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Research Paper

Status and solutions for domestic solid waste management in Cho Don district, Bac Kan province, Vietnam

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ABSTRACT
The study has applied a number of traditional research methods (data collection, actual investigation and survey in the study area, statistics and data process) to assess the current status of domestic solid waste (DSW) management and propose some solutions for DSW management in Cho Don district, Bac Kan province, Vietnam. The results showed that the main component of DSW is organic waste (72%); the total amount of DSW is 25 tons/day; the average emission factor is 0.51 kg/person/day; In the study area, only Bang Lung town has the largest DSW collection rate (95%). In most of the remaining areas, DSW has not been properly collected and treated. Cho Don district invested and built 01 Ban Tan waste treatment area (2.1ha, processing capacity 500kg/h, located in Bang Lung town, operated by incineration and landfill technology) and 03 incinerators (Dong Thang commune (0.3 tons/day), Binh Trung commune (Ban Dieng Village, Ban Ca Village)). Although the local government has made great efforts in the management of DSW, however the DSW management still has many shortcomings. To improve the efficiency of DSW management in the study area, it is necessary to apply some solutions synchronously, such as: Raise awareness of the community on how to identify types of waste and the importance of sorting DSW at source; perform DSW classification at source; collecting all DSW generated from households; effective use of existing incinerators and waste treatment facilities; additional human resources and increased capital mobilization for DSW management ...

KEYWORDS: *Solid waste, environmental management, waste, pollution, Bac Kan*

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I.INTRODUCTION

Urbanization and economic development often lead to increased resource consumption and solid waste generation rate per capita. Urban residents in developed countries generate six times more waste than in developing countries. It is estimated that in developed countries the amount of solid waste can reach 2.8 kg/person/day, in developing countries it is about 0.5 kg/person/day [1]. The average rate of domestic solid waste (DSW) generation worldwide is about 0.74kg/person/day; in which, the rate in the lowest country is 0.11kg/person/day and the rate in the highest country is 4.54kg/person/day. In 2016, the total volume of municipal solid waste generated globally was about 2 billion tons. In which, the largest amount of urban solid waste is in the East Asia - Pacific region with 468 million tons; The lowest was in the Middle East and North Africa with 129 million tons [2]. In Vietnam, the amount of generated DSW is about 25.5 million tons in 2018, of which urban DSW is about 38,000 tons/day and rural domestic waste is about 32,000 tons/day [2]. DSW in urban areas currently accounts for more than 50% of the total DSW of the country and accounts for about 60-70% of the total amount of urban solid waste [2]. It is forecast that the amount of DSW in Vietnam will increase to 54 million tons by 2030 [3]. The average waste generation standard per capita for each type of waste is specific to each locality and depends on the standard of living, civilization and population in each area. However, regardless of the region, there is a general trend in the world that the higher the standard of living, the more waste is generated. According to a report by the World Bank, in big cities, the rate of solid waste generation in New York is 1.8 kg/person/day while in Singapore and Hong Kong it is 0.8 - 1.0 kg/person/day. In Vietnam in 2015, the total amount of DSW generated in cities was 38,000 tons/day. Estimation of DSW amount generated by 2030 will be 2.59 billion tons, and by 2050 it will be 3.4 billion tons [1].

In the world, there have been many studies on solid waste management such as:

