environmental Protection, issued in 2005 (Vietnam National Assembly, 2005). Eight out of the sixteen selected policies addressed waste separation at the source and household participation in sorting domestic solid waste; however, these policies lacked explicit penalties for non-compliance until the enactment of the Law on Environmental Protection in 2020. Table 2 illustrates the types of waste that must be sorted according to legal requirements documents.

Table 2

Specific categories of solid waste required by national and Hanoi government legal documents

| Types of legal documents | Categories of sorted solid waste |
|--|---|
| Law on environmental protection (2005) | Recyclable and landfilled waste |
| Decree on Solid Waste Management (2007) | Reused/recyclable waste and landfilled waste |
| <i>Decision on promulgating regulations on conventional solid waste management in Hanoi City (2013)</i> | <i>Organic and inorganic waste</i> |
| Law on Environmental Protection (2014) | Separate to facilitate recycling and processing |
| <i>Solid Waste Treatment Planning of Hanoi capital to 2030 with a vision to 2050 (issued by national government in 2014)</i> | <i>Organic solid waste (such as vegetables, fruits, and food scraps); inorganic solid waste that can be recycled (such as paper, plastic, and metal), and the remaining solid waste</i> |
| Decree on solid waste and scrap management (2015) | Organic waste, recyclable waste, and other waste |
| Law on Environmental Protection (2020) | Three main categories required: Recycled waste, food waste, and other waste, and two other types encouraged: hazardous and bulky waste in domestic solid waste |
| <i>Decision No. 87/2025/QĐ-UBND on household solid waste management in Hanoi city (2025)</i> | <i>Recyclable waste (paper, plastic); Food waste (leftover, etc, and Others (bulky waste, hazardous waste, and other waste)</i> |

Note. Table 2 presents the categories of waste that must be sorted in accordance with legal documents issued by the Vietnamese government and the Hanoi authorities. Policies specifically applicable to Hanoi and promulgated by the Hanoi government are indicated in italics.

Table 2 reveals two key findings:

First, the guidelines for solid waste categories mandated to be separated at the source, as specified in the 2007 Decree on Solid Waste Management, align with the stipulations set out in the 2005 and 2014 Laws on Environmental Protection. These legal documents required residents to

separate their domestic waste into recyclable materials and the remaining waste designated for burial (Vietnam Government, 2007; Vietnam National Assembly, 2005, 2014). The amended Decree on Solid Waste, promulgated in 2015, together with the recent revision of the Environmental Protection Law in 2020, has further encouraged households to categorize their domestic waste into organic waste, food waste, recyclable waste, and other categories such as hazardous and bulky waste. This progression signifies an evolution in the national government's approach to waste management and provides a comprehensive framework for waste separation.

Furthermore, a discrepancy has been identified between Vietnamese legislation and Hanoi's legal frameworks regarding the classification of solid waste that requires separation. Specifically, previous Vietnamese policies mandated that households segregate waste into recyclable and non-recyclable categories (Vietnam Government, 2007; Vietnam National Assembly, 2005). In contrast, the Hanoi government mandated that residents sort solid waste into organic and inorganic categories. An examination of the relevant policies (Decision on promulgating regulations on conventional solid waste management in Hanoi City in 2013 and Decree on Solid Waste Management in 2007) reveals that the most recent directives issued by both national and local authorities contain inconsistent definitions of waste categories requiring separation. Nevertheless, the two most recent legal instruments—the Law on Environmental Protection (2020) and Decision No. 87/2025/QĐ-UBND of Hanoi—exhibit greater consistency in delineating waste classifications. This alignment is expected to promote greater coherence and uniformity in the implementation of waste management policies.

In addition to identifying discrepancies between national policies and the directives issued by the Hanoi municipal government, the study also reveals a discrepancy between policy requirements and actual household practices. This divergence is particularly evident in two critical dimensions: whether waste separation at the source is implemented, and whether such separation conforms to existing legal guidelines.

