

# Reduction of Plastic Waste in Tourism Activities in Sam Son City, Viet Nam

Truong Sy Vinh, Nguyen Trung Thang, Nguyen Thuy Van\*, and Sunil Herat

**Abstract**—Pollution caused by plastic waste (PW) is becoming urgent, causing negative impacts on tourism development in Viet Nam. This study aims to determine the amount of PW generated in Sam Son, especially from tourism activities. It proposes solutions to reduce PW in the tourism sector in the coastal city of Sam Son, Thanh Hoa province, Viet Nam. A survey of tourists, households, and accommodation establishments carried out the assessment of PW generation. The pilot activity was conducted by providing alternative products to selected hotels to replace single-use plastics. The results show that PW generation from tourism accounts for 42.42% of domestic solid waste. The estimated average rate of PW generation per visitor is about 0.4kg/person/day. The COVID-19 pandemic is estimated to have reduced the PW generated in this sector by about 40%. Although it may result in a 1.4-fold increase in expenses, tourism accommodation establishments and visitors have responded positively to activities replacing single-use plastic products. To reduce PW from tourism in Sam Son, several solutions are proposed, including implementing the extended producer responsibility (EPR) mechanism effectively; implementing a roadmap to eliminate single-use plastic products; building technical infrastructure for classification, collection, and treatment; developing a plan to reduce PW in Thanh Hoa province; promoting and raising awareness and understanding about PW.

**Index Terms**—Tourism, plastic waste, single-use plastic products, non-biodegradable plastic bags

## I. INTRODUCTION

Plastic pollution is one of the major environmental concerns of the twenty-first century. It causes serious impacts on the environment, health, and economy, including tourism. Plastic pollution is not an issue of one state or region, but it is a global issue. All countries have the duty to provide alternative options to reduce plastic pollution locally and internationally.

### A. Plastic Waste and Its Impacts on the Environment, Health

Marine litter and plastic pollution are accumulating in the world's oceans at an unprecedented rate. Plastic waste (PW) is becoming a pressing issue, with about 460 million tons of plastic produced globally in 2019 and 353 million tons of PW generated, 22 million tons of untreated PW appearing in the environment [1]. PW enters the oceans directly and indirectly through pathways, including land, rivers, and the atmosphere

[2].

The volume of PW currently in the oceans has been estimated at between 75 million and 199 million tons. Asia-Pacific countries have a very high material and plastic footprint, 60% of which needs to be better managed [3, 8, 9].

PW takes 300–500 years, even longer to completely decompose, so PW pollution is one of the significant environmental challenges of the 21st century, causing wide-ranging damage to ecosystems and human health [10, 11]. For ecosystems, swallowing PW causes entrapment, starvation, suffocation, severe intestinal obstruction, and organ damage [12]. Getting caught in nets, ropes, and other debris is also a significant hazard to marine life, affecting their health and being a cause of increased mortality, for example, with seals and sea turtles [13]. Marine litter and plastic pollution has been growing rapidly, and emissions of PW into aquatic ecosystems are projected to nearly triple by 2040 without meaningful action [11]. For human health, plastic carries toxic, carcinogenic chemicals such as styrene and benzene into the body through the food chain, causing damage to the nervous system, lungs, and reproductive organs [14–18]. Microplastics have been found in the human placenta [19] and lungs. In addition, exposure to toxic fumes and carcinogenic chemicals associated with burning plastics in open pits and poor incineration is considered a severe health risk, with known gendered effects among waste workers in the informal sector [11, 20–25].