"Analysis of solid waste collection and disposal in oversea, Nasarawa town, Nasarawa state" [4]; "Analyzing key drivers for a sustainable waste management system in Ethiopia: an interpretive structural modeling approach" [5]; Optimal management of solid waste in smart cities using internet of things" [6]; "Urban solid waste management in Chongqing: challenges and opportunities" [7]; "Waste management in Switzerland – Achievements and prospects" [8]; "Solid Waste Management Practices at a Private Institution of Higher Learning in Nigeria" [9]; "Assessment of Domestic Solid Waste Disposal and Management System in Tangail Municipal Area"[10]; "Analysis of Economical and Environmental Costs for the Selection of Municipal Solid Waste Treatment and Disposal Scenarios through Multicriteria Analysis (ELECTRE Method" [11]... However, there has been no research on the current status of domestic solid waste management in Cho Don district, Bac Kan province. In recent years, Cho Don district has had many changes in all aspects, especially socio-economic development, so there have been many significant changes: good economic growth rate; people's living standards are improved; infrastructure and facilities are increasingly spacious and modern. Along with those positive aspects, environmental issues such as: The amount of domestic waste increases; waste has not been properly collected and segregated; many communes/wards do not yet have a domestic solid waste treatment plant. These problems have the potential to affect the quality of the natural environment and reduce the beauty of the area. Before that situation, topic" *Status and solutions for domestic solid waste management in Cho Don district, Bac Kan province, Vietnam*" was implemented with the purposes: supplementing the database on the current state of domestic solid waste management, assessing the strengths and weaknesses in domestic solid waste management; proposing some solutions to improve the efficiency of waste management in the study area

II. RESEARCH SUBJECTS AND METHODS

2.1. Research subjects

Focused research on domestic solid waste management in Cho Don district, Bac Kan province.

2.2. Research Methods

- *Methods of data collection:*

In this study, the authors collected information from books, newspapers, magazines, the internet. From there, the authors synthesized and analyzed documents and data related to the research content.

- *Methods of actual investigation and survey in the study area:*

The field survey method in the study area is used for the purpose of correcting information, verifying existing documents, adding missing or incorrect information, especially focusing on waste collection and treatment activities. The survey method is applied mainly by interviewing with a set of open-ended questions with prepared topics. The study has conducted field surveys in the study area to collect specific information and objectively evaluate the research problem such as DSW collection route, DSW classification at source, DSW treatment area... The actual survey areas are residential areas, solid waste collection points, collection routes, DSW treatment areas...

- *Methods of statistics and data processing:*

All collected documents must be processed, evaluated to check and detect possible errors, thereby taking measures to correct and supplement relevant documents in a timely manner. The data is processed by Microsoft Excel software.

-*Expert interview method:*

Interview with staff from the Department of Natural Resources and Environment of Bac Kan province to verify the results of the interview survey.

III. RESULTS AND DISCUSSION

3.1. Status of domestic solid waste management in Cho Don district, Bac Kan province

In Bac Kan province, the amount of DSW generated in rural areas is twice as large as in urban areas, however, the urban solid waste collection rate is 90.48% while in rural areas this rate is only 36.35 %. The proportion of communes that have not invested in treating domestic waste is 94% compared to 6%, respectively 7 communes have invested in treating domestic waste. In the whole province, only 11% (corresponding to 12 communes) have an environmental sanitation team/team in charge of solid waste collection, the remaining 89% of areas, people treat DSW by themselves by burning method or buried in their gardens [12]. Cho Don is a mountainous district of Bac Kan province, located in the west of Bac Kan province, with a total natural area of 91,135.65 hectares, accounting for 18.75% of the province's natural area (In which, the land is used for agricultural purposes is 85,307.78 ha, non-agricultural purposes is 4,829.04 ha and unused land is 998.83 ha), which is divided into 20 commune-level administrative units (including 01 Bang Lung town and 19 communes): Ban Thi, Bang Lang, Bang Phuc, Binh Trung, Dai Sao, Dong Lac, Dong Thang, Luong Bang, Nam Cuong,

Nghia Ta, Ngoc Phai, Phuong Vien, Quang Bach, Tan Lap, Xuan Lac, Yen My, Yen Phong, Yen Thuong, Yen Thinh). The population in 2019 is about 49,554 people. The population density is 54 people/km².

