



# Assessing the current status of rural domestic solid waste management in Nam Dinh province



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## ABSTRACT

*The management, collection and treatment of domestic solid waste in rural areas are of great significance to reduce its amount generated to the environment. The study has determined that the total amount of rural domestic solid waste generated in Nam Dinh province is 660 tons/day with the average amount of  $0.31 \div 0.35$  kg/person/day and the collection rate is 87 % (about 575 tons/day). The amount of organic in the solid waste is about 60% of total solid waste. Currently, the solid waste is not separated at the source. Specifically, 47 % solid waste (about 112,968 tons/year) is treated by landfilling. Besides that, 43 % solid waste in this province is burned in the incinerator. In the areas where the collection conditions face difficulties, local people self-treat domestic solid waste at home by burning, burying, or composting it, which accounts for 10.0 % of the total amount. In this province, one of the well – known private companies, Tan Thien Phu has manufactured incinerators with the LOSHIHO brand having capacity up to 1,000 tons/day. Combustion method can be used at the sanitation landfill to reduce the volume of wastes brought to burial sites and limit the environmental pollution. Therefore, to achieve sustainable development in this province, it is necessary to improve solid waste management with solutions relating to the separation, collection, storage and treatment of domestic solid waste.*

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## 1. Introduction

Nam Dinh province is located in the South of the Red River Delta, consisting of nine districts

and one city. This province is approximately 1,668 km<sup>2</sup>. The number of people living in rural areas is high, accounted for 72.9% of the provincial population. Therefore, the amount of domestic solid waste generated from agricultural and living activities is increasing. The management, collection, and treatment of rural domestic solid waste have been facing difficulties due to overlaps among different authorities. The responsibility to

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manage solid waste has not been assigned. The solid waste is remained raw and decomposed (Anh et al., 2018).

If solid waste is not collected properly, it may cause environmental pollution. Besides, due to no guarantee on the solid waste treatment technology and low awareness in the community on waste collection, lots of ungathered solid waste will be discharged into the natural environment (e.g., at the riverside, lakeside, field, then pollutes the environment and destroys the beauty of the landscape. Therefore, the management of domestic solid waste in this rural area should be paid attention to and controlled by agencies that can provide suitable solutions to prevent the environment from being polluted.

## 2. Microscopic spherical particle model for expansive soil

### 2.1. Collecting and editing data

The author collected information and data on solid waste management in Nam Dinh Province as the study area. The information of the treatment process for the domestic solid waste was also collected. Reports and documents on domestic solid waste management, domestic solid waste collection fees, transportation, and treatment services in districts of Nam Dinh province were also collected.

The domestic solid waste management information was collected from organizations, such as People's Committee of communes and districts, New Rural Office and Department of Natural Resources and Environment of Nam Dinh province. It is an excellent basis to assess overview so that propose sustainable methods to manage the solid waste for this study area.

### 2.2. Field survey

The field survey is essential to overview the actual situation of generation, collection, and treatment of rural solid waste in the study area. The survey was carried out to collect information on socio - economic development in the area, sampling and determination of rural domestic solid waste components, and habits and methods to manage the solid waste. The following descriptions are details of the methods.

#### 2.2.1. Sampling

It is necessary to determine waste characteristics to assess and choose domestic solid waste treatment in the local area. The sampling method was accomplished according to national standards in assessment the solid waste's components, humidity, mass, etc. The solid waste sampling was implemented at the district's landfills, such as Tan Thinh, Nam Thanh, Nam Hong (Nam Truc district), Bach Long (Giao Thuy district), Xuan Kien, Xuan Ninh (Xuan Truong district), Hai Anh (Hai Hau district), and Truc Hung landfill (Truc Ninh district) ( Figure.1).

#### 2.2.2. Community consultation

The questionnaire consisting of open-ended and closed-ended questions was used to collect information on the current management of solid waste in rural areas.

The information on waste sources, components, volumes, and technologies being implemented in local waste treatment was also collected. The research team organized a survey and assessed the current management of domestic solid waste.

