Classification and Storage of Municipal Solid Waste in Viet Nam: Evidence of Gaps between Regulations and Practice

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***Abstract*—The process of classification and storage of domestic or Municipal Solid Waste (MSW) is essential in domestic solid waste management because this process determines the method of treatment of this kind of waste. In Viet Nam, according to the Law on Environmental Protection 2020, MSW generated by households and individuals is classified into three groups, and the regulations must be implemented by December 31, 2024. However, the practice of classification and storage of MSW in Vietnam still faces difficulties and shortcomings because of economic-financial conditions, cultural issues, habits, and awareness of the public. The study examines the existing regulations and practices of MSW classification and storage in Viet Nam and compares them with Japan's experience in several aspects. Taking Ho Chi Minh City's practice as a representative of MSW management in Viet Nam, the study conducted a survey with 419 respondents from July 17–22, 2025, using online means. Combined with legal description and analysis, the research findings show a substantial gap between the government's expectations and the current practice on the matter at issue. Such a divergence seems to persist for a great deal of time if local governments do not handle the matter practically, seriously taking the public awareness into account as a fundamental step. In addition, paying sufficient investments in facilities necessary for MSW classification and storage is a further step towards sustainable MSW management.**

***Keywords*—municipal solid waste management, environmental protection, sustainable development, Viet Nam**

I. Introduction

Waste generation is a natural product of urbanization, economic development, and population growth [1]. Waste refers to materials that are not prime products (that is, products produced for the market) for which the generator has no further use in terms of his/her own purposes of production, transformation, or consumption, and of which he/she wants to dispose [2]. As a by-product of human activities, waste contains the same materials found in useful products, but it only differs from them by lack of value [3]. In industries, waste can be generated during the processes of extracting raw materials, transforming raw materials into intermediate/final products, and consuming final products.

The impact of human activities on the environment (social aspect), as well as economic progress and global population growth (economic aspect), has resulted in a substantial increase in waste (environmental aspect) [4]. Every year, the world generates 2.01 billion tonnes of MSW, with at least 33 percent of that not being managed in an environmentally safe manner [1]. Waste generation is generally found to increase at a faster rate in the low–income group as compared to the high–income one. In the future, global waste is expected to grow to 3.40 billion tonnes by 2050, and that of the low-income countries is expected to increase by more than three times [1].

Waste management activities generally include three schemes: (a) collecting, transporting, treating, and disposing of waste, (b) controlling, monitoring, and regulating processes of production, collection, transport, treatment, and disposal of waste, and (c) preventing waste production through in-process modifications and reusing and recycling waste [2]. Kulkarni and Anantharama [5], with an emphasis on MSW treatment, found a number of challenges in MSW management in developing countries, such as inadequate facilities, the surge in medical and household wastes, and difficulties in waste recycling. The problem was even exacerbated in the COVID-19 pandemic period when a huge amount of medical waste was being released without proper treatment [6–9]. Thus, to achieve sustainable development on this matter, which is to harmonize economic, social, and environmental factors [10], all activities in waste management must be carried out in a consistent and systematic manner.

Realizing the systematic nature of waste management, Japan has taken the right steps on the issue and is now one of the countries known for its success in managing MSW. Since the 1970s, many policies have been implemented to improve the traditional way of treating MSW by landfilling. A typical example is the "War on Waste" policy initiated in 1971 by the Governor of Tokyo [11]. Subsequently, a number of laws related to MSW were enacted, such as: Waste Management and Public Cleansing Law 1970, Packaging and Packaging Recycling Law 2000, Household Appliances Recycling Law 2000, Food Recycling Law 2001, Green Trade Law 2001, Law on Promoting Efficient Use of Resources 2001, Construction Materials Recycling Law of 2002, and End-of-Life Vehicle Recycling Law of 2005 [12]. These legal initiatives have gradually expanded their scope towards an integrated approach to MSW: from production to consumption, from a common responsibility to sector-oriented duties, and from waste treatment to waste recycling. In addition to such legal fulfillment for a "sound material-cycle society", the Japanese government has strongly designated the management authority on MSW to municipalities with a great degree of autonomy. At this local management level, the MSW scheme has been a nexus among four principal entities: the municipal service providers, private operators, private finance initiatives, and local residents [13]. The laws also set up a pathway for inter-municipal cooperation with at least six types of regional cooperation [14]. In Japan, each local government has

