

Evaluation of Domestic Solid Waste Management in Cai Rang District, Can Tho City, Vietnam

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Abstract

The study was conducted to evaluate the management of domestic solid waste in Cai Rang district, Can Tho city. The study conducted sampling of domestic solid waste from 20 households in four wards Le Binh, Hung Phu, Ba Lang, and Tan Phu within 07 days from March 6 to 12, 2023. At the same time, three groups of subjects including 120 households, 3 Environmental Managers, and 3 employees of Urban Environment Joint Stock Company were interviewed to collect information. The result showed that the average domestic solid waste generation coefficient reached 0.28 kg/person/day, and the amount of domestic solid waste generated can reach about 11,027.3 tons by the end of 2023. Of which, up to 91% of the volume of domestic solid waste was recyclable, including 52% of biodegradable organic waste, and 39% of recyclable waste. As for domestic solid waste management, there was still a limitation in classifying waste at source, this rate only fluctuates between 43.4-86.7%. Besides, the rate of households registered for domestic solid waste collection service had a difference between urban and rural areas, fluctuating from 76.7-96.7%. After being collected, domestic solid waste was transported to the Can Tho household waste incineration plant (EB plant). Meanwhile, the remaining amount of domestic solid waste was treated using unsanitary landfill methods, and thrown into rivers, causing environmental pollution, and public health. Although propaganda activities related to domestic solid waste management were carried out in four wards in Cai Rang district, Can Tho city. However, the level of implementation of these activities was not regular. From that, the study identified a number of difficulties in domestic solid waste management, including solid waste that was not completely classified at source, and garbage collection services that were not organized throughout the area. The district lacked specialized waste collection vehicles after classification, and public propaganda, and education work were limited. This research will help local authorities come up with specific solutions to improve the quality of solid waste management in Cai Rang district, Can Tho city.

Keywords

Cai Rang District, Can Tho City, Classification, Collection, Domestic Solid Waste, Treatment

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1. INTRODUCTION

Every year, community consumption levels increase, affecting the frequency of waste generation. Global municipal solid waste (MSW) generation has increased from 1.3 billion tons in 2012 to 2.1 billion tons in 2016, which by 2025 is expected to increase by 70% to reach a total of 3.4 billion tons (Abubakar et al., 2022). In Vietnam, the total volume of MSW generated each day has increased from 44,400 tons in 2010 to 64,658 tons in 2019, an increase of 46% compared to 10 years ago (Ministry of Natural Resources and Environment, 2020). In particular, MSW generated in urban areas was higher than in rural areas, generating about 35,624 tons/day and 28,394 tons/day, respectively. Currently, the composition of MSW is very diverse and complex, generated

from many different sources, such as food scraps, fruit peels, nylon, plastic, rubber, paper, and metal (Oanh, 2021; My et al., 2022). Notably, the generation of MSW in any area is proportional to population, per capita income, urbanization rate, and tourism development level (Pan et al., 2019; Sunayano et al., 2021). Therefore, MSW management has emerged as a major challenge in environmental protection.

Effective solid waste management helps minimize adverse environmental, and health impacts. While unsustainable solid waste management practices are a potential risk that negatively impacts human health, and environmental sustainability (Abubakar et al., 2022). Typically, Polycyclic aromatic hydrocarbons (PAHs) are dangerous pollutants created by outdoor burning of MSW, which can arise from

pyrolysis or incomplete combustion of waste plastic, wood, paper, and other fuels contain carbon (Zha et al., 2018; Cheng et al., 2022). PAHs can exist in the environment, and accumulate in vascular plants, thereby harming human health through the food chain, and respiratory tract, especially causing lung cancer, genetic mutations, and liver damage (Shen et al., 2019; Cheng et al., 2022). Besides, outdoor burning of solid waste is the main cause of dust, air pollution, and respiratory diseases including nose, throat, difficulty breathing, and asthma (Abubakar et al., 2022). According to research by Mihai et al. (2019), the process of outdoor MSW burning produced large amounts of air pollutants, such as PM₁₀ (47,258.93 kg/year), PM_{2.5} (38,919.12 kg/year), PAHs (1,191.40 kg/year), NO_x (14,852.81 kg/year), SO₂ (1,985.67 kg/year), CO₂ (5,770,355 kg/year), CO (150,910.87 kg/year), and CH₄ (14,693.95 kg/year). Additionally, unsanitary land-filling has been reported to be linked to various environmental problems, such as groundwater pollution, odor pollution, air pollution, and even marine pollution (Sharma et al., 2020; Siddiqua et al., 2022). According to research by Alao et al. (2023), groundwater affected by leachate had high levels of pollutants such as TDS, BOD, and COD in water, fluctuating in the range of 400-1612 mg/L, 371-611 mg/L, and 697-1117 mg/L, respectively.

