

Situation of plastic waste management and health conditions of people in Hai Duong coastal community of Thua Thien Hue province in 2020

Ton That Canh Tri^{1*}, Nguyen Van Thanh Nhan³, Nguyen Le Hanh Nguyen⁴,
Hoang Thi Binh Minh^{5,6,7}, Nguyen Dac Hoang Long⁵, Dang Thi Anh Thu^{1,2}

(1) Faculty of Public Health, University of Medicine and Pharmacy, Hue University

(2) Institute for Community Health Research, University of Medicine and Pharmacy, Hue University

(3) Occupational Health Center, Buu Dien Hospital

(4) Centers for Disease Control and Prevention Ho Chi Minh city

(5) Mien Trung Institute for Scientific Research

(6) Vietnam National Museum of Nature

(7) Vietnam Academy of Science and Technology (VAST)

Abstract

Background: Unmanaged plastic waste will affect the environment and human health. The study was conducted to describe the current situation of plastic waste management and the health conditions related to plastic waste of people in Hai Duong commune, Central Vietnam, in 2020. **Methodology:** A cross-sectional descriptive study using a structured questionnaire was carried out on 291 people over 18 years old in Hai Duong commune, Huong Tra town, from September to October, 2020. **Results:** The amount of plastic waste accounted for 16.5% of the total volume of collected waste. The main forms of plastic waste treatment included collecting at gathering places (87.3%), selling scrap (60.8%), or burning (19.9%). In most cases, plastic bags were collected at the gathering place (90.4%), washed for reuse (45.4%), and burned (14.8%). The notable weakness of garbage collection and transportation was that residents did not sort out different types of garbage (29.6%), and littered indiscriminately in public places with little traffic at night (11.3%). Health conditions related to over-plastic waste use included headache (9.6%), rash (4.8%), cardiovascular disease (5.2%), and gastrointestinal disease (3.4%). **Conclusion:** The management of plastic waste in general and plastic bags in particular is still inadequate. It could be seen that if a lot of plastic products were used and the waste was not handled properly, it would cause much harm to human health. Therefore, appropriate policies need to be implemented to improve local management of plastic waste as well as awareness and effective practices regarding garbage disposal.

Keywords: Plastic waste, nylon bags, health conditions, Hai Duong commune.

1. INTRODUCTION

Plastic waste is one of the most serious and urgent environmental problems in the world today [1]. The amount of mismanaged plastic waste generated by the coastal population of a single country ranges from 1.1 million tons to 8.8 million tons per year [2]. In 2020, a study by the World Wide Fund for Nature (WWF) showed that the amount of solid waste produced by Vietnamese people was 0.94 kg/person/day, in which the proportion of plastic and nylon waste components accounted for 17.8%. It is estimated that the amount of plastic waste lost to the environment is about 5kg/person/year, equivalent to 0.3-0.7 million tons/year [3]. Besides the advantages of plastic products such as high economic efficiency, less energy required for production, medical applications, etc., plastic products, if not well managed, will become the main factor causing environmental pollution and adversely

affect human health such as eye irritation, vision impairment, breathing difficulties, respiratory problems, cancer, skin diseases, effects on fertility, cardiovascular disease, digestive diseases [4], [5], [6].

In Vietnam, 67% of households do not separate their waste at home, and 11% dump it in public landfills [3]. Domestic waste pollution, especially plastic waste, is also a matter of concern in the coastal area of Hai Duong commune, Huong Tra town, Thua Thien Hue province. In the summer, especially on weekends, many domestic and foreign tourists come here to visit and have fun. However, with the development of tourism, this beach is facing serious pollution due to waste. Environmental pollution in the locality has not been thoroughly resolved due to a lack of data to assess the situation and unreasonable management practices. Hence, we conducted a research to evaluate the current

situation of plastic waste management and describe the health conditions related to plastic waste of people in Hai Duong commune, Huong Tra town, Thua Thien Hue province in 2020.

2. METHODS

2.1. Study setting

Data was collected from September 2020 to October 2020 in Hai Duong commune, Huong Tra town, Thua Thien Hue province, located in the central area of Vietnam. Hai Duong commune is a coastal commune.

2.2. Study participants

The study was conducted among people who aged 18 years or older with permanent residence in Hai Duong commune, Huong Tra town, Thua Thien Hue province.

Participant exclusion criteria: People with a history of mental disorders, inability to read, communicate in Vietnamese, deafness, blindness.

2.3. Sample size and sampling

- Research methods: Cross-sectional descriptive study.