specific guidelines for classifying and storing MSW before handing it over to a collector. As an early open-up city to the West, Yokohama's MSW rules present a mix between the increasing public awareness for years and the government's relentless efforts. MSW in this city is divided into 10 groups, and each group has to be contained in two main types: burnable garbage - placed in a transparent or semi-transparent bag, and non-burnable garbage: wrapped in the original box or newspaper with the name being displayed. The purchase and use of garbage bags are designated by local governments so that households and individuals can dispose of their garbage and then take them out for the collectors. If one disposes of his or her garbage in bags other than those specified by the local government, the garbage will not be collected [15]. Public outreach is perhaps a successful experience of the city to promote its G30 waste policy. Only in one year (FY 2014–2015), the public campaign operated 11.000 guidance sessions, 3.300 in-site explanations, and 600 sessions at train stations [15].

Japan's experience may set a bright model for a number of developing countries on MSW management, but challenges remain. Assessing the MSW practices of 16 selected countries in Asia and Africa, Zhang *et al.* [16] highlighted three "structural" challenges for MSW management in these countries, including socio-economic barriers, infrastructural challenges, and cultural factors. The study pointed out that though the MSW collection coverage is over 70% in these countries, less than 10% of the collected MSW is being recycled as compared to 55% on average in the OECD [17]. These authors also stressed the importance of public engagement and awareness in realizing local MSW management schemes, sticking firmly to the producers-consumers line of MSW management. This observation is almost the same as Vinti [18] and Smyth [19].

In Viet Nam, MSW tends to increase along with the forecast of a positive natural population and rapid urbanization. In the pathway towards sustainable development, the country has to take serious efforts to tackle the MSW management problem because this is the out-to-in circuit of primary economic processes in a circular economy [20]. Currently, in Vietnam, the total amount of MSW generated in provinces/cities is about 67,877 tons/day (of which urban areas generate about 38,143 tons/day and rural areas about 29,734 tons/day) [21]. The total volume of MSW in the country has been increasing from year to year, coupled with the expansion of a consumption society. Since 2020, Viet Nam has enacted the new law on environmental protection (Law on Environmental Protection 2020 or LEP 2020), which presents the most robust regulations ever on MSW management. The existing regulations provide a clear and detailed prescription for the MSW management process by adding stricter responsibilities (including criminal offenses) for related entities such as disposers, collectors, MSW treatment providers…, creating a positive position of local groups on supervising local MSW management practices, and strongly encouraging the private sectors investing in MSW treatment schemes [22].

Each country has its own definitions of waste and MSW as a basis for MSW management. In Vietnam, waste is defined as matter in solid, liquid, gaseous, or other forms discharged from production, business, service, living, or other activities, and domestic (municipal) solid waste is solid waste generated in people's daily activities [22]. The classification of MSW is significant in deciding how to handle it for the following stages. However, local practices on the MSW management are still far from the Government's expectations. As reported in a national conference on MSW classification in July 2025, only 34/63 provinces have been implementing the on-source MSW classification scheme, while the law requires completing the first step of the MSW management by 31 December 2024 [23]. This reflects an enduring dilemma in the country where environmental protection is continually put forward by the law, but the practice keeps lagging behind.

Taking this background on the MSW management in Viet Nam, this paper presents an empirical study on the matter at issue in Ho Chi Minh City. Given the fact that implementing MSW management shall significantly rely on investments for capacity building and local residents' habits and awareness, this case study may set a template for understanding the distance between the Government's regulations and the local practices. This logic may hold true for any practical solutions and/or policy implications for the case of Ho Chi Minh City with regard to the MSW management.

II. Materials and Methods

The data used in this study were collected through random questions in Google Forms, which were sent via email and Zalo (a social media app) to individuals living in Ho Chi Minh City, Viet Nam. Ho Chi Minh City is the largest and most populous city in Viet Nam, with a huge, diverse economic, social, and cultural constituents. This city is also the largest hub of industrial operations, citizen settlements, and modern infrastructures. Thus, every year, Ho Chi Minh City welcomes many workers as well as people from all over Vietnam to live, work, and study [24]. Therefore, the respondents are living in Ho Chi Minh City but have previously lived in many different regions of Vietnam. Their answers may partly represent the current waste classification practices in Vietnam. Also, the personal information of respondents is kept absolutely confidential. We will not disclose it in any form. We only use the answers for our research.