Regarding waste separation rate, a review of the selected articles and policies concerning waste separation rates reveals that, despite the requirement for waste separation at the source addressed in the 2005 Law on Environmental Protection and the 2013 Decree on Solid Waste Management issued by the Hanoi Government, the proportion of households practicing waste separation remains comparatively low. As stated in a study of Kawai and Huong (2017), 13.8% of respondents engaged in waste separation practices, whereas 86.2% disposed of mixed waste. The limited implementation of source separation, even within pilot areas acquainted with the 3R project from 2006 to 2009, was affirmed in studies conducted in 2015 (Nguyen et al., 2015) and another in 2021 (T. K. N. Nguyen, 2021). Recently, a study by Hoang, Hanh, et al. (2024) revealed that more than 40% of residents in the samples did not separate their waste at the source.

The low proportion of residents engaging in waste source separation can be attributed to various factors. Primarily, individual-related factors, such as attitudes towards waste separation at the source (Nguyen et al., 2015); trust in authorities (Nguyen & Aramaki, 2022; T. K. N. Nguyen, 2021); and trust in formal waste collectors (Liu et al., 2021; Nguyen et al., 2015). The second factor group was identified as social force and social influences. Specifically, family members, neighbors, and social organizations notably contribute to the advocacy and implementation of household waste separation and collection practices (Nguyen & Aramaki, 2022; Nguyen et al., 2013; T. K. N. Nguyen, 2021). T. K. N. Nguyen (2021) reported that individuals who are more connected to their families and involved in family activities are more engaged in waste separation practices within their communities. Other authors, such as Nguyen and Aramaki (2022); T. K. N. Nguyen (2021), found that when residents feel a sense of belonging and desire to settle in an area long-term, they engage more with their neighborhood. Consequently, the more they participate in community activities, the more willing

they are to properly sort waste at home. Another factor identified was limited space and lack of time (Nguyen & Aramaki, 2022; Nguyen et al., 2015). Additionally, waste collectors contributed to a decrease in the rate of households sorting waste at the source in the 3R project in the pilot wards of Hanoi, as demonstrated in studies by T. K. N. Nguyen (2021); Nguyen et al. (2015). These studies found that residents in these areas stopped practicing waste separation at the source after the program ended in 2009, due to their observation of waste collectors mixing all sorted waste from households. Lastly, incentives, such as monetary rewards or other benefits, were found to encourage residents to sort waste at the source, particularly among new residents who have lived in the area for less than ten years (Nguyen & Aramaki, 2022).

Regarding the proper separation of waste, the reviewed literature indicates that household practices exceed legislative requirements, exhibiting both positive and negative aspects. Firstly, households have separated their domestic waste into recyclable materials, food waste, and other materials based on established habits and customary practices for a long time. Conversely, earlier legal frameworks primarily categorized waste as organic versus inorganic (policies issued by the Hanoi government in 2013) or recyclable versus buried (policies issued by the Vietnamese government in 2005, 2014, and 2014). Second, although food waste constitutes the largest proportion of the municipal waste stream as Kawai et al. (2016); Ngo et al. (2021), and Ministry of Natural Resource and Environment (2019) stated, it was only explicitly and systematically addressed in the 2020 Law on Environmental Protection. Prior policy documents lacked comprehensive guidance regarding the separation of this waste. Nevertheless, households had already been separating food waste in practice. For instance, Nguyen et al. (2015) revealed that approximately 43.3% of respondents sorted their food waste, placing it in food waste barrels for pig fodder or depositing it in organic waste bins. Similarly, Liu and Nguyen (2020) confirmed a proportion of sample households practicing food waste separation and noted a distinction between the practices of rural and urban residents in Hanoi. Notably, the proportion of rural residents who sort leftover cooked food exceeds that of their urban counterparts.