The authors interviewed environmental management officers from the Department of Natural Resources and Environment, and the Division of Natural Resources and Environment of the districts (15 questionnaires); the commune authorities in charge of the environment (20

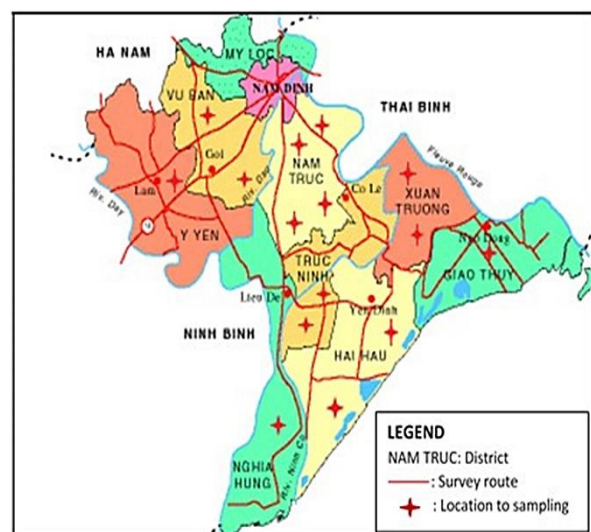


Figure 1. Map of survey location.

questionnaires), workers of the collection teams, incinerators and the landfilling (15 questionnaires), and the households who discharged the solid waste into the environment (60 questionnaires).

### 3. Results and discussion

#### 3.1. The rural domestic solid waste management

The investigation, survey and community consultation results showed that solid waste in rural areas was generated from households, markets, offices, shops, public places, etc. The total amount of solid waste generated in Nam Dinh province is 660 tons per day with an average generation factor from 0.31 to 0.35 kg per person per day. This average generation factor is the same as the average amount of domestic solid waste generation in the Red River Delta's rural areas, which is 0.4 kg per person per day (Anh et al., 2018). However, this rate is also lower than that in the rural areas in big cities like Hanoi and Hai Phong, which is 0.86 kg per person per day (World Bank, 2018). Most of the solid waste in this area was not separated at the source. Biodegradable and non-biodegradable waste were mixed together. This matter made the recycling and reuse of waste more low and challenging treatment efficiency. The main composition of solid waste was leftover food, plastic bags, cans, leaves, rubber, leather, textile, and a little hazardous waste like electronic appliances, broken light bulbs, batteries, etc. The solid waste had high organic content accounting for 60 %. The analysis result of the component of solid waste is shown in Figure 2.

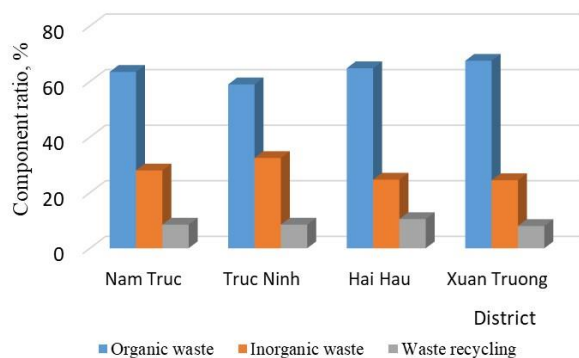


Table 1. Methods of domestic solid waste collection and treatment in the household.

The method of treatment	The number of households	Percentage (%)
Collected by environmental companies	55/60	91.7
Garbage collection	60/60	100
Reuse as food for animal	37/60	61.7
Discharge directly into the environment	5/60	8.3
Other methods (combustion, composting, etc.)	10/60	16.7

The survey result from 60 households shows that the household's domestic waste was stored in the rubbish bins. Only five families had no bins in the house, accounting for 8.3%. Solid waste collection in rural areas has also been awarded in recent years, especially in the increasing of the new rural regions. The survey summary and community consultation results from 60 households on domestic solid waste management is shown in Table 1.

In Nam Dinh province, 2,921 out of 3,076 villages, and 203 out of 204 communes and towns collected solid waste (Department of Natural Resources and Environment of Nam Dinh province, 2017). However, the domestic solid waste generated from different sources is still mixed when being collected. The total amount of collected solid waste is estimated at 575 tons per day (87.5% of total waste) (People's Committee of Nam Dinh province, 2018). Pieces of equipment to daily collect and transport the solid waste are 342 garbage handcarts (with a volume of  $0.5 \div 1 \text{ m}^3$ ), 19 garbage trucks (with the volume from  $6 \div 10 \text{ m}^3$ ). The rest of the environmental sanitation groups in communes and towns mainly used the improved handcarts, agricultural vehicles, and hand trucks to collect waste 2 ÷ 3 times per week. Some communes only collect once a week on Sundays. Due to that low frequency, the organic

waste such as leftovers or fruit peels is easily decomposed and causes a bad smell, especially in warm and hot weather. Therefore, waste collection activity has not met the demand. Recently, the local authority has assigned social organizations and Cooperative to collect the domestic solid waste in the rural areas. The solid waste will then be transported and treated after at the landfill, burning areas, or at the incineration.