Can Tho is one of five centrally run cities in Vietnam, the busiest and most developed city in the Mekong Delta, serving as an economic, cultural, social, and medical center, education, and trade of the entire region. Among the districts in Can Tho city, Cai Rang district is the gateway to the young city of the Mekong Delta, identified as the center of economic, cultural, political, and development security and defense of Can Tho city. Economic development along with population pressure is often accompanied by environmental concerns, especially the problem of solid waste generated which is increasing in both volume and type. According to statistics, every day, the total amount of solid waste (mainly MSW) in Can Tho city reached more than 700 tons. At the same time, the classification, collection, transportation, and treatment of waste has become a difficult problem for managers in most countries around the world, especially countries with developing economies. Stemming from the above issues, research and evaluation of household solid waste management in Cai Rang district, Can Tho city need to be carried out. The study was conducted to evaluate the current status of MSW generation, waste classification at source, MSW collection and treatment in Cai Rang district, Can Tho city. From there, we can evaluate the advantages and difficulties in MSW management, contributing to helping local authorities come up with more effective solid waste management solutions.

2. EXPERIMENTAL SECTION

2.1 Description of The Research Area

Cai Rang district is located in the Southeast of Can Tho city, and is the socio-economic center of the region. The

district has a total natural area of 6,781.72 ha, a population of 107,899 people equivalent to 32,815 households, including seven wards: Le Binh, Ba Lang, Thuong Thanh, Phu Thu, Tan Phu, Hung Phu, and Hung Thanh. Within the scope of the study, the two wards with the largest population, representing urban areas, are Hung Phu and Le Binh wards, while the two wards with the smallest population, representing rural areas, are Ba Lang and Tan Phu wards were selected as research locations. Specifically, Hung Phu, Le Binh, Tan Phu and Ba Lang wards have populations of 19,870 people; 19,522 people; 8,743 people and 6,295 people, respectively. The locations of the study wards are presented in Figure 1.

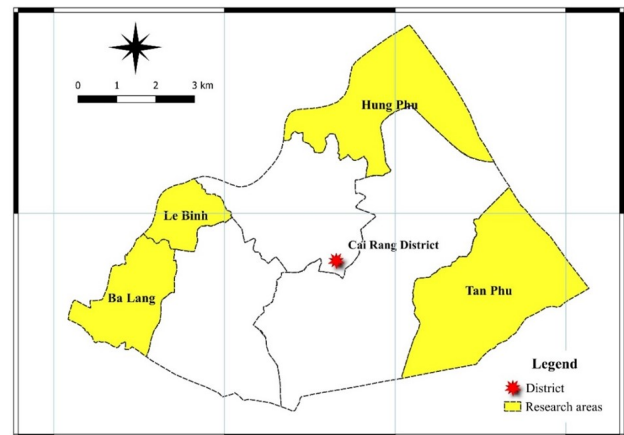


Figure 1. Location of Research Wards in Cai Rang District, Can Tho City

2.2 Method of Collecting and Analyzing MSW Samples

To determine the volume and composition of MSW generated, the study conducted continuous MSW sampling within 7 days from March 6 to 12, 2023 at 20 households in four wards: Hung Phu, Le Binh, Tan Phu and Ba Lang. MSW was randomly collected from five households per ward. Households were equipped with trash bags to facilitate disposal and collection. After garbage samples are collected in each ward, MSW was classified into three groups including easily biodegradable organic waste, recyclable waste, and the remaining waste. Each waste component was weighed using a scale (accuracy 0.01 kg) and the corresponding mass was recorded.