According to Yamane Taro [25], determining the sample size will be divided into two cases: not knowing the total scale and knowing the total scale. Because the authors do not know exactly the total number of the City's residents who are carrying MSW classification and storage (not knowing the total scale), this study applies the latter case's formula to determine the sample size:

$$n = Z^2 \times \frac{p \times (1-p)}{e^2}$$

where:

n: sample size to be determined.

Z: value of the *Z* distribution table based on the selected confidence level. Normally, the confidence level used is 95%, corresponding to $Z = 1.96$.

p: the rate of successful estimation of sample size n. Usually, we choose $p = 0.5$ so that the product $p(1-p)$ is the largest; this ensures safety for the estimated sample n.

e: allowable error. Usually, the three commonly used error

rates are: ±01 (1%), ±0.05 (5%), and ±0.1 (10%), in which the most common level is ±0.05.

According to the above formula, the minimum sample size required for the study would be 385 respondents. This study collected 419 respondents from July 17th to July 22nd, 2025, and this is completely consistent with the blind sampling method. A 3-step approach was used in data collection:

1) *Data collection form:* The form that contained the questions was carefully created and directly linked to my Google user's accounts. The Google Form created had some fields, including but not limited to private characteristics of the respondents (including name, email address, age, gender, occupation, etc.), and some specific questions that related to sorting of MSW. There are flexibility questions with both open-ended and closed-ended questions, so that the respondents could input text where necessary.

2) *Data collection:* The form was directly sent to respondents through Zalo and email. The survey lasted for 6 days to get 419 responses at the end.

3) *Synthesis and analysis of the collected data:* Responses were automatically saved and stored in Google Forms. Google Forms admits direct linking of input through the "Answer" tab on the form. The "Summary" of the "Answer" containing the data was downloaded and analysed. For the findings presented in this paper, descriptive and synthetic methods were used.

III. Research Findings

A. Classification of Municipal Solid Waste

The classification system is based on the origin of waste – whether it comes from agricultural, municipal, industrial, or mining activities [4]. Waste can generally be classified by a multitude of schemes: by physical state (solid, liquid, gaseous), and then within solid waste by: original use (packaging waste, food waste, etc.), by material (glass, paper, etc.), by physical properties (combustible, compostable, recyclable), by origin (domestic, commercial, agricultural, industrial, etc.) or by safety level (hazardous, non-hazardous) [3]. MSW is the most common form of waste, which comprises household and commercial disposals. It, therefore, can bring about adverse impacts on the environment and life expectancy if it is not properly managed [26].

Classifying MSW into the correct groups is a prerequisite for the treatment of this kind of waste in order to protect the environment and society at large. Correct classification can help shorten the time in the next stages of the MSW treatment process. Therefore, the LEP 2020 specifies principles for classifying solid waste as well as the time for this classification scheme to be fully implemented (no later than December 31, 2024). Pursuant to the existing regulations, MSW generated by households and individuals is classified into the following groups: (1) Solid waste that can be reused or recycled; (2) Food waste; (3) Bulky waste; (4) Hazardous waste; (5) Other remaining waste.

In Ho Chi Minh city, the survey results (419 responses totally) showed that the rates of agreement on and strong agreement on the classification of MSW are 45.2% and 36.8%, respectively (Fig. 1). The majority of respondents, who agreed with the practice of classifying MSW, indicate high levels of agreement, suggesting broad social acceptance and generally favorable perception of MSW classification. In contrast, the proportions expressing "Disagree" and "Totally disagree" are minimal, indicating negligible resistance. Collectively, most respondents are in favor of MSW classification.

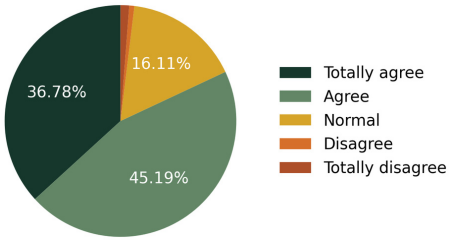

Fig. 1. Opinion on the classification of MSW.

They all recognized the benefits of classifying MSW (Fig. 2), such as environmental protection, conserving natural resources, encouraging recycling activities, promoting a green, clean, beautiful lifestyle, and supporting the process of treating MSW (garbage) more effectively.

Fig. 2. Benefits of classifying MSW.