The survey result shows that the communes/districts in the study area have many methods and technologies to treat the domestic solid waste. The number of open landfills has recently decreased. Some have changed their functions into the sanitary landfill or burning and incineration. Up to now, 193 communes and towns have had solid waste treatment plants, 106 communes have used the sanitary landfill, and 88 have used incinerators. Besides, 26 communes and towns have sanitary landfills and incinerators, such as Nam Thanh, Nam Hong, and Nam Thai commune, Nam Truc district. The domestic waste of communes that do not have waste treatment plants is collected and sent to other district's plants. Furthermore, the solid waste treatment plant has been built in this area, such as Loc Hoa, which is used for concentrated solid waste treatment. Using these methods to treat solid waste reduces the environmental risk and pollution.

The statistical values also show the amount of solid waste treated by each method: 112,968 tons per year going to landfill (47%), 103,093 tons per year are burnt (43%), and 24,000 tons per year are self-treated in the households. Figure 3

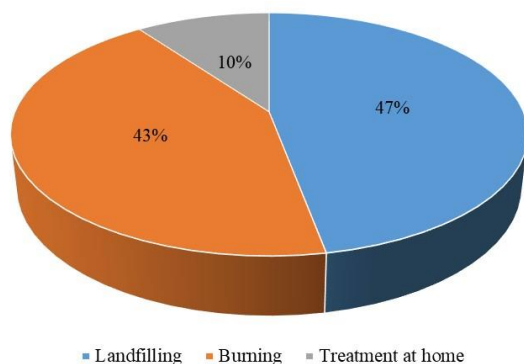


Figure 3. The proportions of domestic solid waste in Nam Dinh province was treated by each method.

describes the ratio of domestic solid waste treated by each method.

In fact, this study shows that the proportion of landfill method in this province decreases, and the proportion of burning and recycling increases. It helps to decrease the area of land using for landfill and limit environmental pollution. According to the previous research result, in the Red River Delta, the primary solid waste treatment is landfilling (52,5%), next is self-treatment at home (30.9%), burning (15,5%), and composting (1,1%) (Hoa, 2019). These numbers shows indicate that Nam Dinh province has been interested in the investment and selection of suitable solid waste treatment technology.

With 85 landfills and 87 solid waste incinerators available to date, none of the waste treatment facilities uses composting technology to treat solid waste. Some of the reasons are the low amount of organic matter in the trash, and unclassified waste at the source. The domestic solid waste was not immediately collected and transported to the treatment facilities (the waste is usually collected 2 - 3 times/week depending on the communes). Therefore, the organic waste partially decomposed while transported to the treatment plants. Hence, the classification process becomes difficult. The quality of the waste was degraded, and the biological composting methods are unable to be applied. The survey results show that the compost houses are not used in the microbiological fertilizer production technology plant in Xuan Kien commune, Xuan Truong district. This is a waste of money on land use and investment costs. Besides, the result reveals that

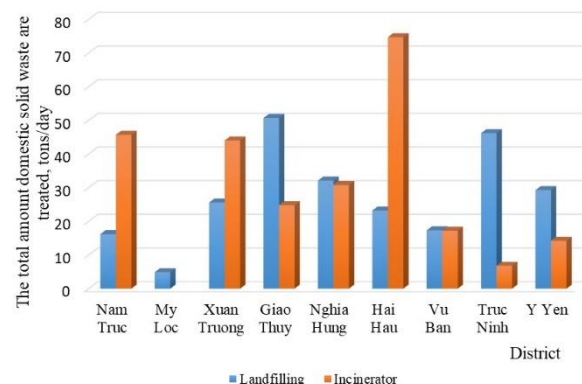


Figure 4. The total amount of domestic solid waste incinerated and treated by landfilling in Nam Dinh province.



the total amount of rural domestic solid waste treated by burial and incineration methods varies among districts (Figure 4).

The total area of the solid waste treatment plants is usually between three to five hectares and is over 10 ha in the My Thang and Thinh Long commune plants. (Department of Natural Resources and Environment of Nam Dinh province, 2017). The landfill is the primary method used in Truc Ninh, Giao Thuy, Y Yen, and My Loc. In Hai Hau, Xuan Truong, and Nam Truc districts, the burning method is mainly used. The proportion of solid waste treated by the burning and landfilling methods is similar among communes in Nghia Hung and Vu Ban districts.

