



METHOD OF COLLECTING DOMESTIC SOLID WASTE IN THE URBANIZATION PROCESS IN NAM TU LIEM DISTRICT, HANOI CITY

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Abstract

Nam Tu Liem district is a newly established district of Hanoi city, the urbanization process is taking place rapidly, and urban facilities and infrastructure are being developed, on the other hand, it also creates pressure on the environment, increasing the amount of solid waste. This study aims to understand the changes in the management and collection methods of domestic solid waste in residential areas, during the urbanization process. The study uses the field survey method, collects information from residents and management agencies, conducts analysis, and evaluates the effectiveness of waste collection methods currently being implemented in this district. The study results calculated that there are about 330.34 tons of domestic solid waste generated every day, domestic solid waste is collected at fixed locations and times in residential areas. For old apartment buildings, waste is collected at no fixed time, by collection pipes along the height of the building and then led to the ground floor. The collection model has changed in new apartment buildings, solid waste is collected at the garbage collection room on each separate floor, then the garbage collectors will transport it to the garbage collection point. The study found that 70 % of respondents did not classify solid waste at source, 29 % did classify solid waste to extract some recyclable waste components to sell to scrap collectors, and a few people classified organic waste to compost for growing plants at home. Most people understood or had heard of waste classification at source, but only 34 % of respondents were willing to change their habits or spend money to classify waste at source.

Keywords: Nam Tu Liem; Domestic solid waste; Classifying solid waste at source.

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1. Introduction

Domestic solid waste (DSW - also known as household waste) is solid waste generated in people's daily activities.

DSW is generated from households, public areas, commercial areas, construction areas, hospitals, waste treatment areas, etc. Of which, household waste accounts

for the highest proportion. The quantity, composition, and quality of waste in each country and region are very different, depending on the level of economic, scientific, and technical development [1].

The process of rapid economic growth and urbanization with the number of manufacturing and business sectors, industrial parks, and urban services increasingly developing has created a migration flow from rural to urban areas. Economic development and urbanization on the one hand create millions of jobs for workers, on the other hand also create pressure on the environment, increasing the amount of waste generated, especially household waste. The amount of solid waste generated each day in urban areas depends mainly on the population size, urbanization, and industrialization rate of the city [2]. Meanwhile, the urban infrastructure system has not developed synchronously; the level and capacity of management do not meet the development needs of the urbanization process, causing many pressures on the environment and public health. In recent years, environmental pollution from solid waste, especially at landfills, has been a pressing issue for society [3]. DSW in urban areas accounts for more than 50 % of the total amount of solid waste in the country, increasing from 32,000 tons/day in 2014 to 35,624 tons/day in 2019, accounting for 55 % of the total amount of solid waste generated in the country. Hanoi is the city with the second highest amount of solid waste generation in the country, after Ho Chi Minh city [4]. In these two cities alone, the total amount of urban solid waste generated each day is up to 12,000

tons, accounting for 33.6 % of the total amount of urban solid waste generated nationwide. The amount of solid waste generated in the 5 largest cities, namely Hanoi, Ho Chi Minh city, Da Nang, Hai Phong, and Can Tho, accounts for about 40 % of the total amount of solid waste generated from all cities in the country [5, 8]. In urban areas, DSW generated from households is usually collected by units at certain times, manual vehicles are used by collectors to transport waste to collection points, from there they are loaded onto trucks to transport to treatment facilities or to transfer stations, and finally transferred to treatment facilities [4]. The collection rate of domestic solid waste in urban areas of localities ranges from 62 % to more than 90 % [3]. In concentrated apartment buildings, many places do not have the infrastructure to ensure the collection and classification of waste at source, leading to people not having waste classification activities [6]. The urbanization rate of the whole country has increased rapidly from 30.5 % in 2010 to about 40 % in 2020; Creating favorable conditions for socio-economic development, and promoting economic and labor restructuring towards industrialization and modernization, the urban area is expanded [7, 8]. This study may provide more useful information on how solid waste collection practices have changed during urbanization, and some recommendations to improve the efficiency of urban solid waste management.

2. Research methodology

Documents on the urbanization situation and the status of DSW

collection and management in Nam Tu Liem district were collected from annual socio-economic development reports of specialized management agencies of the district and Hanoi city. Reference documents released from 2020 to 2022.

Supplementing the current status of solid waste generation through survey activities in 03 wards (My Dinh 1, Phuong Canh, Tay Mo), during the period from February to May 2023. Accordingly, 50 households in the area were randomly selected and then distributed collection bags, weighing the amount of solid waste (wet) generated each day by the family. Solid waste generated during the day was collected from 6.00 AM to 6.00 PM, while solid waste generated at night was calculated from 6.00 PM the previous day to 6.00 AM the following day, data were collected for 10 consecutive days.