### B. Impacts of Plastic Waste on Tourism

The tourism industry has been one of the most affected by plastic waste. According to a report by the World Economic Forum [26], plastic pollution could outweigh fish in the world's oceans by 2050 if nothing is done to stop it. The tourism industry plays a significant role in this problem, generating massive amounts of plastic waste daily [27]. UNEF estimates that the tourism industry accounts for around 8% of global carbon emissions and 4.5% of plastic waste production, and every year, 8 million tons of plastic from tourists enter the ocean. With the current rate of PW pollution, marine tourism resources are at risk of being polluted. Tourist attractions that attract tourists because of their beauty and natural landscapes under the impact of PW can cause negative visual and aesthetic impacts for tourists, leading to tourists being alienated and do not want to return [28–30], which causes losses to the economy in general and tourism in particular [31–35].

Sources of PW generation at coastal tourism destinations include those on land and sea from socio-economic development activities and people's livelihoods [36]. In tourism activities, PW on land is discharged from tourists and tourist establishments (accommodation, entertainment,

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catering, goods selling, etc.) [37, 38]. PW at sea arises from using and serving tourists from sightseeing or staying on boats, etc. [39]. The amount of PW generated from the tourism sector depends on many factors, such as destination characteristics, accommodation type, travel mode, tourist behavior and attitudes, infrastructure, waste management systems, policy, and regulations [27, 38, 40–43].

### C. Viet Nam's Tourism Industry and Challenges from Plastic Waste

Viet Nam has much potential for coastal tourism because it owns a coastline of more than 3,260 km and more than 3,000 islands, with white sandy beaches, pristine bays, and tropical islands far from the coast with yearly green forest ecosystems [44]. Viet Nam's tourism in recent years has made breakthrough developments [45]. In 2017, Viet Nam was ranked 6<sup>th</sup> among the ten fastest-growing tourist destinations in the world by the World Tourism Organization (WTO) and first in Asia by the WTO. According to the Viet Nam National Administration of Tourism (VNAT) statistics, the average growth rate in 2015–2019 was about 22.5%/year for international tourists and 10.5% for domestic ones [44]. The coastal area attracted about 70% of tourists, contributing about 60% of the total revenue from tourists and 8% of the GDP [46]. However, the development of tourism, especially the high growth of tourist numbers, also generates a large amount of waste [47]. Many beach resorts in Viet Nam face environmental pollution from waste, especially plastic ones [48]. For example, Phu Quoc Island in Kien Giang province is a popular tourist destination for domestic and foreign tourists, but plastic pollution has impacted water resources, reducing its attractiveness. For low-income communities, which mainly rely on tourism, plastic pollution is threatening their livelihood [37].

### D. Viet Nam's Policy Context on Plastic Waste

With increasing plastic pollution, Viet Nam has devised many policies to tackle it. Specifically, the National Action Plan on Ocean Plastic Waste Management (2019) aims to reduce 75% of plastic discharged into the ocean by 2030 [49]. Law on Environmental Protection (2020) and Decree No. 08/2022/ND-CP regulated the development of a circular economy. At the same time, many regulations are issued: (i)

reduce plastic waste by banning single-use plastics, especially plastic bags, promoting environmentally friendly alternative materials, limiting products containing microplastics, and controlling imports of plastic scraps; (ii) promote recycling plastic products and packaging through extended producer responsibility (EPR) mechanisms; (iii) strengthen segregation at source and charge by volume, and at the same time ban the discharge of plastic waste into the aquatic environment; and (iv) promote safe disposal of plastics by phasing out direct landfilling.

### E. Objectives of the Study

Although the impact of PW on the tourism industry is already present, studies on plastic pollution in the tourism sector in Viet Nam are still minimal. PW generation in the tourism sector, in general, and Sam Son City, in particular, has yet to be determined. The questions for research are what is the rate of PW generation in the tourism sector in a small city like Sam Son? What would be the most suitable solution for resolving PW pollution? This study aims to answer the above questions by determining the amount of PW generated in Sam Son, especially from tourism activities (tourists, accommodation establishments), and proposing some measures to reduce the PW from tourism activities. These results would contribute to the knowledge of tourism plastic pollution and developing policies to reduce PW in Sam Son and Viet Nam.