The multi-stage cluster sampling method was used to select residents from 6 villages of Hai Duong commune, each cluster corresponds to 1 village, including Thai Duong Ha Bac, Thai Duong Ha Trung, Thai Duong Ha Nam, Thai Duong Thuong Tay, Thai Duong Thuong Dong, and Vinh Tri.

The first phase: We made a list of households in each cluster and randomly selected 48 households representing.

During the second phase, we interviewed people who were 18 or older and contacted them according to the sampling criteria.

- The sample size of people interviewed was calculated using the formula:

$$n = Z^2_{(1-\alpha/2)}$$

In which:

n: sample size

$Z_{(1-\alpha/2)} = 1.96$ ($\alpha = 0.05$)

$p = 0.78$: The percentage of people having correct knowledge about plastic waste in WWF's Survey on the Status of Plastic Waste in Vietnam [3]

$d = 0.05$: The tolerance level of the study

We computed the number of participants as 264. We estimated the rate of inaccurate responses and refusal to participate in research at 10%. In reality, we collected 291 responses.

2.4. Data collection

- Data was collected by interviewing the subjects through a set of prepared questions 'to assess

the collection and treatment of plastic waste and the residents' health.

- To determine the volume and composition of waste, we followed these steps as follows:

+ Location: Sampling was done at the garbage collection area in Hai Duong commune, Huong Tra town, Thua Thien Hue province. There was only one garbage collection area.

+ a Total number of waste samples: 7 samples. We analyzed 200kg of solid waste per sample according to EPA rules, 2002 [7].

+ Sampling time: From October 12th, 2020 to October 18th, 2020, we collected 7 samples on 7 consecutive days at 6 am when garbage trucks brought solid waste to the collection point.

+ Instruments for sampling and classifying garbage: Gloves, masks, polymer tarpaulins, scales, shovels.

+ Steps of sampling solid waste [7]:

Step 1: Randomly select garbage bags until reaching 200kg

Step 2: Mix 200kg of domestic solid waste in 10 minutes and divide the garbage into 4 parts (50kg each) afterward.

Step 3: Combine 2 opposite parts and mix well, then divide the mixture into 4 equal parts (25kg each).

Step 4: Repeating step 3 and dividing the remaining into 4 smaller parts (12.5kg each).

Step 5: Take 2 opposite parts and mix well (25kg)

Step 6: Classifying solid waste into 5 main groups (organic waste, recyclable waste, inorganic waste, household hazardous waste, and medical waste). Then, classifying plastic waste according to 7 main groups [8]. Finally, determining the weight of each type of waste by weighing and recording the results on the prepared form.

According to the Society of Plastics Industry (SPI), which established a classification system in 1988, there were 7 types of plastics that were coded from 1 to 7 and were printed on products when they were manufactured: (1) Polyethylene Terephthalate (PET), (2) High-Density Polyethylene (HDPE), (3) Polyvinyl Chloride (PVC), (4) Low-Density Polyethylene (LDPE), (5) Polypropylene (PP), (6) Polystyrene (PS) and (7) Other (Polycarbonate and Polylactide) [8].

2.5. Data analysis and statistical methods

Data were coded and entered using Epidata 3.1 software. SPSS 20.0 software was used to analyze and describe the data. Descriptive statistics, including frequencies and percentages, were computed to

describe sociodemographic characteristics, the current situation of plastic waste management, and the health conditions related to plastic waste. The results are presented in the form of tables and graphs.

2.5. Ethical considerations

Subjects were explained and agreed to participate in the study. All information related to the subject is encrypted, entered into the computer, and known only to the research team to ensure the confidentiality of the subject information. Subjects have the right to refuse to participate in the study at any time.

3.2. Situation of plastic waste management

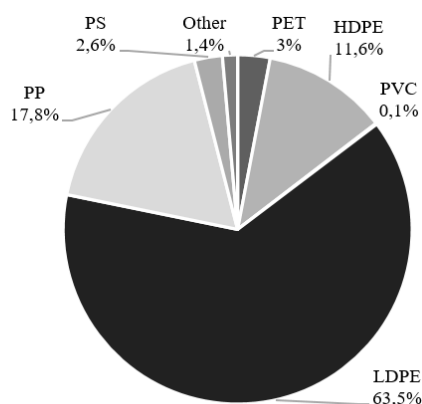


Figure 1. Classification of plastic waste samples according to the Society of Plastics Industry (SPI)

The amount of plastic waste collected was 29.1kg, accounting for 16.6% of the total volume of garbage. When we sorted plastic waste, approximately two-thirds of the weight was LDPE plastic. PVC plastic was discharged the least by households, accounting for only 0.1%. The proportion of single-use plastic bags was 58.3% of the total collected plastic waste.

