



Waste Classification at Source: Empirical Study in Thai Nguyen City

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Abstracts

In Vietnam, along with economic development, the continuous increase in population is making domestic waste in big cities in Vietnam increase faster than other countries in the world. The management and treatment of urban domestic waste in our country is still very backward, mainly burial. Thai Nguyen city is no exception, with the rapid urbanization, the average volume of waste in the city is about 130 tons per day, equivalent to 47,450 tons per year. Currently, all household waste is treated by landfill method. The People's Committee of Thai Nguyen city has implemented the Scheme of waste classification at source since 2014. However, the implementation of the project is still inadequate, largely due to the incomprehensive collecting and processing infrastructure. Therefore, it is necessary to study the current situation, evaluate the implementation results of the Scheme of waste classification and shown assess the limitations of the waste classification at source in the city, in order to have practical solutions that contribute to minimizing the amount of waste, minimizing the risk of environmental pollution, and improving the efficiency of domestic waste management in Thai Nguyen city is the main content of this article.

Keywords: Waste classification at source, the Scheme of waste classification, Waste in Thai Nguyen city



1. Introduction

In the context of urbanization and population growth, waste has become an increasingly serious environmental problem worldwide. Especially in developing countries, waste management can consume 20-50% of the budget. The transitional countries will be severely affected, as there is no tax or fee to maintain waste treatment programs in these countries. Sorting waste at source is meaningful in many ways. In terms of environmental protection, "turning waste into a resource" will reduce the amount of garbage to be buried, reduce the volume of leachate, and reduce negative impacts on the environment. In addition, recycling waste helps preserve natural resources because instead of exploiting new resources, products can be used as a secondary source of raw materials. In terms of economics, waste classification helps create clean raw materials for compost production; most urban household waste is recyclable, such as nylon, glass, plastic, paper, metal, rubber, etc. In terms of society, propaganda and good implementation of the domestic waste classification at source contribute to raising the awareness of the community in protecting the environment.

Thai Nguyen is a first-class city, the tenth most populous city in Vietnam and the third largest city in the North after Hanoi and Hai Phong. With the rapid urbanization, the average volume of waste in the city is about 130 tons per day, equivalent to 47,450 tons per year. Currently, all household waste is treated by landfill method. The People's Committee of Thai Nguyen city has implemented the Scheme of waste classification at source since 2014. However, the implementation of the project is still inadequate, largely due to the incomprehensive collecting and processing infrastructure. Therefore, it is necessary to study the current situation and assess the limitations of the waste classification at source in the city, in order to have practical solutions that contribute to minimizing the amount of waste, minimizing the risk of environmental pollution, and improving the efficiency of domestic waste management in Thai Nguyen city.

2. Research Methodology

The author used the top-down and open-system approach, which means analyzing the experience of sorting waste at source of some countries in the world, the situation in Vietnam and in Thai Nguyen city; then, evaluated and proposed solutions to enhance the management of waste classification at source in Thai Nguyen city in particular and in big cities in the country in general.

Methods of data collection: secondary data were collected through published reports, books, newspapers, magazines, websites, and related summary reports; Primary data were provided from surveys and statistics of Thai Nguyen Urban Management Division and Thai Nguyen Environmental & Urban Works Joint Stock Company. In order to evaluate the progress of implementing the scheme of the waste classification at source of Thai Nguyen city in the period of 2017-2020, these two entities combined surveys and gathered information from 11,000 households,



nearly 299 agencies, business households in three wards of Thai Nguyen city. The survey results were collected from 245 workers in charge of waste collection of 91 residential groups and 299 agencies of 03 pilot wards; Methods of data analysis: descriptive statistics, comparison, synthesis.

3. Research results

3.1. Overview of classifying domestic waste at source

The waste generated in daily activities of people is called domestic solid waste or household waste. Waste generated from production, business and service activities is called industrial solid waste. In addition, there are solid medical wastes such as bandages, gauze, needles, etc. arising from medical examination and treatment activities. Construction solid waste such as scrap iron arises from construction activities, demolition, renovation and repair of construction works. In the article, the author discusses mainly about domestic solid waste and classification of domestic waste at source.