2.3 Interview Method

To evaluate the current status of MSW management, the study conducted direct interviews with three groups of subjects including households, employees of Urban Environment Joint Stock Company and Environmental management officers in Cai Rang district using a pre-designed questionnaire. For management staff, the study interviewed three officials

at the Department of Natural Resources and Environment of Cai Rang district. In addition, the study also interviewed three employees of Can Tho City Urban Environment Joint Stock Company. For households, the study conducted random direct interviews with households in four wards: Hung Phu, Le Binh, Tan Phu and Ba Lang. The interview content revolved around the current status of MSW generation, classification, collection, transportation, and treatment of MSW. The sample size was determined according to Slovin's formula as Equation (1) (Bhusal et al., 2020).

$$n = \frac{N}{(1 + Ne^2)} \quad (1)$$

In which: n is the number of households to be interviewed, N is the total number of households in four wards of Hung Phu, Le Binh, Tan Phu and Ba Lang in Cai Rang district. According to the 2022 population statistics report, there are 17,177 households in the four wards of Hung Phu, Le Binh, Tan Phu, and Ba Lang. e is the allowable error of 10%. In this study, to ensure sample size and representativeness of the whole, the total number of households that need to be interviewed is 120 samples in four wards, equivalent to randomly interviewing 30 households in each ward.

2.4 Data Processing Method

Determine the percentage composition of MSW types as Equation (2).

$$\% \text{Waste type} = \frac{m_i}{m} \times 100 \quad (2)$$

With: m_i is the mass of the type of household waste to be calculated (kg) and m is the total mass of household waste collected (kg).

The MSW generation coefficient is calculated as Equation (3).

$$\text{Waste generation coefficient (kg/person/day)} = \frac{\text{Mass of solid waste}}{\text{Number of household members}} \quad (3)$$

For qualitative data, the study conducted data coding, descriptive statistics of total, average and percentage.

3. RESULTS AND DISCUSSION

3.1 Current Status of MSW Generation in The Study Area

3.1.1 Volume of MSW Generated

The result recorded that there were 4 sources of MSW generation in the research areas in Cai Rang district, Can Tho city. Firstly, MSW was generated from residential areas such as the Cadif residential area, and the Hung Phu 1 residential area. Secondly, MSW was generated from commercial

areas, which included the Cai Rang market, 586 market, Cai Chanh market, and restaurants, hotels, business stores, and repair services in the study area. Thirdly, MSW was generated from agencies, offices, and schools in the study area. Finally, MSW was generated from public areas, including central bus stations, landscape parks, streets and tourist attractions. To determine the volume of MSW generated, the study collected waste samples from 20 households. After 7 days of collecting garbage samples, the total volume of MSW generated in the four wards of Hung Phu, Le Binh, Ba Lang and Tan Phu reached 119.1 kg, ranged from 25.5-36.1 kg (Figure 2a). In particular, Le Binh ward had the highest MSW generation, while Tan Phu ward had the lowest. The reason may be due to some differences in family members, economic conditions, occupations and product use needs between different regions. Regarding the waste generation rate, the MSW generation coefficient ranged from 0.26 kg/person/day to 0.31 kg/person/day, reaching an average of 0.28 kg/person/day (Figure 2b). This result showed that there was a difference in the level of MSW generation in urban and rural areas in Cai Rang district, in which Hung Phu and Le Binh wards have high populations, many shopping centers and markets. Convenient for people to buy and use a variety of products, thereby creating a large amount of waste. From there, if calculated based on the current population in Cai Rang district, the amount of MSW generated can reach about 11,027.3 tons by the end of 2023. The level of MSW generation in the study area tends to be lower than in some other research areas. Typically, the MSW generation coefficient in 6 wards in Bac Ninh city ranged from 0.34-0.94 kg/person/day, averaging at 0.65 kg/person/day (My et al., 2022). Similarly, the biocide generation coefficient in Homs City (Syria) and Phong Dien district (Can Tho city) was also significantly higher than the current research area, reaching an average of 0.68 kg/person/day and 0.65 kg. /person/day, respectively (Noufal et al., 2020; Giao et al., 2023). Besides, in 5 communes in Dong Hung district, Thai Binh province, the MSW generation coefficient ranged from 0.53-0.61 kg/person/day, higher than the current research area (Oanh, 2020). At the same time, this result was lower than the waste generation coefficient published by the World Bank, on average one person generates about 0.74 kg of solid waste per day (Source: https://datatopics.worldbank.org/what-a-waste/trends_in_solid_waste_management.html).