Table 1. Patterns of plastic waste and nylon bags treatment

Form of treatment		N	%
Plastic waste	Collected or brought to the gathering places	254	87.3
	Littered indiscriminately	33	11.3
	Sold as scrap	177	60.8
	Threw into the trash in the garden	17	5.8
	Burnt	58	19.9
Nylon bags	Collected or brought to the gathering places	263	90.4
	Washed and reused	132	45.4
	Burnt	43	14.8

Plastic waste and nylon bags were mainly collected or brought to gathering places with 87.3% and 90.4%, respectively. In total, 60.8% of plastic waste was sold as scrap, and 45.4% of nylon bags were reused by washing and reusing. Some households also practiced burning with 19.9% plastic waste and 14.8% plastic bags.

3. RESULTS

3.1. General characteristics of research objects

Characteristics of the 291 research objects showed that there were 46.0% male and 54.0% female. Most people were aged 40-49 (29.2%) and over 60 years old (25.1%). Occupations were quite diverse, consisting of a housewife (22.3%), trader (21.3%), fisherman (15.1%), and self-employed workers (10.7%). A total of 83.2% of the participants are educated in secondary school and below. There were 5.5% of households with poor and near-poor economic status.

Table 2. The situation of people reducing, recycling, and reusing

	Situation	N	%
Reducing	Plastics	70	24.1
	Nylon bags	55	18.9
Recycling	Plastics	3	1.0
	Nylon bags	0	0
Reusing	Plastics	94	32.3
	Nylon bags	128	44.0

Over a period of 1 year, the percentage of people who reused plastic products and nylon bags was 32.3% and 44.0%, respectively. In the study, only about 1/5-1/4 of participants tended to reduce their use of plastic products and nylon bags. Most people did not care about recycling plastic waste and the figure for this issue was only 1.0%.

Table 3. Limitations of collection and transportation

	Limitation	N	%
	Lack of funds/Shortage of budget	6	2.1
	Lack of workers to collect garbage	32	11.0
	Poor/Outdated collection facilities	12	4.1
	Distance between collection sites and residential areas	11	3.8
	Lack of gathering places, arising temporary littering sites	17	5.8
	Indiscriminate litter	33	11.3
	No garbage sorting	86	29.6
	High environmental fees	9	3.1
	An attitude of staff and unreasonable collection time	4	1.4

The biggest obstacle to collection and transportation was people not separating garbage (29.6%). Many people littered indiscriminately in places with little traffic, at night (11.3%).

3.3. Health conditions related to plastic waste

Table 4. Health conditions related to plastic waste

	Health conditions	N	%
Symptom	Rash	14	4.8
	Allergy	10	3.4
	Nausea, vomiting	9	3.1
	Headache	28	9.6
	Eye irritation	8	2.7
	Diarrhea	4	1.4
Pathology	Cancer	8	2.7
	Endocrine, thyroid, neurological and memory problems	7	2.4
	Cardiovascular disease	15	5.2
	Digestive diseases	10	3.4
	Others	5	1.7

There were many symptoms and pathologies related to plastic waste and nylon bags. The most common symptom was headache (9.6%) and the most common pathology was a cardiovascular disease (5.2%).

4. DISCUSSION

Using a classification system developed in 1988 by the Society of Plastics Industry (SPI) in the US, synthetic products were divided into 7 groups [8]. Accordingly, the survey in Hai Duong commune showed that plastic waste derived from LDPE accounted for the highest proportion with 63.5%, followed by PP (17.8%), HDPE (11.6%), PET (3%), PS (2.6%), other (1.4%) and the lowest of PVC (0.1%). Meanwhile, statistics in Thailand in 2016 showed that the proportion of plastic waste produced from materials was HDPE (48%), LDPE (25%), PP (16%), PS (8%), PVC (2%), and PET (1%) [9]. It could be seen that the 3 materials (HDPE, LDPE, and PP) were used the most in 2 studies in 2 different countries because this was considered the safest plastic for human health [8]. Besides, this was also the material for creating common and necessary items in life. Items were made from HDPE, such as milk containers, machine oil, shampoo bottles, conditioner bottles, detergent bottles, etc. Items were manufactured from LDPE, including nylon packaging, food wrapping film, etc. Items were made from PP, such as drinking straws, transparent plastic food containers, bottle caps, yogurt boxes, plastic plant pots, etc. [8].