Well-sorted waste classification at source will reduce costs, facilitate treatment and recycling and reduce environmental impacts. Domestic waste should be strictly managed to prevent and minimize adverse impacts on the environment and human health. Sorting waste at source is a waste classification model that uses a method of performing color synchronization from plastic bins in households, agencies and entities to garbage collection place and vehicle to avoid confusion. The model of waste classification at source should be carried out step by step:

(1) Organic waste is the waste after food processing such as vegetables, tubers, fruits. They will be transferred to waste production facilities by the waste collection workers to produce fertilizers.

(2) Inorganic waste is trash such as crockery, bricks, coal slag, nylon, wood. These are types of garbage that cannot be reused and recycled but can only be brought to the landfill. Therefore, to contribute to environmental protection we should limit the use of this inorganic waste.

(3) Recycled waste such as paper, metal, cans, etc. will be transported to craft villages for recycling into new types of products. Therefore, when using bottles, cans, paper boxes, etc., we should not throw them in the trash, but gather them to sell to the scrap metal collectors, helping to earn additional income and protect the environment.

Together with economic development, people's lives and consumption habits have been enhanced, along with the increase in the population, leading to an increase in the amount of waste generated from daily activities. Waste sources include personal activities, households, public places such as residential areas, agencies, schools, service centers and commercial centers. The rate of waste generation increases proportional to the increase in GDP per capita.



In Vietnam, along with economic development, the continuous increase in population is making domestic waste in big cities in Vietnam increase faster than other countries in the world. Currently, Vietnam generates 12 million tons of domestic waste every day. It is expected that by 2020, the amount of municipal waste generated will be 20 million tons per day. Most of the waste generated in big cities like Hanoi, Ho Chi Minh City, Hai Phong. The management and treatment of urban domestic waste in our country is still very backward, mainly burial. In Hanoi city, the volume of domestic waste increases an average of 15% a year, the total amount of waste discharged into the environment is up to 5,000 tons per day. Ho Chi Minh City has more than 7,000 tons of household waste every day, requiring 235 billion VND each year to treat.

According to environmental experts, if Vietnam conducts the classification of domestic waste at source (only inorganic waste must be sent to landfill), it will reduce at least 50% of the volume of waste and environmental issues will be reduced as well. Specifically, it will mitigate environmental pollution by reducing the amount of greenhouse gases like methane (CH₄) and CO₂ generated from landfills; minimize the volume of leaking water, and make the leaked water be treated more easily; reduce budget burden on street sanitation, transportation and waste handling.

Survey results in 2016 - 2017 of Hanoi Architectural University in collaboration with the Institute of Research and Development (IRD – France) showed that in Hanoi, there are more than 10,000 scrap collectors on the road everyday to look for recyclable waste or buy from residents. Then, they resell to waste buyers at 800 waste storage facilities across the city. However, these activities are not regulated in any legal documents.

Meanwhile, in developed countries in Europe such as Denmark, England, Netherlands, and Germany, the waste management is done very strictly, the classification and collection of garbage have become routine and people strictly abide by this regulation. A number of Southeast Asian countries such as Singapore, Thailand or the Philippines have also taken practical and concrete actions to actively promote resource saving and environmental protection through waste segregation at sources.

Japan is considered a successful country in implementing the program of waste classification at source. It is also among the countries with the most modern technology of waste recycling in the world. It is worth mentioning first that implementing waste classification at source will increase waste collection costs but in the long run this cost will be reduced by reducing waste disposal costs and increasing revenues from recycling. The benefits are enormous. In fact, sorting waste at source helps avoid direct burial of unstable waste such as food waste and ensures a better quality of waste for recycling. To achieve this success, it took the Japanese Government 10-20 years for their people to realize and cooperate on separating waste sources. The first time of implementation also met many difficulties. Local authorities must regularly and closely follow the people in a long time to guide them to separate waste in the household. In addition, in the school system, most students are



educated and aware of serious problems due to environmental pollution. Then, they consciously participate in environmental protection activities, including waste classification at source [6].