3.1.2 Components of Generated MSW

The composition of MSW generated in 4 wards in Cai Rang district, Can Tho city, was divided into 3 groups, including biodegradable organic waste group, recyclable waste group, and remaining waste group with the amount ranged from 14.51-17.1 kg (total 62.32 kg), 10.08-13.97 kg (total 46.22 kg) and 0.57-6.87 kg (total 10.53 kg), respectively (Figure 3). Among them, the group of easily decomposable organic waste accounted for the largest proportion, on average about

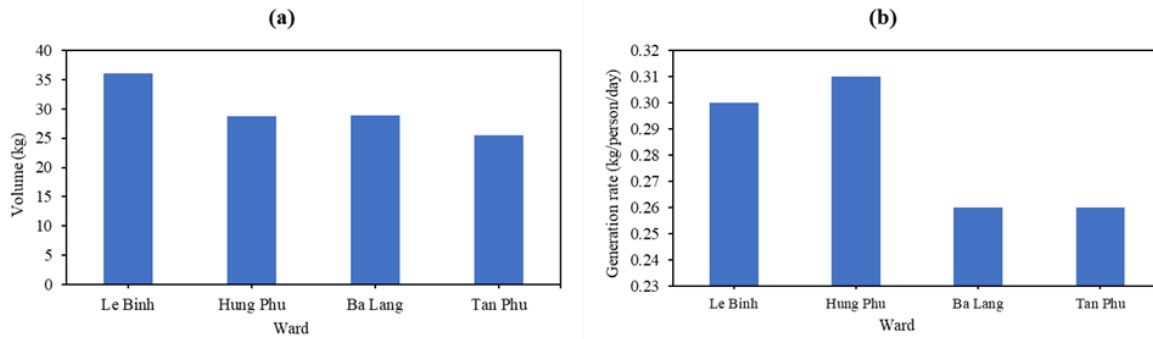


Figure 2. Volume and Generation Coefficient of MSW in the Study Area

52% of the total. Next, the recyclable waste group, and other waste group average about 39% and 9% of the total, respectively. The composition of organic waste accounting for the majority of MSW was also recorded in some other areas, such as Dien Bien district (accounting for 64%) (Gioi et al., 2020), Dong Hung district-Thai Binh province (accounting for 45-51%) (Oanh, 2020), Cau Giay district-Hanoi (accounting for 65-69%) (Oanh, 2021), Phong Dien district-Can Tho city (accounting for 50.68-58.67%) (Giao et al., 2023). At the same time, this result is consistent with the 2019 national environmental status report, the organic waste component ranged from 46-71.8%, accounting for a higher proportion than other waste components (Ministry of Natural Resources and Environment, 2020). Additionally, according to estimates by Al Seadi et al. (2013), the volume of MSW will increase to 2200 million tons by 2025, with about 46% organic waste content.

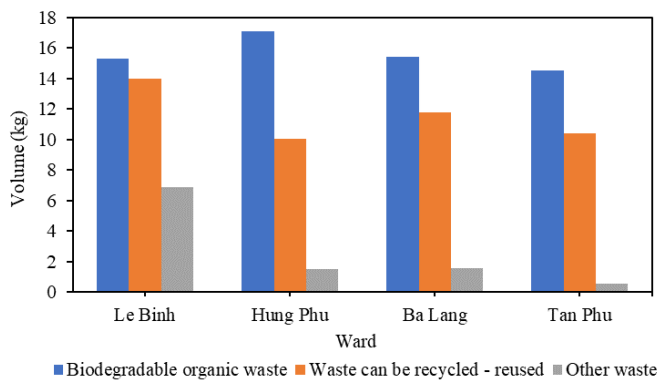


Figure 3. Volume of MSW Components Generated in the Study Area

3.1.3 Biodegradable Organic Waste

The volume of biodegradable organic waste in 4 wards Le Binh, Hung Phu, Ba Lang and Tan Phu in Cai Rang district, Can Tho city, was 15.28 kg (accounting for 42.33%), 17.1 kg (accounting for 59.58%), 15.43kg (accounting for 53.58%)

and 14.51 kg (accounting for 56.90%), respectively, with the highest concentration in Hung Phu ward (Figures 3-4). However, there was not a significant difference in the volume of this component between urban and rural areas. The reason may be because urban areas have many markets and grocery stores, people can easily buy food, vegetables, and fruits, while rural areas are agricultural and horticultural production areas, so the amount of waste is high. Improper management of organic waste will lead to many problems such as environmental pollution, eutrophication, loss of urban aesthetics, greenhouse gas emissions and effects on human health. However, this is a raw material source that can be utilized to produce fertilizer through techniques such as composting and vermicomposting (Sharma et al., 2019; Ayilara et al., 2020). These are widely used technologies to convert waste into fertilizer, thereby recycling mineral nutrients (nitrogen-N, phosphorus-P and potassium-K) that can be used for agricultural purposes (Wojnowska-Baryła et al., 2020). In addition, recycling this waste source brings a number of environmental and economic benefits such as reducing greenhouse gas emissions, preserving soil by reducing waste landfilling and replacing chemical fertilizers, and protecting underground water sources, reducing the cost of landfilling and transporting waste, and reducing the cost of importing and producing chemical fertilizers (Sharma et al., 2019). Therefore, it is necessary to guide and encourage people to classify waste at source to be able to take advantage of this resource.