However, responses on the current status of MSW classification reflect a sense of dissatisfaction. Fig. 3 illustrates the respondents' assessment regarding the current status of MSW classification. Specifically, 46.04% of respondents assumed that "not good", representing the largest proportion within the dataset. Additionally, 24.94% thought the situation was "very bad". Collectively, these two categories account for more than 70% of all responses. Thus, the existing practice of MSW classification is far from meeting the expected goal set by the government - that is, to implement regulations on MSW classification across the country from January 1, 2025.

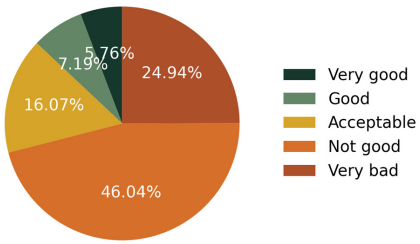

Fig. 3. The current status of MSW classification.

The survey also shows that there are a number of factors affecting the implementation of existing regulations on classification of MSW, including (Fig. 4), such as: the habit

of not classifying MSW from the past: 69.1% (288 respondents); a presumption that there is a unit responsible classifying and collecting MSW: 39.3% (164 respondents); and a presumption that the collectors will collect MSW altogether so there is no need to classify it: 37.2% (155 respondents).

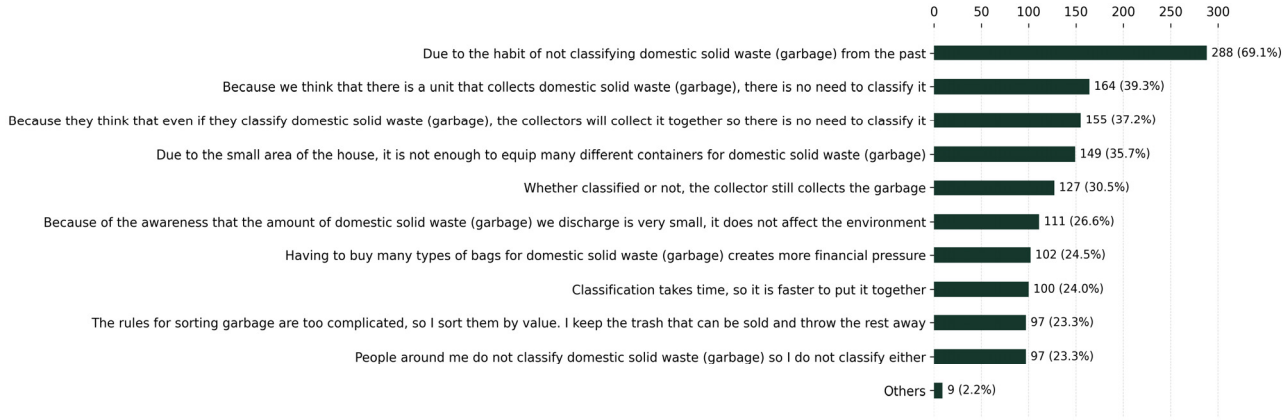

Fig. 4. Issues affecting the implementation of regulations on the classification of MSW.

In connection with the aforementioned factors, a great number of respondents (59.4% (249 respondents)) are of the opinion that they classify MSW in accordance with their habit, primarily separating items with resale value, indicating limited adherence to formal classification systems. While 32.5% (136 respondents) said that they conduct daily MSW classification. This showed that consistent engagement with required sorting practices remains low. Notably, 24.8% (104 respondents) have never classified MSW before, while 13.1% (55 respondents) do not know how to classify MSW, reflecting significant awareness and practice gaps. Furthermore, 13.1% (55 respondents) classified MSW according to the legal regulations and instructions (Fig. 5).

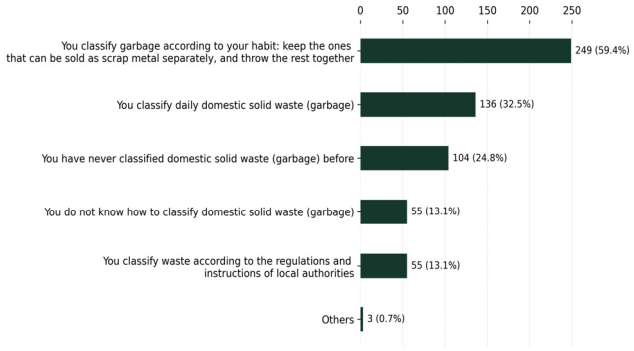

Fig. 5. The implementation of MSW classification.