In Korea, the classification of waste at source has been conducted for about 30 years. It has basically succeeded in separating waste into two types: biodegradable organic waste is collected and treated daily, and garbage – recyclable or safe for landfills, is collected weekly. Over the past decades, South Korea has made significant changes in domestic solid waste management policies. It is the use of recycling instead of incineration, while promoting the reduction of solid waste. Currently, South Korea has taken a step forward, treating solid waste as a recirculating resource – waste is not a subject of treatment, but a resource [4]. And Vietnam is now in the plight of Korea 30 years ago. It was in 1982, the landfill rate in Korea was 96%. So far, the landfill rate has dramatically decreased to 16%, the amount of recycling has increased to 59%, the incineration is 25%. Therefore, in Vietnam in general and major cities of the country in particular cannot be outdated compared to other countries in waste management, it is time for us to focus on the classification of domestic waste at source.

3.2. Situation of waste classification at source in Thai Nguyen city

Thai Nguyen is a first-class city, with 27 administrative entities including 19 wards and 8 communes. It is the 10th most populous city in the country (over 33,000 people), the 3rd largest city (170, 7 km²) in the North after Hanoi and Hai Phong. Thai Nguyen City is the 3rd largest education and training center in the country after Hanoi and Ho Chi Minh City. Over the years, the city's economy has had relatively high and stable growth, the economic structure has shifted in a positive direction. With the urban development speed of Thai Nguyen city, the volume of domestic waste generated is increasingly large and diverse. This requires the increasing quality of urban infrastructure services, including a service for collecting and treating domestic waste. The average volume of domestic waste collected in the city is about 130 tons per day, equivalent to 47,450 tons per year. Currently, all domestic waste is treated by landfill method at the No. 2 and No. 3 yards with the total area of 2.8 ha in Khe Da Mai waste disposal area, Tan Cuong commune.

Thai Nguyen City has invested in the construction of Da Mai solid waste treatment plant, belonging to Thai Nguyen Environmental and Urban Works Joint Stock Company, using combustion technology with a capacity of 150 tons per day and night, mainly treating domestic waste for Thai Nguyen city. The factory has a total investment of nearly VND 100 billion, built on an area of 3 hectares, including the following items: a workshop for sorting waste and dehumidifying composting, an incinerator system, a smoke treatment tank, a workshop storing recycled substances, waste water treatment lakes, and regulating lakes. In 2018, the plant was put into trial operation. To create input materials and exploit the capacity of the plant, it requires sorting waste at source to minimize the amount of waste buried.



Along with that, Thai Nguyen City implemented a scheme to classify domestic waste at source in the city area for the period of 2014 - 2016, but the implementation results did not reach the objectives of the Project. The classification of waste at source is still inadequate, the proportion of the city population that classifies waste at source is low, the project has not come to life of the city people. Meanwhile, the disposal of domestic waste by landfill method is no longer appropriate due to the need for a large area of land. Thai Nguyen City People's Committee continues to implement the Scheme of waste classification at source in the period of 2017 - 2020. In particular, the city strives to have 70% of households and agencies in the province sorting waste at source by 2020; the rate of collection and transportation of household waste in the province reaches 90% and that of domestic waste reaches 100%. The City People's Committee has granted 10,287 billion Dong, equivalent to 97.78% of the estimate to implement the Scheme. The classification of waste at source in Thai Nguyen city is done on the basic principle. Organizations and individuals in Thai Nguyen city actively prepare plastic bags and then divide the waste into 2 bags: Burnable and non-burnable. After that, people put garbage out for environmental workers to collect.