3.2 Recyclable Waste

The volume of recyclable waste in 4 wards Le Binh, Hung Phu, Ba Lang and Tan Phu in Cai Rang district, Can Tho city, was 13.97 kg (accounting for 38.68%), 10.08 kg (accounting for 35.12%), 11.76 kg (accounting for 40.90%) and 10.41 kg (accounting for 40.83%), respectively, mainly concentrated in two wards in urban areas (Figures 3-4). The reason is that in urban areas people need to use a variety of pre-made or packaged drinks and foods rather than cooking at home, which gives rise to many types of packaging, plastic straws, plastic bottles, nylon bags, paper

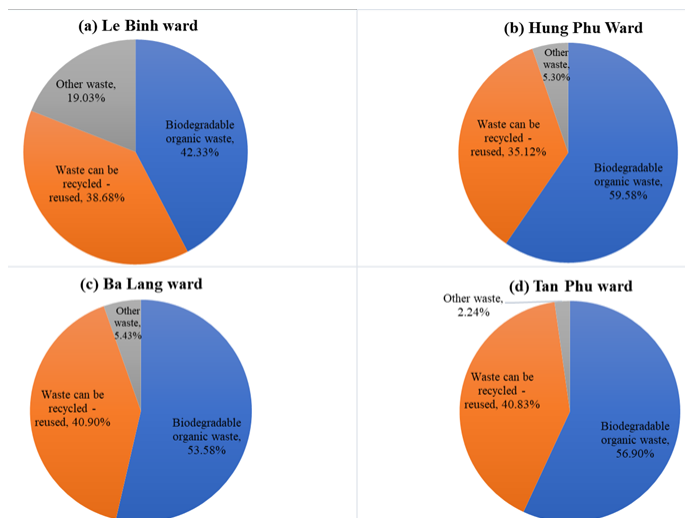


Figure 4. Percentage of MSW Generated in the Study Area

and milk cartons. Notably, single-use plastic waste accounts for the majority of this waste stream. Currently, single-use plastic products are very commonly used in daily life, due to their convenience, cheapness and ease of use. According to a report by the [General Department of Environment \(2020\)](#), the amount of plastic waste generated by humans globally is enough to cover four times the Earth's surface area, of which 13 million tons of plastic waste is dumped into the ocean, negatively impacting the environment, ecosystem and sustainable development of the country. This is because they are not easily biodegradable and persist for a long time in the environment, typically each plastic bag or piece of plastic takes an average of 200-300 years to decompose ([Kibria, 2017](#); [General Department of Environment, 2020](#)). Therefore, waste separation at source is considered a key factor affecting recycling ([Almasi et al., 2019](#)). Recycling is a method to optimize the use of other resources and create less waste, thereby helping to reduce waste collection and treatment costs, especially contributing to minimizing environmental pollution ([Almasi et al., 2019](#); [Huang et al., 2022](#)).

3.2.1 Other Waste Group

The volume of other waste groups in 4 wards Le Binh, Hung Phu, Ba Lang and Tan Phu in Cai Rang district, Can Tho city, was 6.87 kg (accounting for 19.03%), 1.52 kg (accounting for 5.30%), 1.57 kg (accounting for 5.43%) and 0.57 kg (accounting for 2.24%), respectively (Figures 3-4). This group of waste continues to be highly concentrated in two wards in urban areas. The reason may be because urban areas have a highly concentrated population and a large and diverse demand for products. This group of waste includes baby diapers, old clothes, cigarette butts, broken glass, tissue paper, and masks.