However, 175 respondents (42.48%) answered that they did not know how many types of MSW there are (Fig. 6) while 269 respondents (65.29%) answered correctly about the types of MSW (Fig. 7). This discrepancy highlights varying levels of awareness within the respondents and points to the need for promoting the effective ways on practices of MSW classification.

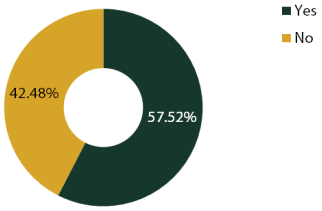

Fig. 6. Knowledge of types of MSW.

Fig. 7. Types of MSW.

This situation comes from many reasons, such as: (1) not receiving any instructions on the classification of MSW from the local government – 48.2% (200 respondents); (2) propaganda sessions on classifying MSW are often organized sporadically, focusing on theory and lacking practice – 51.2% (214 respondents); (3) having no time to participate to propaganda sessions on MSW classification – 19% (79 respondents) (Fig. 8). Thus, this result emphasizes the need that local authorities have to conduct more and more propaganda sessions on MSW classification more continuously in a manner that can effectively attract the public.

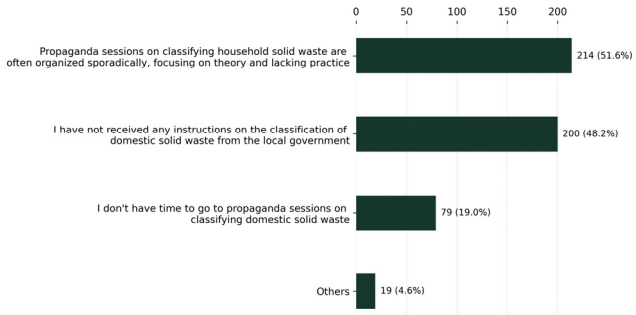

Fig. 8. Propaganda on implementing regulations on classifying MSW.

B. Storage of Municipal Solid Waste

In Vietnam, households and individuals in urban areas must contain and pack MSW after classification into packages for transfer (LEP, 2020, art.73) [22]. Packaging used for different types of MSW has to be identified in different colors:

+ Green packaging for food waste;
+ Gray packaging for other remaining MSW or domestic

MSW not classified according to regulations.

+ MSW that can be reused or recycled is stored in regular packaging, ensuring that it can be stored and does not pollute the environment.

The survey's results show that 172 respondents (41.1%) reuse plastic bags taken from supermarkets or markets for MSW storage, and 67 respondents (16%) use any bags for this purpose. In addition, there are 148 respondents (35.4%) using garbage bags for the purpose of storing MSW (Fig. 9).

Fig. 9. Storage of MSW.

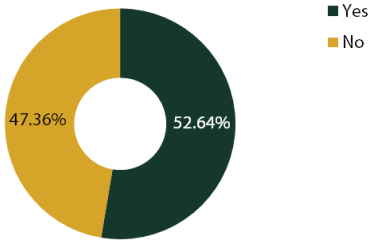

Fig. 10. Facilities' authority to deny collection due to non-adherence to MSW classification rules.

Thus, up to the time of the survey, the majority of respondents had not yet complied with the regulations on storing MSW, although 219 respondents (52.6%) knew about the regulations: "MSW collectors have the right to refuse collecting and transporting MSW from the households and individuals who do not classify or use appropriate packages according to the regulations and to notify competent authorities for inspection..." (Fig. 10).

Even with bulky solid waste, most of the respondents handle it as follows: "If the garbage is bulky and can be sold as scrap, then it will be sold. If not, it will be divided into small pieces and put into bags to be given to the collector" - 45.1% (187 respondents) (Fig. 11).

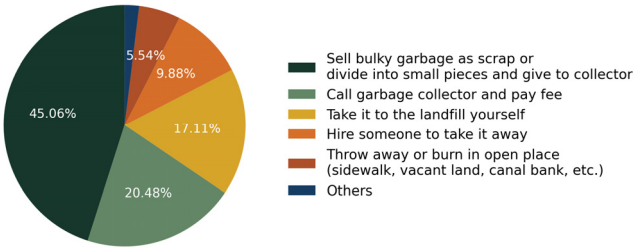

Fig. 11. Bulky waste.