In addition, there remains a persistent reality in which households do not separate waste in accordance with policy guidelines. Kawai and Huong (2017) revealed that 41.5% (by weight) of the collected waste classified as organic was actually inorganic and that one-third of the waste labeled as organic was also inorganic. This discrepancy might result from a lack of knowledge and misunderstanding of the types and composition of waste generated. The current situation in Hanoi suggests that, despite the legal system addressing regulations on source waste separation, additional guidance documents are required promptly. Otherwise, the lack of guidance and insufficient facilities may hinder households' ability to practice waste separation at the source (Tsai et al., 2020).

2. Household solid waste storage and collection

Most documents stipulate that sorted waste should be maintained within appropriate containers and transferred to designated areas (Vietnam Government, 2015; Vietnam National Assembly, 2020). Nevertheless, these legal documents do not provide technical guidelines for households regarding the storage of various types of sorted waste. Only the National Decree on Solid Waste Management, enacted in 2007 and amended in 2015, mandates that sorted waste be stored in bags or tanks of designated colors and not be retained for more than two days (Vietnam Government, 2007). The same decree outlines the obligations of waste collectors and transporters to supply households with waste containment bags and to provide guidance on the separation of solid waste, which must be stored in colored bags, tanks, and other appropriate facilities.

However, in practice, households often lack sufficient equipment and facilities; consequently, they tend to store waste in plastic bags. As noted by Nguyen and Fogarassy (2020), household food

waste and other forms of waste are stored in plastic bags or small shopping bags, which are subsequently transported to designated waste collection points, such as sidewalks and pavements, for official collection. Similarly, in a study by Liu et al. (2021), among 252 respondents surveyed, 68.65% reported reusing plastic shopping bags for lining their kitchen bins. Notably, 30% of these bags were disposed of without proper separation. This household practice indicates convenience-oriented behaviors. Unfortunately, such improper waste disposal practices impose additional burdens and challenges on solid waste management and treatment, particularly due to the presence of unseparated plastic bags, which are non-biodegradable components within the waste stream. Concurrently, this situation highlights existing gaps in policy formulation and deficiencies in infrastructure and equipment needed to support household compliance.

Furthermore, gaps in policy formulation are evident, as there are no specific guidelines for waste collection. Official documentation has failed to delineate the utilization of specialized equipment or the implementation of separate collection systems tailored to different waste categories; as a result, waste is often mixed during collection. Conversely, when sorted waste is subsequently combined during collection, this practice dissuades households from maintaining waste separation, as they perceive their time and effort as wasted.

3. Household solid waste recycling

The policy review indicated that of the sixteen national waste management policies, nine explicitly encourage households and individuals to recycle, but do not impose penalties on individuals who do not engage in solid waste recycling. In practice, the informal sector significantly contributes to solid waste recycling in Hanoi, with approximately 877 scrap facilities primarily situated in urban areas (T. H. Nguyen, 2021). In particular, the percentage of waste recycled by junk buyers can reach 8.8% by weight or 26% by volume of the total waste generated (Kawai et al., 2012). Meanwhile, at the household level, only a limited number of individuals participate actively in waste recycling. Kawai et al. (2012) indicated that the citizens of Hanoi are well-aware of the types of waste collectors and junk buyers willing to purchase different materials. They either store their waste for sale or donate it to junk buyers, primarily focusing on four material categories: paper, plastic, glass, and metal. Additionally, the study indicates that among households that separate recyclable waste, only 7% reuse paper waste, and 6% reuse glass. Similarly, later research conducted by Yokoo et al. (2018) indicated that over 80% of households within four central wards of Hanoi participate in waste recycling activities, despite the absence of formal regulatory frameworks. Approximately fifty percent of these households participating in recycling sold their recycled materials to informal junk buyers, while the rest provided materials free of charge. This indicates that household recycling practices are relatively limited and largely characterized by indirect participation rather than active engagement. Nonetheless, such indirect involvement remains crucial, as the effectiveness of recycling initiatives is highly contingent upon proper waste separation at the source. Additionally, households should be further encouraged to participate more actively in recycling and reuse activities following the sorting process. However, there is a notable lack of comprehensive guidelines to assist households in implementing these practices, particularly with regard to hazardous waste and plastic waste, which accounted for 14% of total household solid waste as of 2022, with an impressive collection rate of 99% (WWF-Viet Nam, 2023), contributing to constraints and impediments in households' waste management practices in practical contexts. Furthermore, there is an urgent need to enhance policy focus in the informal sector, as the current disparity between existing policy frameworks and effective waste management strategies undermines practical implementation. A study by De Bercegol et al. (2017) confirmed that