3.3 Current Status of MSW Management

3.3.1 Current Status of Classification and Management of MSW at Source

Figure 5 shows the level of MSW classification at source by households in the study area. The result showed that the rate of MSW classification in households in two wards in urban areas was significantly higher than in two wards in rural areas, ranged from 80-86.7% and 43.4-53.3%, respectively. Households do not have the habit of classifying MSW at source or do classify it but only do it in a simple and not thorough way. For example, solid waste from the garden is collected in one place to burn to get ash as fertilizer for plants; Leftover food such as vegetables and fruits used as pet food; Plastic bottles and waste paper are sold as scrap. In addition, when asked about solid waste classification activities at source if they receive specific instructions from local agencies and organizations, households said that they rarely receive specific instructions on how to classify solid waste at source. Households in the study area also said that, although on the mass media, typically the ward's radio program, meetings organized by the Women's Union, and Farmers' Union encouraged households participate in environmental protection, however, the classification of MSW at source is only disseminated in general terms, without specific instructions, so people still do not fully understand MSW groups. For example, what is organic waste, recyclable inorganic waste, non-recyclable inorganic waste or hazardous solid waste. In particular, for households that participate in MSW collection services but they do not classify waste at source, the reason is that solid waste, whether classified or not, is dumped into specialized vehicles or trucks. There is no design of compartments suitable for each classified waste group. Similarly, the results of interviews with staff of Urban Environment Joint Stock Company and Environmental management officers said: "Currently, in Cai Rang district in particular and Can Tho city in general, the problem of classifying solid waste at source is very difficult to do, although classifying solid waste at source brings many great benefits such as helping to manage solid waste better, reducing the amount of waste that must be treated, thereby reducing waste storage area and saving treatment costs, saving resources due to recycling". Japan passed a waste classification law in the 1970s, which classified MSW into 25 categories, resulting in the recovery rates of paper and plastic reaching 76% and 59%, respectively, in 2017 ([Wang et al., 2021](#)). Similarly, MSW in Germany is classified into 14 types and achieves a recovery rate of 66.2% ([Wang et al., 2021](#)). Doing a good job of separating waste at source is essential to implementing a sustainable waste management system ([Wang and Tan, 2022](#)), which is the key to achieving the goal of reducing harmless waste and recovering resources, and is also the best way to improve solid waste reuse ([Qiao and Hua, 2021](#)). However, to do this requires a huge amount of funding to equip appropriate solid waste collection vehicles. In addition, households must be

supported with different solid waste containers corresponding to solid waste groups classified according to regulations. At the same time, there needs to be specific policy solutions, propaganda, and law enforcement to improve the rate of waste classification at source in the study areas as well as bring about efficiency from waste classification at source.

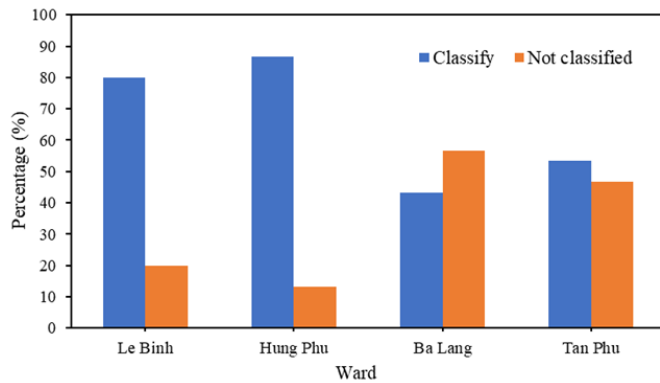


Figure 5. Rate of Waste Separation at Source in the Study Area

3.3.2 Current Status of MSW Collection and Transportation

The rate of households registered for MSW collection service was different between urban and rural areas in the study area. Specifically, in two wards Le Binh and Hung Phu, the rate of registration for collection services ranged from 86.7-96.7%, while in two wards Ba Lang and Tan Phu, this rate ranged from 76.7-80%. This is because most of the roads in the two wards in urban areas are convenient for the movement of specialized collection vehicles, and at the same time, garbage collection is only collected on major roads and residential areas or resettlement, and on small, sparsely populated roads, there is still no garbage collection service. Currently, collection and transportation of MSW from households, organizational, business, and service units in the district are all performed by Can Tho City Urban Environment Joint Stock Company. The garbage collection process is conducted once a day between 3-4 PM. This collection frequency is highly appreciated and reasonable by most people, accounting for over 75% of the total. In the process of collecting trash throughout the district, there are about 4 specialized trucks (8-9 tons) collecting trash on major roads, and about 15 types of rudimentary vehicles mainly collecting at markets or a small road that trucks cannot access. After collection, household waste is gathered at rendezvous points or transfer stations. Here, the waste is gathered and transferred to a specialized garbage compactor truck to the treatment site, the Can Tho waste incineration plant (EB plant). For garbage collection fees, Urban Environment Joint Stock Company applies Decision No. 40/2016/QD-UBND stipulating service rates in Can

Tho city dated December 30, 2016 (People's Committee of Can Tho City, 2016). Specifically, for fixed trade and retail households, the MSW collection fee ranges from 20,000-30,000 VND/month. For households that do not produce or do business in the frontage, and in the alley, the fee ranges from 10,000-20,000 VND/month.