Research results show that domestic solid waste in the study area arises mainly from residential areas, schools and markets; The emission factor is 0.51 kg/person/day, the waste volume is 25 tons/day, the DSW component is mainly organic matter (68.5-72%), hazardous waste accounts for the lowest percentage (under 1%), plastic, nylon and paper account for the same proportion, ranging from 4.6% to 10.4%, metal accounts for the proportion from 2.8 to 4.4%, rubber and leather (3.1-4.2 %), glass accounts for the proportion from 0.6%to 2%, tissues (1.8-2.7%), inert accounts for the proportion from 14.2% to 23.2% depending on the research area.
In the study area, garbage is collected by hand trolley to the garbage collection area, then the waste will be transported from the localities to the landfill for treatment by landfilling or incineration by trucks (2.5-3.5 tons) or specialized garbage compactor (5 tons). The amount of DSW generated in the inner city (Bang Lung township) is collected daily by Bac Kan Cho Joint Stock Company, transported to Ban Tan garbage disposal area for classification and treatment by burning or sanitary landfill method. In villages and hamlets far from the center of Bang Lung town (Ban Duong 1, Ban Duong 2, Na Pai), the population is sparse, the human resources of the collection unit are small, so the collection and treatment of solid waste at Centralized waste treatment area has not been implemented, but households often collect and treat their domestic waste by themselves.

Cho Don district has invested in building a Ban Tan waste treatment area according to combustion and sanitary burial technology, with a total area of nearly 2.18 hectares, a burial capacity of 38,804 m3, in order to treat the amount of solid waste in Bang Lung town and neighboring areas. Ban Tan waste treatment area has been officially put into use since January 2017 with an actual waste treatment capacity of 0.5 tons/day. This treatment area is managed and operated by the Management Board of Bang Lung town market. By 2022, after the Management Board of Bang Lung town market stopped performing the task of collecting and treating domestic waste in the area of Bang Lung town, the Department of Economy and Infrastructure of Cho Don district implemented bidding activities and signed contracts with Bac Kan Market Joint Stock Company to perform public services of collecting, transporting and treating waste in Bang Lung town in 2022. Up to now, after nearly two years of signing a contract with service providers, the situation of waste collection, transportation and treatment in Bang Lung town has achieved many positive effects, such as: All DSW daily has been collected and treated, basically there is no residual domestic waste, environmental sanitation is ensured with the waste collection rate in the city area reaching about 95%.

The research results also show that the distance from the center of some communes to Bang Lung town is quite far, so the collection and transportation of garbage from the commune cluster centers to the Ban Tan garbage treatment area follows the general planning of the province faced a lot of difficulties and could not do it.

In order to do well in environmental protection and waste treatment in the communes, in 2016, Cho Don District People's Committee also invested in building a DSW treatment facility in Dong Thang commune. The DSW treatment plant started operating in March 2017 with a design capacity of 100 kg/h, the average actual capacity of the treatment station is 0.3 tons/day. In Binh Trung commune, in two villages (Ban Dieng and Ban Ca) there is a centralized incinerator and workers to collect and treat garbage every 10 days/1 time. In addition to the areas mentioned above, in other rural areas in Cho Don district, households collect and treat their domestic waste on a household or individual scale.

3.2. Difficulties and solutions for domestic solid wastes management in Cho Don district, Bac Ninh province

Human resources to perform environmental protection tasks of state agencies and enterprises, production and business units are still lacking in quantity, limited in quality, capacity and professional expertise. In some areas, the terrain is complicated, the population is scattered, not concentrated, people's awareness is still not high, leading to indiscriminate littering. Therefore, the collection and treatment of waste in these areas is not thorough, the amount of domestic waste, especially plastic and nylon waste, remains stagnant, causing unsightly beauty and affecting the quality of the environment. Bordering areas between localities, a number of main roads in district centers, areas along rivers, streams, footbridges, along a number of inter-communal roads, provincial roads, national highways, there are also spontaneous garbage dumps. In many places, people handle their own waste, so when implementing centralized waste collection and treatment, there are many difficulties.