the government acknowledges the informal waste recycling sector's contribution to municipal solid waste. However, there are no official provisions regarding its integration into national policies.

4. The costs for household solid waste collection, transportation, disposal, and treatment

Legal documents, including the Environmental Protection Laws of 2005 and 2014, outline households' responsibilities for payment of waste collection and treatment services. Local governments, operating within the framework of national policies, possess the authority to establish tailored fee structures for waste management services, customized to the specific objectives and contextual circumstances of individual cities or regions.

In Hanoi (before the policy that merged districts and communes and changed to a two-tier local government system), urban residents were required to pay a monthly fee of 6,000 VND for waste collection services, while rural residents paid 3,000 VND (Hanoi People's Committee, 2016). The recently amended environmental protection law, enacted in 2020, introduces a new approach to funding solid waste management services for all households and residents across the country. This approach follows the principles of "polluter pays" and "pay-as-you-throw," requiring households to pay waste treatment fees based on the amount of waste they produce (excluding recyclable and food waste separated at the source), rather than using a flat rate. As a result, individuals who generate more waste and do not participate in source separation will face higher fees for solid waste management.

Discussion

Challenges for household solid waste management towards Sustainable Development Goal 11.6, 12.3, 12.5

1. Sustainable Development Goals and a link to household solid waste management

The 2030 Agenda, comprising its 17 Sustainable Development Goals (SDGs), functions as a fundamental framework that directs nations in the development of policies, strategies, and actions aimed at achieving developmental objectives. Within this framework, the formulation, refinement, and implementation of policies that encourage sustainable production and consumption, along with the judicious and efficient utilization of resources and energy, are of paramount importance. Furthermore, the advancement of renewable materials and fuels, coupled with recycling initiatives, is essential. Such measures enhance operational efficiency across sectors, reduce greenhouse gas emissions, improve individual quality of life, and facilitate the transition towards a green and circular economy. Consequently, the global priorities of emission reduction, climate change adaptation, and the promotion of sustainable development have become central concerns and are advancing with notable progress. The United Nations has established a framework of Sustainable Development Goals (SDGs) that are explicitly or implicitly linked to the management of solid waste (Sondh et al., 2024). For example, Target 11.6 aims to diminish the adverse environmental effects in urban areas—particularly concerning air quality and waste management—by 2030. Indicator 11.6.1 specifies that it measures the proportion of municipal solid waste that is collected and processed in controlled facilities relative to the total municipal waste generated by cities. Furthermore, Target 12.3 endeavors to halve global food waste at retail and consumer levels by 2030, while also seeking to reduce food losses across the entire production and supply chain, including post-harvest losses. Target 12.5 underscores the importance of substantially reducing waste through prevention, reduction, recycling, and reuse by 2030.

In Vietnam, a comprehensive policy framework for sustainable development has been substantially developed and explicitly articulated through several key documents issued by the Government. These documents include Resolution No. 136/NQ-TW, dated September 25, 2020, on Sustainable Development; Decision No. 622/QĐ-TTg, which approves the National Action Plan for the implementation of the 2030 Agenda for Sustainable Development; the Law on Environmental Protection enacted in 2020; the Socio-Economic Development Strategy for the period 2021–2030; the National Climate Change Strategy; and the National Action Plan on Green Growth, among others.