Results of a practical survey on waste classification at source in 03 wards in Thai Nguyen City, after more than a year of implementing the Scheme of waste classification at source in the period 2017 -2020. Three wards in the city were selected to pilot the implementation of the project (Quang Trung, Hoang Van Thu and Dong Quang wards). The People's Committees of the wards conducting the pilot held a Conference to implement the Project to departments, unions, agencies, units, enterprises, and residential groups; organized the distribution of propaganda materials such as trash and plastic bags to the population groups and households; organized to sign commitments with households to classify rubbish and litter at the right time and at the prescribed place.

**Table 01: Summary of results on waste classification at source
in 03 wards of Thai Nguyen City in 2019**

No .	Entity	Total waste owners		The owners sorted waste				The owners threw waste at the right time			
		House holds	Agen cies, units, busin esses	Households		Agencies, units, businesses		Households		Agencies, units, businesses	
				Amo unt	(%)	Amo unt	(%)	Amo unt	(%)	Amo unt	(%)
1	Quang Trung Ward	4,608	186	4,267	92.60	107	57.53	3,347	72.63	90	48.39
2	Hoang Van Thu Ward	4,031	84	3,009	74.65	47	55.95	3,044	75.51	58	69.05
3	Dong Quang Ward	2,620	29	2,338	89.24	29	100.0	1,657	63.24	19	65.52
4	Total	11,259	299	9,614	85.39	183	61.20	8,048	71.48	167	55.85

Source: Summary of survey results of Thai Nguyen City Resources Department

In Quang Trung ward, the authorities organized distribution of propaganda materials and containers to the population groups and households; signed a commitment with 4,608 households in 40 residential areas to classify rubbish and litter at the right time and at the prescribed place; 4 delegations continuously checked the implementation of waste clarification by households. Notably, the Women's Union of Quang Trung Ward has established 40 self-governing women's models for sorting domestic waste with 2,308 members and their families. As a result, 4,586 households have separated waste, reaching 99.52%; the number of households who classified correctly is 3,627, equivalent to 78.71%; the number of households who classified incorrectly is 959, equivalent to 21.29%. The number of entities that have separated waste is 107, accounting for 56.02%; the number of entities classifying incorrectly is 93 units, reaching the rate of 50%; the number of entities using materials for the right purpose is 186 units, achieving the percentage of 100%.

In Hoang Van Thu Ward, the authorities distributed trash and plastic bags to groups and households; signed a commitment with 4,031 households in 33 residential groups to classify rubbish and litter at the right time and at the prescribed place; set up 3 inspection teams to regularly check the garbage classification of households. The results show that the number of households separating waste is 3009, equivalent to 74.65%; the number of households classifying correctly is 1,660 households, accounting for 41.18%; the number of households classifying incorrectly is 1349

households, equivalent to 33.47%. Waste classification results at agencies and units are: The number of entities that have separated waste is 47 units, reaching the rate of 55.95% (the total number of agencies in the ward is 84); the number of entities classifying incorrectly is 23, equivalent to 27.38%; The number of units using garbage containers for the right purpose is 84 units, reaching the rate of 100%.

**Table 02: Summary of the results on consciousness of waste owners
in 03 wards of Thai Nguyen City in 2019**

No.	Entity	Total waste owners		Waste owners sorted incorrectly				Waste owners used the collecting materials for the right purposes			
		Households	Agencies, units, businesses	Households		Agencies, units, businesses		Households		Agencies, units, businesses	
				Amount	(%)	Amount	(%)	Amount	(%)	Amount	(%)
1	Quang Trung Ward	4,608	186	959	20.81	93	50.00	4,608	100.00	186	100.00
2	Hoang Van Thu Ward	4,031	84	1,349	33.47	23	27.38	3,267	81.05	84	100.00
3	Dong Quang Ward	2,620	29	1,410	53.82	13	44.83	2,620	100.00	29	100.00
4	Total	11,259	299	3,718	33.02	129	43.14	10,495	93.21	215	71.91

Source: Summary of survey results of Thai Nguyen City Resources Department

In Dong Quang ward, the authorities here also organized distribution of propaganda materials and containers to the population groups and households; signed commitments with 2,620 households in 18 residential groups to classify rubbish and litter at the right time and at the prescribed place; 2 teams continuously inspected the classification of waste by households. As a result, 2,338 households classify rubbish, reaching 89.24%; the number of households that have separated waste but incorrectly is 1,410 households, equivalent to 53.82%. The number of agencies and units that have classified garbage is 29 units, accounting for 100%; the number of entities classifying incorrectly is 13, reaching 44.83%; The number of units using garbage containers for the right purpose is 29, reaching 100%.