## II. METHODOLOGY

### A. Introduction of the Study Site

Sam Son coastal tourist city in Thanh Hoa province (Fig. 1) has rich and diverse tourism potential, including natural and cultural tourism resources, as a small city with over 108,000 people [50]. Sam Son currently has 546 hotels (147 are rated 1-5 stars) with about 20,000 rooms, 100 restaurants with a total capacity of 18,500 seats, and receives about 4.5 million tourists annually, with domestic tourists accounting for a significant proportion [51]. The peak tourism season in Sam Son is from June to September [51].

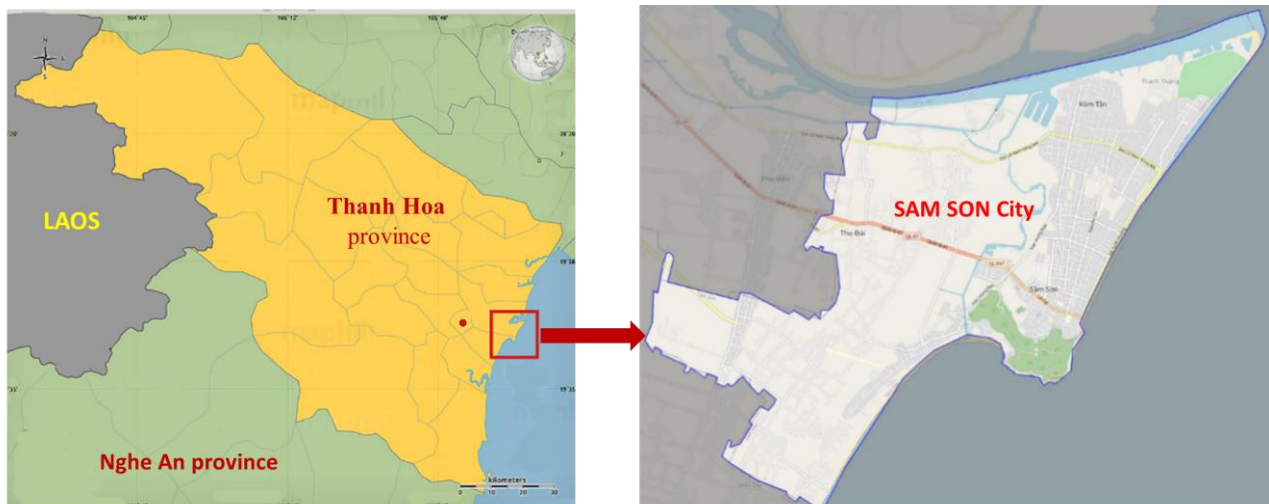


Fig. 1. Location of Sam Son City in Thanh Hoa province, Viet Nam. (Source: Research's result)

Sam Son's development orientation in 2021–2025 is to become a smart, attractive, and friendly tourist city, one of the country's high-quality tourism centers, focusing on vacation and sea tourism. From 2015 to 2019, tourists to Sam Son grew steadily, with a growth rate of 5.04%. However, in 2020, due to the impact of the COVID-19 pandemic, the number of tourists to Sam Son decreased sharply, only 65.65% compared to 2019 [51].

#### *A. Data Collection and Pilot*

##### *Phase 1—Collecting data on the source, volume, and type of plastic waste in the coastal tourist city of Sam Son*

The study collected primary and secondary data to identify waste sources, waste mass, type of PW, and measures taken to manage and treat PW in Sam Son.

The secondary data collected includes:

- Data on the current state of tourism development (total tourist arrivals, number of tourist accommodations) of Sam Son City.
- Data on environmental protection activities in general and environmental protection in tourism in particular of Sam Son (amount of solid waste, including PW; the current status of solid waste collection and treatment in general and PW in particular)
- Strategies, plans, and policies for tourism development and policies related to tourism development and environmental protection.