Previous research highlights positive behavioral traits among residents that facilitate progress toward sustainable development goals. For example, a subset of residents separates waste into recyclable materials, food waste, and other categories—a habit and customary practice that reflects a favorable trend toward achieving SDG 12.3 (food waste reduction) and SDG 12.5 (promotion of waste recycling). Additionally, the involvement of informal groups in recycling activities is likely to contribute to national recycling rates (SDG 12.5). As a result, these effective practices will help ensure urban environmental quality (SDG 11.6). Moreover, the Vietnamese government has established a policy framework, notably the 2020 Law on Environmental Protection, which addresses various aspects of municipal solid waste management and introduces innovative environmental service fee structures to promote equity and incentivize waste reduction and source separation. Building on the experience gained through the 3R (Reduce, Reuse, Recycle) initiative, Hanoi demonstrates both institutional capacity and practical mechanisms to advance waste minimization and recycling. Collectively, integrating a strategic policy framework with evidence of residents' behavioral practices may substantially accelerate progress toward sustainable development goals.

2. Legal framework, household practice, and challenges in monitoring the Sustainable Development Goals

Although the policy framework for municipal solid waste management has progressed in line with the recent Law on Environmental Protection (2020), significant deficiencies persist in its design. These gaps in policy formulation are likely to affect both the implementation process and the effectiveness of behavioral compliance with regulations among households and individuals. As a result, the attainment of the Sustainable Development Goals (SDGs) may be impeded.

For instance, there are limited detailed technical guidelines for the storage and collection of various sorted waste types, particularly food and plastic waste, despite these categories representing a substantial portion of the total waste generated. A lack of guiding documents was also confirmed in the study by Trinh et al. (2021), which indicated that Hanoi prioritizes policy execution rather than the stages of policy formulation, guideline issuance, and reporting. The lack of consistent, coherent guidelines for waste classification, storage, and collection procedures, even if well implemented, may result in ineffective classification within the broader waste management framework. Furthermore, the policy framework has yet to establish clear sanctions or provided detailed guidance on enforcement mechanisms. Although waste separation and recycling have been acknowledged in policy documents since 2005, these measures have not been supplemented by specified penalties for noncompliance with domestic solid waste segregation and recycling mandates. Additionally, the Environmental Protection Law enacted in 2020 authorizes waste collectors to refuse to collect household waste that is not properly separated. However, implementing this regulation may pose significant challenges; if enforced, it could lead to social conflicts and adverse reactions among households, waste collectors, and other community stakeholders, particularly if residents are insufficiently informed or supported in complying with these regulations. This social consequence is reminiscent of an experience observed in the 3R project in Hanoi from 2006 to 2009, where residents in that pilot program distrusted the

waste collectors due to mixed waste collection (T. K. N. Nguyen, 2021). There is evidence that promoting public policies contributes to effective solid waste management, as demonstrated by countries leading in this domain (Sondh et al., 2024). This statement affirms the crucial role of policy in facilitating the effective implementation of municipal solid waste management initiatives. Experiences from developed countries, such as Germany, which has achieved positive outcomes in municipal solid waste management, demonstrate that effective waste management policies are grounded in three key pillars: a clear and comprehensive legal framework, regularly conducted public communication campaigns, and a transparent waste treatment fee system (Azevedo et al., 2021). Those facts emphasized the need for adequate policy formulation to promote effective municipal solid waste management in Hanoi.