The incineration on site and burning in landfills has increased the landfill's treatment capabilities, while reducing pollution on land, water, and air. However, when using the burning method, it is necessary to check and evaluate the technological process, equipment, and technical requirements to minimize the risk of secondary pollution. Survey and evaluation results show that the study area's incinerators have a capacity smaller than one ton per day or even less than 0.5 ton per day. Three incinerators with the capacity of over one ton per day were built in the solid waste treatment plant at Nam Giang, Lam, and Kim Thai communes. Most of them are operating to reduce the amount of solid waste that needs to be buried. It helps to save the area for landfill and restrict environmental pollution by landfill. However, the small capacity incinerators are still inadequate due to insufficient amount of solid waste needed to burn, or low initial heat. As a consequence, the incinerators generate a lot of smoke. Beside, the exhaust gas treatment system of the incinerator is not standard updated (QCVN 61-MT:2016/BTNMT), which results in air pollution. Some equipments are old or damaged which may lead to the risk of secondary pollution (Lam et al., 2019). Therefore, the management of small incinerators has many difficulties and inefficiencies in environmental management. Recently, the large incinerators have been designed including the exhaust gas treatment system. For example, in this province, Tan Thien Phu Company is one of the well – known private companies that has researched and produced LOSHIHO models of incinerators with the



*Figure 5. The incinerator with emission treatment system by absorb in the sanitary landfill in Xuan Ninh commune, Xuan Truong district.*

treatment capacity of 350 to 1,000 tons/day. It helps manage domestic solid waste in Nam Dinh province effectively and reduce environmental pollution risk (Figure 5).

Also, the model of solid waste treatment and recycling is implemented by the socialization formality and by Nam Truc Green Environment One Member Limited Company in Nam Giang town. The organic process is to collect and compost organic solid waste to produce microbiological fertilizers. Plastic components are utilized to recycle and produce RPF burning pellets. The remaining inorganic is treated by the incinerator. Ash and slag are conducted to solidification to produce bricks. This effective treatment technology helps minimize the amount of waste needed to treat, save resource, and prevent environmental pollution. For those communes having problems in collecting, transporting, and treating solid waste, treatment models at home is a proper way. In this model, local people often burn waste, compost waste in the garden, or use organic waste as food for the livestock. In the composting method, the households build underground storage tanks or use specialized plastic containers to compost organic waste. The local government has supported this model by partially funding or providing the biological products for the composting process. The percentage of waste treated by this method was up to 42.9% and has been accepted by the local people. To ensure operating conditions, the Department of Natural