Assessing people's awareness through random interviews with 100 people in households participating in the waste collection program of this study, interview information such as waste collection and classification activities, as well as people's willingness to implement waste classification regulations. Other interviews were also conducted with waste collection and transportation service companies, experienced experts, and district environmental management officers on waste management policies, describing the collection and transportation process of domestic solid waste, and the price of waste collection services for different waste generators. The experts made comments based on observations of urban practices in Hanoi.

3. Results and discussion

3.1. Current status of domestic solid waste generation in Nam Tu Liem district

According to statistics of the Hanoi Urban Environmental Company (URENCO) in 2021, on average 330.34 tons of DSW are generated in Nam Tu Liem district every day (Table 1). On weekdays, it ranges from 320 - 325 tons/day. Peak weekend volume can reach 340 - 350 tons/day. The amount of waste generated is about 45 - 50 tons during the daytime and at night about 280 - 290 tons. DSW is generated from households, shops, shopping malls, apartment buildings, and state and private organizations. Nam Tu Liem district is a new district established in 2013, from the old Tu Liem district, so the urbanization process is taking place rapidly, and many businesses have been established. Nam Tu Liem district also welcomes many new residents from many places to settle down, live, and work. The amount of household waste generated from households is greater in the evenings and weekends than during the day [2].

Table 1. Domestic solid waste generated in Nam Tu Liem district in 2021 [8]

No.	Wards	Average waste (tons/day)	Average waste (tons/year)
1	Trung Van	60,800	22.192,18
2	Me Tri	44,275	16.160,38
3	Phu Do	22,183	8.096,98
4	Tay Mo	37,639	13.738,42
5	Dai Mo	44,079	16.089,02
6	Xuan Phuong	24,725	9.024,63
7	Phuong Canh	26,013	9.494,75
8	My Dinh 1	39,870	14.552,73
9	My Dinh 2	46,356	16.920,12
10	Cau Dien	37,536	13.700,64
Total		333,460	121,712,90

A survey of 50 families with 193 people, for 10 consecutive days, in My

Dinh 1 ward (17 families), Phuong Canh (17 families), and Tay Mo (16 families) showed that on average each person generates 1.065 kg per day, with the most household waste generated on the two weekends, reflecting the living characteristics of urban residents.

The population of Nam Tu Liem district in 2020 was 290,052 people, an increase of 56,562 people compared

to 2013, equivalent to 24.22 %. With the standard of domestic solid waste generation through survey research of 1,065 kg/person, the total amount of solid waste generated in the area is estimated at approximately 309 tons/day, this figure reflects a similar reflection to the statistical report on the volume of domestic solid waste published by the URENCO, which is from 320 to 325 tons/day.