The 3R rule (reduce, recycle, reuse) had not been practiced much. 32.2% of people reuse plastic products such as plastic bottles, boxes, and paint cans to store trash, and 44.0% of people also reuse plastic bags. They kept clean bags for other purposes such as storing garbage, trading, and food. The percentage of people reducing the use of plastic products was 24.1%. Products that people eliminated included plastic cups, plastic boxes, plastic bottles, and single-use plastic items. The proportion of people reducing the use of nylon bags was 18.9%. Most people did not recycle, and only 1.0% of people recycled plastic products. According to Tangwanichagapong, the 3R rule positively impacted people's attitudes toward waste management and their sense of avoiding creating waste. Therefore, it was necessary to raise immense public awareness and take measures to decrease the amount of waste, including plastic [12].

The local governments had signed a contract with private and public companies for with garbage collection. Therefore, the form of collection at dumping sites prior to collection sites accounts for 87.3% of plastic waste and 90.4% of plastic bags. Besides, there were also several other forms, such as selling scrap (60.8%), and reusing washed plastic bags (45.4%). It not only reduced the amount of waste discarded in the environment but also

saving households money. Some households faced several difficulties, such as collection points far from their homes (3.8%), high environmental fees (3.1%), and the unprofessional attitude of collectors (1.4%), so they often burned garbage or dumped it in the garden. Burning plastic waste and plastic bags, releases toxins that exacerbate the risk of cardiovascular disease, respiratory disease, nerve damage, rashes, nausea or headaches, damage to eyes and mucous membranes [18]. The level of education of subjects in this area is still low, and there is a shortage of garbage collectors (11.0%), temporary positions (5.8%), leading to indiscriminate littering (11.3%), which affects the landscape and pollutes the environment, especially the marine environment. This result was quite similar to the study of Tran Thu Huong, the collection rate was 91%, the average littering rate was about 5-10% [3]. Such handling was a potential risk to the health of the population.

The biggest limitation to the collection and transportation of plastic waste was that people did not separate garbage (29.6%), followed by people littering indiscriminately in places with little traffic at night (11.3%), lacking workers to collect garbage (11.0%), etc. In Thailand, when it came to the main obstacles to plastic waste management and recycling, people were unaware of separating waste at source [14] and were not trained in recycling and which types of recyclable plastic bags [15]. This showed that the problem of waste separation at the source was the biggest obstacle. If this problem could be resolved, waste classification would limit the amount of waste released into the environment through recycling, reuse and reduce the workload for waste collectors. Lack of awareness of waste segregation at source can be explained by a lack of information, garbage collectors not paying attention to the issue, and the lack of funds and equipment at waste treatment facilities. This system is not able to collect different types of waste separately. This means it can collect different types without further separation. This leads to people not being involved in sorting waste despite their awareness of this urgent issue.

Plastic waste not only pollutes the environment, affected marine species but also causes significant harm to human health. Several studies have shown that plastic products contain harmful substances and can lead to adverse health effects. Plastic contains many chemicals and harmful substances such as Bisphenol A (BPA), phthalates, polybrominated diphenyl ethers (PBDE), di-(2-Ethylhexyl)phthalate

(DEHP) antiminitroxide, brominated flame retardants, poly-fluorinated, etc. [5], [16], [17]. Plastic waste is related to dangerous risks to human health, such as eye irritation, vision impairment, breathing problems, liver dysfunction, cancer, skin diseases, affect fertility, cardiovascular disease, digestive disease, headache, dizziness, etc. [5], [6], [18]. The study results showed that people suffered from many symptoms and related diseases. The most common symptoms were headaches (9.6%) and cardiovascular disease (5.2%). As the results indicated, these negative effects on the human body were mainly related to people's use and treatment of plastic waste. Therefore, more studies would be needed to investigate and provide more evidence on the harmful effects of plastic products. This would enable people and local authorities to think about appropriate solutions to minimize harm to health.

Limitations of the study

The study was conducted in one commune, so it is less representative of the coastal area of Thua Thien Hue province. Recall errors are often encountered when interviewing for information on the use of plastic waste. The researchers and readers might be carefully considered our findings in investigating the resident's health condition and behavior in plastic waste management.

5. CONCLUSION

Research results showed that plastic waste accounted for 16.5% of the total volume of collected waste. Plastic waste and nylon bags were collected from the gathering places at 87.3% and 90.4%, respectively. In addition, some people still burn garbage and litter indiscriminately, which leads to environmental pollution and health effects. There were many symptoms and pathologies related to plastic waste that people had. The most common symptom was headache (9.6%), and the most common pathology was a cardiovascular disease 5.2%. It could be seen that if a lot of plastic products were used and the waste was not handled properly, it would cause much harm to human health. Therefore, it was necessary to have appropriate policies to limit this situation.

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