IV. Conclusion and Recommendations

The LEP 2020 and its subordinate documents provide relatively clear regulations on the classification and storage of MSW. On that basis, local governments across the country organize appropriate implementation schemes within their areas based on their own socioeconomic circumstances. The research findings show that the implementation of such MSW regulations has not been strict and effective enough to meet the Government's goals on sustainable waste management. Reasons for this failure are many: the public's weak awareness, unestablished habits of citizens on waste treatment, or the regulations on the classification and storage of MSW are less practical to the public. It is, in addition, due to the lack of necessary facilities and resources on which the local governments can rely in order to implement the MSW regulations properly.

The abovementioned research findings provide an implication that, by taking Ho Chi Minh city as a model case study, it may take a great amount of time and effort for the Government to implement the MSW classifying and storing regulations nationwide. At present, although local governments are designated much more authority on MSW management, the practice seems to be a mess of difficulties. The laws on the matter at issue at first need to be fulfilled by numerous guidance and training conducted by local authorities so as to build up the beginning but fundamental step: raising the public's awareness and correct habits. Lessons from Yokohama city on its own local rules and its long-time preparation on MSW classification and storage are useful for Viet Nam to keep the country cleaner and cleaner.

In combination with conducting numerous on-site training sessions, as properly done in Yokohama, this kind of environmental propaganda could be held at large in schools and supermarkets, targeting two primary groups: households and pupils. The guidance has to be more practical and demonstrable so as to easily be followed by the public instead of a legal training session. The more active participation of residential communities in MSW management is also encouraged because they present a sense of solidarity and social cohesion for a shared responsibility to the environment. In addition, paying sufficient investments on facilities necessary for MSW classification and storage, such as free MSW pamphlets, free or cheap garbage bags, more storage settlements in residential areas… is a further step to transform the laws on paper into the laws in practice.

Several limitations should be identified in interpreting the research findings of this study.

Firstly, the use of random questions with the blind sampling method may have introduced sampling bias, limiting the generalizability of the results to the Vietnamese citizens. Respondents may differ in groups (e.g., education, awareness, or interest in the study) from those who did not, potentially influencing the research findings.

Secondly, the data were collected via self-report measures, which are subject to various biases. Respondents may have either overreported or underreported certain behaviors or attitudes, which could affect the accuracy of the research findings.

Thirdly, the study employed a cross-sectional design, which collects data at a single point in time. Thus, it is not possible to withdraw conclusions about causality or to assess changes in behavior or attitudes over time.

Finally, the short data collection period may have constrained the diversity of the sample and limited the ability to account for temporal factors that could influence the results.

Appendix

QUESTIONNAIRE

Dear Sir/Madam,

We are lecturers at Ho Chi Minh City University of Economics; I am currently conducting scientific research on "Classification and storage of domestic solid waste in Vietnam - The gaps between regulations and practice."

Scope of survey: Individuals living in Vietnam.

We hope that you will take some time to answer the questions in this survey. Your answers will be very useful for our research and reflect the reality of classification and storage of domestic solid waste in Vietnam after December 31, 2024, the time when domestic solid waste classification at source is mandatory.

Your personal information is kept absolutely confidential. We will not disclose it in any form. We only use the answers for our research purposes.

For more information, please contact me via email: anhluatkt@ueh.edu.vn.

We look forward to hearing from you.

Thank you very much.

A. Responder Information

1. Full name: (not mandatory)
2. Email: (not mandatory)
3. Age:
   - ◯ Under 18 years of age
   - ◯ From 18 years of age and older
4. Gender:
   - ◯ Male
   - ◯ Female
   - ◯ Others
5. Occupation:
   - ◯ Pupil
   - ◯ Student
   - ◯ Officials, civil servants, public employees
   - ◯ Employee
   - ◯ Employer
   - ◯ Housewife
   - ◯ Others: .....
6. Your current residential address:
   - ◯ City
   - ◯ Countryside
   - ◯ Mountainous, remote areas
   - ◯ Coastal area
   - ◯ Others: .....