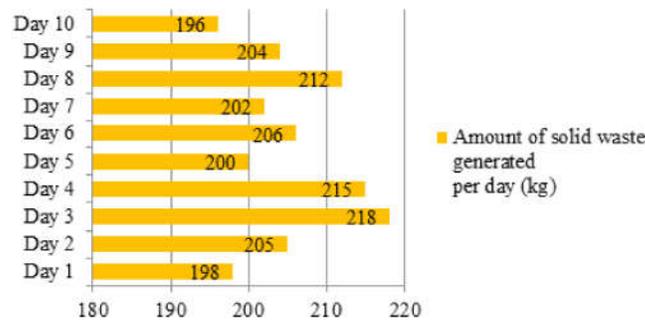


Figure 1: Daily domestic solid waste generation volume of the study area

3.2. Current status of solid waste collection management in Nam Tu Liem district

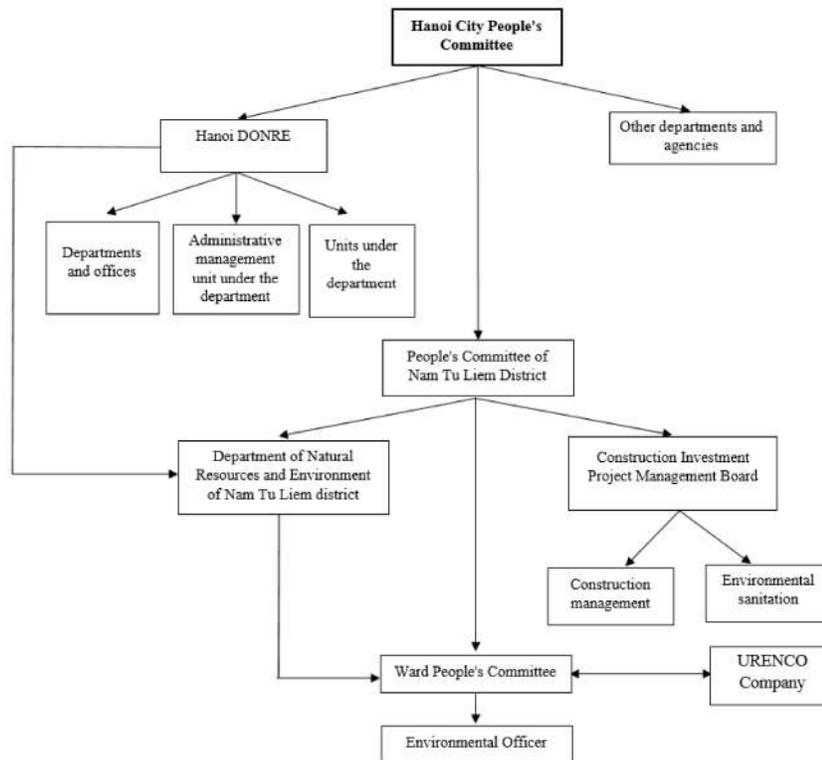


Figure 2: Organizational structure for domestic solid waste management in Nam Tu Liem district

Currently, environmental sanitation work, including DSW collection in the Nam Tu Liem district, is carried out by the URENCO. The solid waste collection and treatment model applied by the URENCO in the Nam Tu Liem district is still manual. Although there is some combination of machinery, it is still limited, the number of manual workers still accounts for the majority. Workers collecting in alleys and lanes mainly still use hand-pushed vehicles, which takes a lot of effort and time.

Currently, the management of domestic solid waste in Hanoi is related to several state management agencies. The Department of Natural Resources and Environment is responsible for managing and advising the City People's Committee to resolve issues related to solid waste in the city; the Department of Construction is responsible for appraising the design of waste treatment facilities; the Department of Finance is responsible for managing the city's budget for collecting, transporting and treating domestic solid waste. The Department of Natural Resources and Environment of Nam Tu Liem district is a specialized agency directly responsible for managing the environmental sector in the district, including the management of domestic solid waste. The district Construction Investment Project Management Board is responsible for managing the collection, transportation, and treatment. URENCO company is the unit that collects and transports domestic waste in the Nam Tu Liem district. Environmental officers of wards are responsible for

advising the Ward People's Committee and directly managing the state on environmental issues in the ward under their management.

On average, each day the collection unit will collect domestic solid waste with an average transport volume of 330 tons divided into 2 shifts: Day and night shifts. The day shift uses vehicles with a load capacity of 6.5 tons and 10.1 tons with a collection volume of about 46.2 tons. The night shift uses vehicles with a load capacity of 6.5 tons, 9.57 tons, 11 tons, 10.3 tons, and 10.1 tons with a collection volume of about 284.14 tons. In Nam Tu Liem district, average solid waste fees are collected according to customer groups including Individuals, production and business households, administrative agencies and public offices, and other organizations (Table 2). However, the funds collected from households and production and business establishments for domestic solid waste only cover part of the collection or transportation costs, the remaining part of the transportation and treatment costs is paid by the local budget. Funding for domestic solid waste management is taken from the local budget, and allocated according to the proposal of the Department of Finance to the People's Committee and People's Council of Hanoi for annual approval.

Table 2. Environmental sanitation service price for household waste in Nam Tu Liem district

No.	Individual/Organization	Unit	Price
1	Individual	VND/person/month	6,000
2	Production and business households		
2.1	Households doing business in hotels, restaurants, trading, food and beverage items, construction materials (bricks, sand, stone, gravel,...), vegetables, fruits, fresh food, flower business, village craft		
a	Waste volume $\leq 1 \text{ m}^3/\text{month}$	VND/household/month	130,000
b	Waste volume $> 1 \text{ m}^3/\text{month}$	VND/ m^3 VND/ton	208,000 500,000
2.2	Small business, other trade	VND/household/month VND/household/day	50,000 3,000
3	Organizations (administrative agencies, schools, hospitals...)		
3.1	Waste volume $\leq 1 \text{ m}^3/\text{month}$	VND/unit/month	130,000
3.2	Waste volume $> 1 \text{ m}^3/\text{month}$	VND/ m^3 VND/ton	208,000 500,000
4	Other organizations and establishments	VND/ m^3 VND/ton	208,000 500,000

3.3. Methods of collecting and transporting domestic solid waste in households and residential areas in Nam Tu Liem district

The urbanization process of Nam Tu Liem district has led to significant changes in the living community and residential infrastructure. Old residential areas are characterized by unsynchronized

infrastructure, concentrated low-rise housing, narrow roads, and alleys, typically in Me Tri, Phu Do, Tay Mo, and Dai Mo wards. In recent years, many concentrated residential areas and newly built apartments have had more complete infrastructure. The collection and transportation of solid waste from residential areas have also changed a lot.