With regard to household practices, numerous deficiencies persist in the implementation of municipal solid waste management at the household level. Notably, a knowledge gap persists regarding waste separation, as indicated by the low separation rate; this practice has not yet achieved widespread adoption, and many residents fail to dispose of waste properly. If organic or food waste is not processed for specialized purposes, it is directed to landfills, where it undergoes anaerobic decomposition, releasing methane that accelerates greenhouse gas emissions and leads to the loss of potentially recyclable materials. Additionally, the mixing of food waste with other waste streams by households hampers accurate measurement, inhibits proper disposal, and diminishes opportunities for composting. Such practices may hinder the achievement of Sustainable Development Goal (SDG) 12.3. Moreover, these issues can have broader implications for the overall efficiency of municipal solid waste management and urban environmental quality, thereby affecting progress toward SDG 11.6. Specifically, inadequate waste segregation and improper waste disposal practices negatively impact recycling rates. As Navarro Ferronato (2023) stated, if waste separation at the source is effectively practiced and selective collection significantly enhances the quality of recyclable materials, thereby boosting recycling rates. When recyclable materials such as paper, plastic, and metal are mixed with food waste or other contaminants, their suitability for recycling diminishes considerably, and in some cases, they become entirely non-recyclable. This directly impedes the achievement of the goal to “substantially reduce waste generation through prevention, reduction, recycling, and reuse.” Moreover, the excessive utilization of plastic bags contradicts the “reduce” principle of the 3Rs (Reduce, Reuse, Recycle), leading to increased environmental release of plastic waste and undermining the efficiency of recycling processes, consequently disrupting the material value chain. As a result, ineffective waste separation at the source hampers the monitoring of SDG 12.5 by reducing the overall recycling rate.

The current waste storage and collection practices present considerable challenges and reveal a significant gap, due to residents’ habits and customs. Typically, residents store waste in non-biodegradable plastic bags, which are not separated from other waste after use. During the collection process, various types of waste are often mixed together with no specialized vehicles for the separate collection of distinct waste categories. This circumstance complicates waste management processes and heightens the risk of urban environmental pollution, especially given that waste is still primarily managed through landfilling. Furthermore, the prevailing waste collection methods, as noted by Nguyen and Fogarassy (2020), have several shortcomings that lead to air pollution and water leakage, thereby affecting the efficiency and quality of waste collection in densely populated areas. As a result, Sustainable Development Goal 11.6 may be affected by ineffective collection and a polluted urban environment.

Regarding waste recycling, the 2023 report by the Hanoi municipal government indicates that waste burial accounts for approximately 2,400 to 2,900 tons per day, representing 37% to 41.5% of

total waste management methods. Notably, the prevalent practice of landfilling food waste—contributing 8% to 10% of total emissions within the agri-food system—has potential adverse effects on climate change and environmental sustainability (Mai Dan, 2024). Currently, recycling activities are largely undertaken by the informal sector; however, policy focus on this group remains inadequate. Without sufficient support and recognition from authorities and given that household-level recycling practices are not yet widespread, progress toward achieving SDG 12.5 will likely be impeded.

The gap between policy and practice is undeniable, as the analysis above demonstrates. Identifying this gap, on the one hand, helps reassess the practical situation and identify and supplement the necessary conditions to encourage households to implement solid waste management effectively. On the other hand, current practices also provide a basis for policymakers to review and refine incomplete policy documents. Useful behaviors and habits (such as separating recyclable waste and food waste) should be reinforced and formalized through legal provisions; meanwhile, behaviors that are not yet well-practiced require more detailed, specific guidelines and clear fine systems.

From an academic research perspective, the process of comparing policy and practice should be conducted regularly to promptly adjust the legal framework for more effective implementation and enforcement. Only in this way can more favorable opportunities be created to achieve the Sustainable Development Goals. The systemic nature of household solid waste management and the Sustainable Development Goals is clearly reflected in the close interconnection between each phase of the solid waste management process and each specific goal within the SDG framework. Therefore, it is necessary to ensure the simultaneous fulfillment of all stages of the household solid waste management process and to integrate the Sustainable Development Goals into solution implementation.