B. Information on Classification and Storage of Domestic Solid Waste (Garbage)

7. Regarding the implementation of household solid waste classification (multiple answers can be selected):
   - ☐ You classify daily domestic solid waste (garbage)
   - ☐ You have never classified domestic solid waste (garbage) before
   - ☐ You do not know how to classify domestic solid waste (garbage)
   - ☐ You classify garbage according to your habit: keep the ones that can be sold as scrap metal separately, and throw the rest together.
   - ☐ You classify waste according to the regulations and instructions of local authorities.
   - ☐ Others: .....
8. According to you, what issues affect the implementation of regulations on the classification of domestic solid waste (garbage) (multiple answers can be selected):
   - ☐ Due to the habit of not classifying domestic solid waste (garbage) from the past
   - ☐ Because of the awareness that the amount of domestic solid waste (garbage) we discharge is very small, it does not affect the environment.

☐ Because we think that there is a unit that collects domestic solid waste (garbage), there is no need to classify it.

☐ Due to the small area of the house, it is not enough to equip many different containers for domestic solid waste (garbage).

☐ Having to buy many types of bags for domestic solid waste (garbage) creates more financial pressure.)

☐ Because they think that even if they classify domestic solid waste (garbage), the collectors will collect it together, so there is no need to classify it.)

☐ Classification takes time, so it's faster to put it together.

☐ Whether classified or not, the collector still collects the garbage.

☐ The rules for sorting garbage are too complicated, so I sort them by value. I keep the trash that can be sold and throw the rest away.

☐ People around me do not classify domestic solid waste (garbage), so I do not classify it either.

☐ Others: .....

9. Do you know how many types of household solid waste (garbage) there are and what each type is specifically?

○ Yes
○ No

10. According to legal provisions, domestic solid waste (garbage) is classified into:

○ (1) Solid waste that can be reused or recycled; (2) Food waste; (3) Bulky waste; (4) Hazardous waste; (5) Other remaining waste.
○ (1) Solid waste that can be reused or recycled; (2) Food waste; (3) Other remaining waste.
○ (1) Solid waste that can be reused or recycled; (2) Food waste
○ (1) Solid waste that can be reused or recycled; (2) Other remaining waste.

11. Regarding propaganda on implementing regulations on classifying domestic solid waste (garbage) (Multiple answers can be selected):

☐ I have not received any instructions on the classification of domestic solid waste (garbage) from the local government.

☐ I don't have time to go to propaganda sessions on classifying domestic solid waste (garbage).

☐ Propaganda sessions on classifying household solid waste (garbage) are often organized sporadically, focusing on theory and lacking practice.)

☐ Others: .....

12. Your opinion on the classification of domestic solid waste (garbage):

○ Totally disagree
○ Disagree
○ Normal
○ Agree
○ Totally agree

13. Where do you usually put your domestic solid waste (garbage) before handing it over to the collector?

○ Any bags
○ Garbage bags are purchased for the purpose of carrying garbage.
○ Make use of plastic bags when shopping at supermarkets, markets...
○ Put it directly in the trash, and when the collector comes to collect it, take it out and give it to them.
○ Others: .....

14. For bulky waste, you:

○ Take it to the landfill yourself
○ Take it to an open place to throw away or burn (sidewalk, vacant land, canal bank, ditch, river...
○ Hire someone to take you away
○ Call the garbage collector to have them pick it up and pay a fee.
○ If the garbage is bulky and can be sold as scrap, then it will be sold. If not, it will be divided into small pieces and put into bags to be given to the collector.
○ Others: .....

15. Do you know the regulation: “Facilities collecting and transporting domestic solid waste have the right to refuse to

collect and transport domestic solid waste from households and individuals that do not classify or use packaging according to regulations and notify competent authorities for inspection and handling according to the provisions of law..."

- ◯ Yes
- ◯ No

16. Benefits of classifying domestic solid waste (garbage) (multiple answers can be selected):

- ☐ Environmental protection
- ☐ Protect natural resources because trash is a resource
- ☐ Provide benefits to citizens to encourage recycling activities
- ☐ Help people's living environment to be green, clean - beautiful.
- ☐ Helps the process of treating domestic solid waste (garbage) effectively.
- ☐ Others: .....

17. What do you think about the current status of domestic solid waste classification?

- ◯ Very bad
- ◯ Not good
- ◯ Acceptable
- ◯ Good
- ◯ Very good

Thank you very much for your cooperation and support.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Anh Nguyen Thi conceived the idea, sketched the outline, and wrote the first draft. Hoc Duong Van modified the draft with further legal analysis and recommendations. Truc Vo Thanh formatted and polished the manuscript. All three authors jointly constructed the data and conducted data analysis. All three authors jointly discussed the research results and agreed upon the manuscript submission.

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