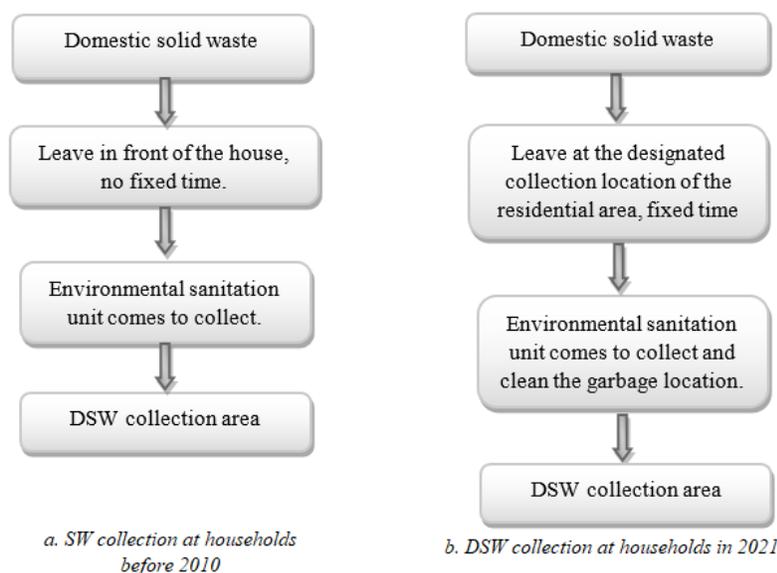


Figure 3: Domestic solid waste flow chart in residential areas

Before 2010, the waste collection model in Nam Tu Liem district was manual and had no clear regulations. Waste was left in front of the house by people and there was no specific time (Fig. 3). There was always waste scattered on the streets, leading to a lack of urban aesthetics and environmental sanitation, and bad odors appeared in places where people gathered waste. Since 2020, solid waste collection in residential areas has been reorganized and become more reasonable, with

regulations on waste locations and the time when households can bring waste to the collection location. At a specific time of the day (depending on the regulations of each residential area), waste is left in designated locations, and the environmental unit is responsible for collecting and cleaning the waste location. The new form of solid waste collection aims to ensure urban aesthetics while keeping the urban area clean and making people more aware of solid waste collection.