Conclusions

A review of twenty-four selected articles and sixteen national and local policies related to household solid waste management in Hanoi City was conducted, providing insights into the two research questions. First, this study has identified gaps between policy and practice in household solid waste management, including deficiencies in technical guidance, knowledge dissemination, behavioral aspects, enforcement, and infrastructure. These deficiencies are attributed to various factors, as outlined in the Results section. They may arise from policy designs that lack comprehensiveness, detailed technical implementation guidelines, and clear enforcement mechanisms. As a result, despite the issuance of numerous policy documents, their implementation outcomes have failed to meet policymakers' expectations. Additionally, inconsistencies among different policy documents should also be considered. Furthermore, individual-level factors—such as awareness, behavioral patterns, habitual practices, and perceived convenience of plastic bag use—also contribute to the persistence of these gaps.

The close interconnection between municipal solid waste management and the Sustainable Development Goals (SDGs) presents substantial challenges for Hanoi in achieving these targets if waste management practices remain ineffective and policy–practice discrepancies persist. The second research question is addressed through the examination of this dynamic of influence. Among the various SDGs, SDG 11.6, 12.3, and 12.5 are the most prominent and directly affected in Hanoi's context. The limited public adoption of waste sorting adversely affects the efficiency of waste collection and management processes, thereby obstructing efforts to reduce environmentally harmful disposal methods, which continue to threaten public health and environmental integrity (SDG 11.6). Furthermore, consumption behaviors and insufficient waste separation at the source hinder progress toward minimizing food waste (SDG 12.3) and enhancing recycling practices (SDG 12.5). Notably,

the analysis presented in Section 4 indicates that the existing gaps do not affect individual SDGs but rather generate interconnected and spillover effects across those goals. This observation underscores the structural similarity between the municipal solid waste management system and the SDG framework, as both comprise interrelated components that influence one another.

Based on the findings presented in this study regarding policy–practice discrepancies and the obstacles to achieving the Sustainable Development Goals, the author proposes several solutions to narrow these policy gaps and mitigate inappropriate community practices.

- Regarding policy formulation, it is essential to promulgate comprehensive technical guidelines outlining procedures for storing and collecting various waste types after separation, as well as household-level recycling protocols. These guidelines should be systematically aligned with the distinct phases of municipal solid waste management—from waste segregation, storage, and collection to final disposal—and should include explicit sanctions, enforcement mechanisms, and monitoring protocols. Policy frameworks should also give greater consideration to informal recycling actors by formalizing their role in the sector and integrating their participation in policy development processes. Such measures are likely to enhance recycling rates, especially in contexts where household engagement is limited. Furthermore, national and regional legal instruments should be periodically reviewed to prevent overlaps or inconsistencies, thereby providing clear guidance to households on waste separation, storage, and recycling practices.
- In terms of household practice, it is imperative to bolster communication strategies and awareness campaigns to increase household waste separation rates and adherence to proper sorting standards. Concurrently, the effective deployment of economic instruments—including incentive schemes and the pay-as-you-throw principle—is recommended. This dual approach aims to combine intrinsic motivations—such as environmental consciousness and responsibility—with external regulatory mechanisms, thereby fostering improved compliance with household solid waste management practices.

Limitations and future directions

Despite the efforts undertaken, this case study of Hanoi City exhibits several limitations. First, it does not address other dimensions of household solid waste management, including stakeholder participation, local governance capacity, and additional waste treatment and disposal methods. Furthermore, it does not consider other Sustainable Development Goals beyond those analyzed herein. Second, the predominant reliance on peer-reviewed literature may lead to an incomplete portrayal of the current state of household solid waste management in Hanoi City. Additionally, the majority of the identified studies were conducted within Hanoi’s inner districts, potentially introducing publication bias or spatial bias. Future research should employ quantitative methodologies to assess the influence of policy design, behavioral practices, and policy–practice discrepancies on specific SDG indicators. Furthermore, comparative studies across different urban settings—such as various cities or contrasting urban core and peri-urban areas of Hanoi—are also needed to develop a more comprehensive and generalizable understanding of the key issues.

Competing interests

No potential conflict of interest was reported by the author.

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