Lack of funds to invest in the construction of concentrated domestic waste treatment facilities and operating expenses when they are put into use;

The rate of domestic waste collection in rural areas is still low, infrastructure has not been invested in the collection and treatment of domestic waste to meet actual needs; calling for socialization in the collection and treatment of domestic waste is still difficult. In addition, the mechanisms and policies on solid waste management, especially domestic solid waste promulgated by the Central Government, are not suitable for the

topography of mountainous provinces such as Bac Kan, due to the large area and low concentration of population.

The basic causes of the problems mentioned above are: First of all, the investment in infrastructure construction for the collection and treatment of domestic waste is still limited and has not met the current actual needs. Next, due to the low awareness of a part of people in the collection and treatment of waste, indiscriminate littering still occurs in some places. In some communes, the responsibility of the local government, especially the head, has not really paid attention to the collection and treatment of waste, still allowing the situation of littering and indiscriminate dumping of waste, causing environmental pollution, degrading the landscape of the area. Another reason is that the central government does not have mechanisms and policies suitable for different regions on solid waste management.

Therefore, in order to improve the efficiency of DSW management in the study area, it is necessary to apply some solutions synchronously, such as: Raise awareness of the community on how to identify types of waste and the importance of sorting DSW at source; perform DSW classification at source; collecting all DSW generated from households; effective use of existing incinerators and waste treatment facilities; additional human resources and increased capital mobilization for DSW management. In addition, it is necessary to raise the responsibility of the leader in domestic waste management; Strengthening the organizational system for environmental protection from central to local levels according to the Law on Environmental Protection 2020 [13] …

IV. CONCLUSION

The process of socio-economic development in Cho Don district, Bac Kan province has made the amount of DSW in the province tend to increase over the years, creating a lot of pressure on environmental management in the area. Research results show that DSW in the study area arises mainly from residential areas, schools and markets; The emission factor is 0.51 kg/person/day, the waste volume is 25 tons/day, the DSW component is mainly organic matter (72%). Cho Don district currently has 01 Ban Tan garbage treatment area (processing capacity 500kg/h, located in Bang Lung town, operated by incineration and landfill technology) and 03 incinerators (Dong Thang commune (0.3 tons/day), Binh Trung commune (Ban Dieng Village, Ban Ca Village)). The study results also show that Bang Lung town has a collection rate of DSW reaching 95%, the remaining areas of the district have a very low rate of DSW collection, there are many localities where DSW has not been collected and treated centrally. Although the local government has made great efforts in the management of DSW, however the management of DSW still has many shortcomings: Human resources operating in the field of environmental protection are still lacking, professional qualifications cannot meet actual needs; Lack of funds to invest in the construction of concentrated domestic waste treatment facilities and operating expenses when they are put into use; Vehicles used in the collection and transportation of garbage are mainly handcarts, vertical trucks or trucks;

Many villages and hamlets are far from the town center (Ban Duong 1, Ban Duong 2, Na Pai), the terrain is complicated, the population is sparse, the human resources of the collection unit are small, so the collection and treatment of solid waste at Centralized waste treatment area has not been implemented, but households often collect and treat their domestic waste by themselves.

There are many reasons leading to limitations in DSW management in the study area: the investment in infrastructure construction for the collection and treatment of domestic waste is still limited and has not met the current actual needs; the low awareness of a part of people in the collection and treatment of waste, indiscriminate littering still occurs in some places. In some communes, the responsibility of the local government, especially the head, has not really paid attention to the collection and treatment of waste, still allowing the situation of littering and indiscriminate dumping of waste, causing environmental pollution, degrading the landscape of the area; the central government does not have mechanisms and policies suitable for different regions on solid waste management. To improve the efficiency of DSW management in the study area, it is necessary to apply a number of solutions synchronously, such as: Raise awareness of the community on how to identify types of waste and the importance of sorting DSW at source; perform DSW classification at source; collecting all DSW generated from households; effective use of existing incinerators and waste treatment facilities; additional human resources and increased capital mobilization for DSW management ...

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