From the actual survey, we see that some entities have implemented and conducted waste classification at source quite well. Typically, the Women's Union of the three pilot wards has signed a commitment to implement, establish and maintain 133 models of self-managed Women's Union to classify domestic waste at source. However, besides the well-implemented units, there are still many households, agencies and units that have not followed the classification of domestic waste at source. In addition, among the implementing households, there are still many households who do not classify properly.

According to the assessment of the Urban Management Division, after the pilot period, the political system at all levels from the city to grassroots level has been involved in leading, directing and organizing the implementation. Most departments, units, localities have actively implemented assigned tasks. In addition, through working and inspecting in pilot wards, the community have basically agreed with the policy of sorting waste at source; The percentage of households implementing waste classification at source has gradually increased.

3.3. Evaluation of some limitations of waste classification at source in Thai Nguyen City

Although the classification of domestic waste at source has been piloted in some central wards of Thai Nguyen city, the effectiveness is only limited to the classification in households. Most people are still not aware of the importance of separating domestic waste at source, although there have been many projects and programs to educate and raise awareness in the community. The scale is not big enough, the content is theoretical and especially the implementation method is not practical for people to easily implement.

Many city people are still confused with the implementation of waste classification at source. Many people think that the fine is too high, while implementing waste classification at source requires a comprehensive investment: from two-compartment bin systems or two different color bins in each household, to the system of 3 rubbish bins and various color dump trucks located in public places in the city. In addition, households as well as environmental sanitation companies have to invest more to buy different color garbage bags according to the city's regulations.

People's awareness of this activity is not high. There are still households who have not yet implemented waste classification, or made incorrect classification, failed to use the garbage bins for the right purposes, failed to grasp the garbage collection schedule and litter at the prescribed time. Many households, agencies, units, schools have not purchased garbage containers. A small number of households take advantage of available plastic bags that do not match the colors as prescribed.

There is still a garbage collection situation when it is not yet classified; sorted waste bags are mixed. Transport is still facing many difficulties, waste burial sites are often far from residential areas, increasing transportation costs. The main reasons are incomplete collecting and processing infrastructure, lack of collection facilities and equipment, no specialized vehicles for each type of classified waste, lack of management of the garbage collection force, lack of waste treatment



technology. These reasons explain why the quality of waste treatment as well as the efficiency of waste classification at source in the city are low. At the same time, the local government has no specific regulations or sanctions for the investment of construction works and collection equipment to ensure the classification is maintained from the waste source to the treatment area.

In addition, the financial management mechanism in the collection and classification of domestic waste is mainly based on funding from the state budget. It has not mobilized the participation of economic sectors. The social properties of this activity are low. The people have not actively participated in waste collection and classification activities, mainly relying on the scrap purchasing force. Meanwhile, the current sanitation fee collected from households is only partially paid for waste collection, which is not enough to cover and maintain transportation.

3.4. Solutions to strengthen the domestic waste classification at source in Thai Nguyen city

The goal of Thai Nguyen city to 2020 is to minimize the amount of waste to bury and minimize the risk of environmental pollution; continue to raise the sense of responsibility of agencies, units and people in protecting the environment; improve the efficiency of solid waste management in the city; reduce the risk of environmental pollution due to unclassified landfills, prolonging the life time of burial sites; create raw materials for recycling.

As a general solution, to achieve the above objective, the city has promoted socialization, created a competitive environment, prioritized investment projects on solid waste treatment by recycling technology, etc. Especially, raising the community's awareness about daily-life solid waste collection and treatment will help form an environmentally friendly lifestyle.