3.3.3 Current Status of MSW Treatment

The result showed that there were 3 forms of MSW treatment applied in households in Le Binh, Hung Phu, Ba Lang and Tan Phu wards, including self-burying and treatment at the EB plant and thrown into the river (Figure 6). Among them, the MSW treatment method at the EB plant accounted for the largest proportion, ranged from 76.7-96.7%. At the same time, this rate was highly concentrated in two wards in urban areas: Le Binh (accounting for 96.7%) and Hung Phu (accounting for 86.7%). Currently, more than 70% of the volume of MSW generated in Cai Rang district was processed at the Can Tho household waste incineration plant, located in Truong Xuan commune, Thoi Lai district, Can Tho city. The factory operates under the management of EB Can Tho Energy and Environment Limited Liability Company (part of Everbright Environment Group). The main activity of the plant is to receive and burn household waste to recover energy to generate electricity with a processing capacity of 400 tons of waste/day. After more than 3 years of operation, the plant has processed a total amount of waste of over 500,000 tons, connecting more than 180 million kWh to the national power grid. As for burying and throwing garbage into rivers, the rates fluctuated between 3.3-13.3% and 10-13.3%, respectively, concentrated mainly in wards in rural areas (Figure 6). This situation is because some areas in rural areas lack household waste collection services, so people have to use alternative methods that are often unsafe and unsanitary. As reported by Gómez-Sanabria et al. (2022), highlighted that about 80% of improperly disposed waste in rural areas was significantly related to uncollected waste. This situation was also recorded in some other rural areas in Vietnam and around the world, such as Minh Nghia commune-Thanh Hoa province (Hong and Thuong, 2016), Chieng Ngan commune-Son La province (Toan et al., 2019), Ogun state-Nigeria (Olukanni et al., 2020), and Nhon Nghia commune-Can Tho city (Giao et al., 2023), contribute to environmental pollution and significant impact on public health. Landfills and open dumps were associated with emissions of methane (CH₄), a greenhouse gas (Abubakar et al., 2022). As reported by Scarlat et al. (2015), about 29 tons of CH₄ were released annually from landfills globally, accounting for about 8% of estimated global emissions. In addition, leachate from landfills contaminated water sources for drinking and other household uses, posing significant risks to public health, typically causing cholera and other intestinal tract (Abubakar et al., 2022; Al-Taai, 2022). Bad smells from landfills caused air pollution, especially affecting the lives of people living in neighboring areas (Siddiqua

et al., 2022). In addition, the spread of waste of various types, accumulating on land without proper treatment or management, leads to changes in soil quality, reducing soil fertility (Al-Taai, 2022). Meanwhile, littering in the river pollutes the water, clogs drains and risked causing floods due to clogging the river flow (Ayilara et al., 2020; Pijoh et al., 2023). Waste entering water bodies can adversely affect water bodies by reducing pH, causing toxicity to aquatic organisms and humans using that water source (Ayilara et al., 2020).