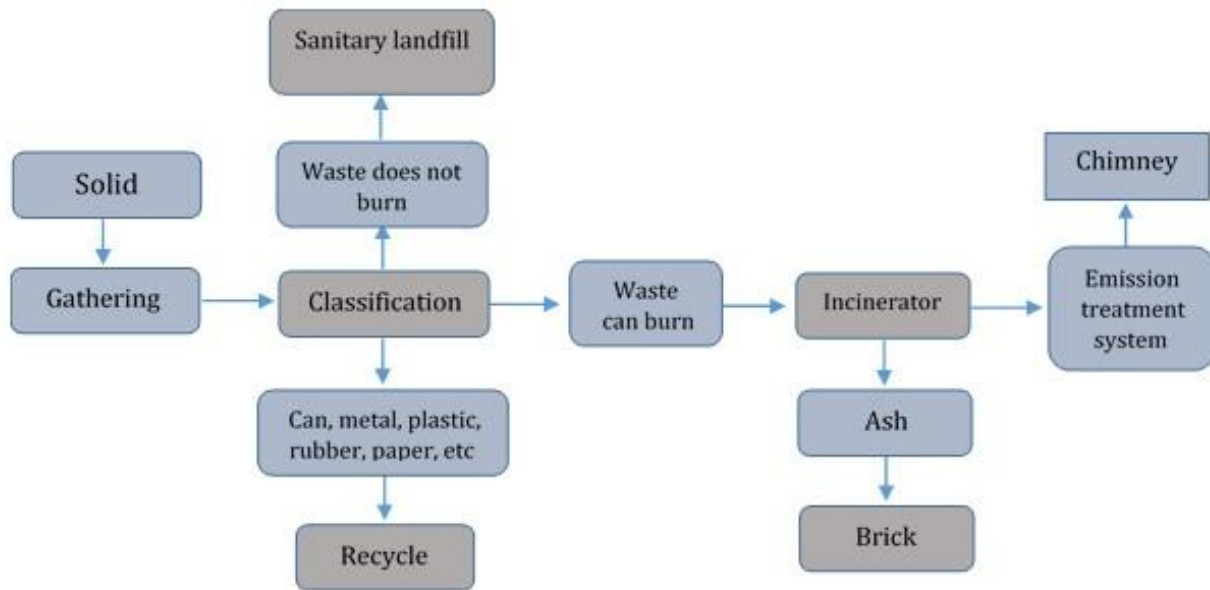


Figure 6. Process of rural domestic waste treatment in the concentrated solid waste treatment plant.

Resources and Environment has instructed localities to collect and treat solid.

Replacing old equipment and increasing collection frequency to meet the amount of generated solid waste;

- Researching and developing treatment technology to reduce the amount of solid waste needed to bury and increase the proportion of recycling and reusing of solid waste. Based on the assessment of the technology treatment solid waste in Nam Dinh province, it is necessary to continue developing the model solid waste treatment at the Nam Giang plant. Classifying solid waste at the source is very important to use organic solid waste for composting and recycling plastic scrap. Development of the solid waste treatment model to compost and plastic recycling in this province or expand the treatment capacity at Nam Giang solid waste treatment plant to meet waste at the landfill and treatment at home accordingly with the Guideline No. 2275/HD-STNMT. Based on the collected document and survey results in 150 households, the waste proportions of dumping into the garden, self-burning, and self-buried accounted for 6%, 6%, and 3.3%, respectively (Trung and Ngoan, 2017).

### 3.2. Solution proposal

The requirement of solid waste treatment and plastic recycling;

- Reducing and stopping the construction of small-capacity incinerators that do not meet environmental standards. Renovating and upgrading the exhaust treatment system of old incinerators that do not meet QCVN 61-MT: 2016/ BTNMT - Standard of Technical Regulation National about the domestic solid waste incinerator;

Continuing implementing, expanding the solid waste classification model at home, and synchronizing the collection, transportation, and treatment of solid waste in the studying area. Constructing large-scale concentrated solid waste treatment plants with modern technology to treat thoroughly and to minimize environmental pollution. The proposed treatment process for rural solid waste is described in Figure 6.

- Continuing implementing the Decision No 3053 /QD-UBND on the planning of the solid waste management in Nam Dinh province to 2030. (People's Committee of Nam Dinh province, 2016). Educating to raise people's awareness and encouraging community participation in solid waste management (Tuan, 2017). Developing and

carrying out more communication programs in domestic solid waste management.

#### 4. Conclusion

The current solid waste management in Nam Dinh province's rural areas has been improved in recent years. However, the collection, transportation, and treatment of rural daily-life solid waste have been facing many difficulties with the following reasons: unclassified solid waste at source; inappropriate solid waste treatment technology; limited human resources; or low resident's awareness of waste management. The research results show that the ratio between landfilling, burning and incineration, and self-treatment at home in Nam Dinh province is 47%, 43%, and 10%, respectively. This study also shows that the proportion of landfill method reduces, and the burning method and recycling the domestic solid waste increases. The ratio of solid waste treatment between the burning and landfilling methods is different among the district's communes.

To effectively manage the solid waste, it is necessary to build and expand the model with classified solid waste at the source. It also requires the use of incinerators that meet the national standard with a larger capacity and suitable for the amount of waste generated in the region. Stop operating the small and manual incinerator to treat solid waste. In addition, Nam Dinh province continues building the concentrated solid waste treatment plants and using treatment models at households in areas having difficult conditions to collect and transport waste. Besides, more education programs are needed to raise people's awareness about solid waste management and reach the consensus of the whole community in this province.

#### Acknowledgment

Thuy Thanh Thi Tran take part in the survey, sampling, and community consultation to set up the data. In this paper, she is the author of the introduction, study method, the current of management of rural domestic solid waste, solution proposal to manage the solid waste in Nam Dinh province and conclusion.

Huy Khanh Pham take part in the survey, sampling, and community consultation to set up the data. In this paper, he is the author of the assessment the current generated and collected the domestic solid waste in Nam Dinh province.

Hoa Mai Nguyen take part in the survey, sampling, and community consultation to set up the data. In this paper, she is the author of abstract, assessment the current of solid waste treatment method in Nam Dinh province.

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