In the coming time, it is necessary to have close guidance of the People's Committee of Thai Nguyen province on investment in renovation, upgrading, and building new landfills or treatment and recycling plants up to hygienic environmental standards; to solve synchronously from the issuance of documents, enhancing the capacity of environmental service units, to propagandizing and raising people's awareness. In the immediate future, it is important to increase the capacity of garbage collection, select locations to construct hygienic landfills, and solve environmental pollution caused by garbage; establish a model of collection and treatment of daily-life waste in a unified management, financial support mechanism, especially with guidelines and mandatory implementation of the waste classification at source to 2025 in the whole province in general and in Thai Nguyen city in particular; Promoting propaganda, raising awareness, inspecting and strictly handling violations of management of daily-life solid waste, which cause environmental pollution, for individuals and organizations engaged in production, business and service.



Specific solutions, promoting propaganda on provincial television and radio; Continuing to strengthen the guidance on the classification of waste at source in various forms such as establishing propaganda delegations and equipping garbage collectors to mobilize and guide people to sort domestic waste at source; promote propaganda in schools. In order to guide people to carry out waste classification at source more effectively, it is necessary to develop a video guiding classification of domestic waste at source on provincial radio and television; build reportage of examples of households, agencies and units that well carry out the waste classification at source, discharge waste on time and at prescribed places. In addition, it is necessary to equip knowledge for waste collection workers to mobilize and guide people to classify domestic waste at source. Integrating the teaching of knowledge and skills in the classification of household waste at source into curricular and extracurricular programs.

It is essential to strengthen the supervisory role of the self-management groups in the classification of domestic waste at source in the area. The People's Committee of the ward or commune takes the lead in working with relevant departments, units and units to regularly propagate and supervise the classification of domestic waste at source in the city; continue to guide agencies, units, businesses and schools in the area to purchase color garbage containers in accordance with regulations, classify household waste at source.

Local governments necessarily create a reasonable policy mechanism for the management of collection, transportation and treatment of domestic waste. In addition, the successful implementation of the waste classification scheme depends not only on the collection forces but also on the people's awareness and actions. Therefore, the authorities of Thai Nguyen need to finalize the legal documents and research to provide mechanisms to encourage people and businesses to effectively manage domestic waste.

From the perspective of many environmental experts, "junk" collectors are the ones who are actively involved in urban sanitation services in an informal way, bringing many benefits to the people. The activity of scrap collectors, scrap yards and recycling villages has formed a recycling system that actually brings significant economic resources. Therefore, the city government should have regulations and mechanisms to facilitate this activity to develop and go into order.

It is necessary to put the waste classification into the convention. One of the limitations in the classification of domestic waste at source is that most localities have not yet put the waste classification at source into the convention, the neighborhood rules, and criteria to consider cultural families, cultural neighborhoods every year. In order to successfully carry out the activities of separating domestic waste at source in Thai Nguyen city, in the emulation, the city needs to guide the implementation of waste classification at source into the conventions of the localities. groups and neighbors to become one of the criteria for reviewing cultural groups and neighbors, cultural families and cultural agencies.



It is crucial to strengthen the inspection and supervision of the classification of domestic waste at source; strictly handle violations of environmental sanitation such as dumping garbage at places not prescribed, spillage of waste during collection and transportation, transporting and dumping garbage not in accordance with regulations, collecting and transporting without ensuring environmental sanitation.

3. Conclusion

It can be seen that the classification of domestic waste at source brings environmental benefits, while saving natural resources, reducing waste into the environment, saving costs of collection, transportation and handling. The paper has analyzed the experience of waste classification of some countries in the world, assessed the status of waste classification activities in Vietnam and in Thai Nguyen City. On figuring the inadequacies and existing problems, the author proposed some solutions to improve the efficiency of waste classification at source in Thai Nguyen city, contributing to reducing environmental pollution and to sustainable development of Thai Nguyen city.

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