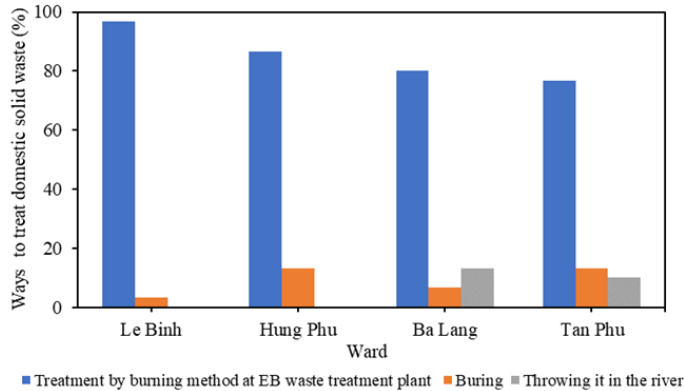


Figure 6. Ways of MSW Treatment in the Study Area

3.4 Current Status of Propaganda Work Related to MSW Management

Through Figure 7, it can be seen that propaganda activities related to MSW management were carried out in four wards in Cai Rang district, Can Tho city. However, two wards Le Binh and Hung Phu in urban areas received more attention and regularly had activities related to solving the problem of MSW generation than two wards in rural areas. For environmental protection communication activities in the study area, the proportion in Le Binh, Hung Phu, Ba Lang and Tan Phu wards were 83.3%; 73.3%; 20%; and 30%, respectively. These activities included posting posters in public areas, using loudspeakers, organizing meetings, and posting news on newspapers and radio. Regarding environmental cleaning activities, typically cleaning and collecting trash on roads in the area, the level of implementation of this activity in the two urban wards together accounted for 66.7%, while this rate in two rural wards only fluctuated between 20-23.3%. Regarding the performance of competitions and performances on waste and environmental sanitation in the study area, the rates ranged from 26.7-40% and 16.7-46.7%, respectively, with the lowest concentration in Tan Phu ward. Similarly, the implementation rate of programs and projects on environmental sanitation in the four wards was also quite low, only fluctuating between 30-46.7%, with the lowest concentration in Ba Lang ward. From there, it was found that the implementation of propaganda activities related to MSW in the study area, especially rural areas, needs to be given

more attention. Propaganda activities on MSW issues and environmental protection are of great significance in changing people’s awareness and habits about waste generation as well as waste classification at source, waste disposal and treatment. Thereby contributing to improving the quality of MSW management locally.

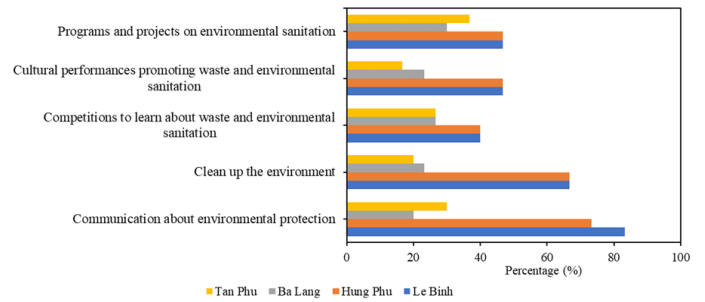


Figure 7. Rate of Implementation of Some Propaganda Activities Related to MSW Management

3.5 Difficulties in MSW Management

From the current situation of MSW management in four wards in Cai Rang district, Can Tho city, this study identified some difficulties in solid waste management. Firstly, MSW was not classified at source, typically the waste classification rate in rural areas only fluctuated between 43.4-53.3%. This caused many difficulties in waste management and treatment. Community awareness of waste classification at source was not high. Many households believing that waste classification was the responsibility of solid waste management units and still had the habit of disposing of all types of waste into the general trash bag. At the same time, local authorities did not actively promote and specific instructions on waste classification for households. Secondly, Cai Rang district had many wards and areas far from the center, so the work of collecting, transporting, and treating MSW was still inadequate. On small roads, there was no garbage collection service, so garbage was thrown indiscriminately into rivers and spontaneous landfills, which were considered to have contributed to environmental pollution. Thirdly, the collection and transportation of waste were limited in terms of labor and equipment, and there were no modern means of transporting MSW. Typically, there was a lack of capital for implementing waste classification on a citywide scale because it required investments in specialized equipment for the separate collection of each type of MSW and a larger workforce compared to conventional collection. According to the Ministry of Natural Resources and Environment (2020), funds collected from environmental sanitation fees were only enough to pay about 20-25% of the cost of collecting and transporting MSW. Finally, public propaganda and education about MSW management were not conducted regularly. Scientific research on the effects of solid waste on water, air,

soil and human health was still limited. On this basis, the research will contribute to helping local authorities come up with specific, practical solutions, thereby improving the quality of solid waste management in Cai Rang district, Can Tho city in the future.

4. CONCLUSION

The MSW generation coefficient in the study area ranged from 0.26-0.31 kg/person/day, reaching an average of 0.28 kg/person/day, with an estimated 11,027.3 tons of MSW by the end of 2023. Of which, two wards in urban areas had a higher level of MSW generation than two wards in rural areas. MSW composition was mainly 52% biodegradable organic waste, and 39% recyclable waste. MSW management in Cai Rang district had several issues: low waste classification rates, incomplete waste collection services, and a lack of specialized collection vehicles. Some uncollected MSW was disposed of unsanitarily or thrown into the river. Although propaganda activities related to household solid waste management were carried out in four wards of Cai Rang district, the level of implementation of these activities was not regular. This research will help local authorities provide specific solutions to improve the quality of solid waste management in Cai Rang district, Can Tho city.

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