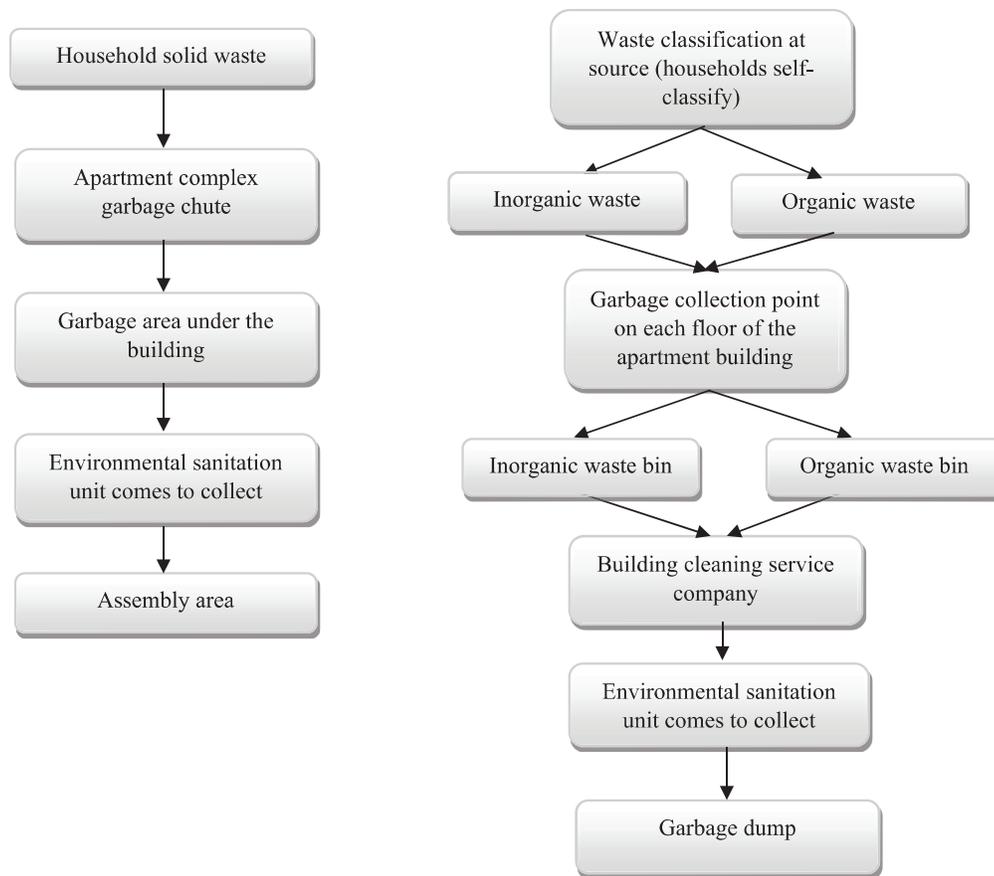


Figure 4: Domestic solid waste flow chart at concentrated apartment buildings in Nam Tu Liem district

Garbage collection in old apartment buildings (used for more than 20 years) in Nam Tu Liem district often uses garbage pipes, a garbage pipe system from the ground floor to the top floor of the building. Residents do not set a

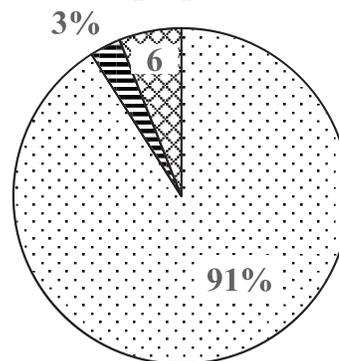
time to put garbage into the garbage pipe. Garbage will follow the pipe down to the first floor of the building. At the foot of the building, there will be a garbage collection room with 1 or 2 large garbage bins. The limitation

of this collection model is that it can easily cause fire explosions or bad smell, garbage bags in the process of free falling can tear, and burst, causing garbage to fall out, and collecting and processing is very time-consuming and laborious. In new apartment buildings, there has been a change in the garbage collection model, typically at Vinhome Smart City apartments, each floor will have its garbage room, equipped with 2-layer doors to prevent odors from spreading outside, the garbage room will have 2 garbage bins to classify organic and inorganic garbage. At a certain time of the day, the sanitation unit of the apartment management board will be responsible for collecting the garbage from each floor and bringing it to the garbage collection location of each building. Next, the unit responsible for garbage collection in the district will transport the garbage to the collection point. This collection model can both classify garbage at the source and clean the garbage collection area. Although each building's garbage collection room has inorganic and organic garbage bins, households have not yet classified their garbage. This is only an encouraged action, not a mandatory one. Nam Tu Liem district has not yet had a successful pilot model of waste classification at the source.

3.4. Assessment of people's awareness in Nam Tu Liem district on current domestic solid waste management

The interview results show that 91 % of people surveyed feel satisfied with the current solid waste collection model, 3 %

of people feel dissatisfied with the reason for the delay of the collection unit in the area, and 6 % of people feel acceptable.



□ Satisfied ■ Dissatisfied ▨ Acceptable

Figure 5: Evaluation of domestic solid waste collection activities

According to the interview results, 83 % of the interviewees know how to classify solid waste at source, but 70 % of the respondents do not classify it at source, 29 % of people classify solid waste to get recyclable materials such as paper, plastic, metal, beer cans,...to sell to scrap collectors, only 1 % classify at source to compost organic waste for home plants. 96 % of the respondents know the phrases “Sort solid waste at source”, and “Waste classification” through the media and social networks, but only 34 % are willing to change their habits or spend money to classify waste at source

4. Conclusion

The results of the research and field survey show that the model of collecting and transporting solid waste in the Nam Tu Liem district has changed during the urbanization process. The total amount of solid waste generated in Nam Tu Liem district is estimated at an average of 333.46 tons/day. The collected solid waste reached 100 % in 2021,

URENCO is responsible for maintaining environmental sanitation in the entire district, but there is no waste sorting at the source. In residential areas, solid waste is collected at fixed locations and times. For old apartment buildings, waste is collected by collection pipes along the height of the building and then led to the ground floor. The collection model has changed in new apartment buildings, solid waste is collected at the garbage collection room on each separate floor, then the garbage collectors will transport it to the garbage collection point. The study found that 70 % of respondents do not separate their waste at source, 29 % do separate their waste to extract some recyclable waste components to sell to scrap collectors, and a small number of people separate organic waste to compost for growing plants at home. The majority of people understand or have heard of source separation, but only 34 % of respondents are willing to change their habits or spend money to separate waste at source.

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