The secondary data are taken from the People's Committee of Thanh Hoa province, the Department of Culture, Sports and Tourism of Thanh Hoa, and Sam Son Urban Environment and Tourism Service Joint Stock Company. In addition, the authors met with the offices to clarify the above secondary data. At the same time, a field survey was also carried out to assess and test the collected data (evaluate the capacity of the city's existing PW collection and treatment facilities; consider collection measures and estimate the number of PWs of some tourist accommodation establishments... then compare with the collected data...).

Primary data:

A review of the collected secondary data shows they need more information on emissions and PW composition from tourism activities. Therefore, the study surveyed to collect data to determine the above information. The survey was conducted using questionnaires with prepared questions.

Survey subjects include (1) Tourists; (2) tourism enterprises; (3) Local community. The tourists are randomly selected among tourists staying at hotels; the local communities are households who have lived in Sam Son for a long time (at least five years) without providing tourism services and focus mainly on families of 3-5 people (average family size in Sam Son [50]). Accommodation establishments selected for the survey are small and medium-scale (these are the characteristics of accommodation facilities in Sam Son [51]), with a large and stable number of tourists over the years. Each survey subject has its questionnaire. However, all these questionnaires have questions to determine the average number of plastic products used daily, from which the mass of PW is estimated. The plastic products under investigation include (i) non-biodegradable plastic bags, (ii) Plastic water

bottles, (iii) Disposable bottles of shampoo, shower gel, razors, shower caps, cotton swabs, etc., (iv) Food and beverage packaging (cake shells, candies, snacks, packaged foods, etc.) and another plastic-based packaging (v) Disposable bowls, chopsticks, spoons, cups, straws.

The survey was carried out from April to July 2021. This is the time when Sam Son City usually has a lot of tourists [51]. However, because the time of the survey was also the period of the covid pandemic, there were fewer tourists in Sam Son, and fewer hotels were open. At the same time, the access to households for surveying was limited. Monitoring is also difficult due to the policy limiting contact during the pandemic. Therefore, the study issued 610 questionnaires (350 for tourists, 150 households, and 110 tourism enterprises); however, the number of votes collected was only 513, of which 302 were from tourists, 108 households, and 103 tourism enterprises (including 59 hotels and 44 restaurants).

##### *Phase 2—Pilot measures to reduce single-use plastic products and non-biodegradable plastic bags*

The pilot aimed to estimate the magnitude of PW reduction from tourism businesses using alternatives to single-use plastic products and non-biodegradable plastic bags and to review feedback of tourists and accommodations when using alternative products as a basis for proposing appropriate measures to reduce PW in Sam Son City.

The study selected ten hotels for the pilot. These hotels represent the hotel groups of Sam Son, including two hotels rated 3–4 stars, three hotels rated 1–2 stars, and five hotels not rated. The selected hotels are also those out of 59 that have been assessed for their status and remain open to tourists during the COVID-19 pandemic.

To conduct the pilot, the study supports replacing some single-use plastic products and non-biodegradable plastic bags in the hotel rooms in all the pilot hotels. In each hotel room, a questionnaire is available for guests (with about eight questions about whether or not guests use alternative products, the need to replace single-use plastic products, and willingness to pay extra costs when using alternative products...). During the pilot period, hotels recorded and tracked the PW generated daily. The questionnaires for tourists and for the selected hotel (with about nine questions about quantity and cost to purchase disposable plastic products and non-biodegradable plastic bags, assessment of substitution and willingness to replace disposable plastic products and non-biodegradable plastic bags, and recommendations) were collected at the end of the pilot. The pilot period is 30 days, starting from the end of July 2021. At the end of the pilot, the study received 203 comments from tourists staying at the pilot hotels (30% of the total number of tourists that ten hotels could accommodate) and ten comments from selected hotels. The research supported several products to replace single-use plastic products and non-biodegradable plastic bags for each hotel, including ten pairs of porcelain shampoo and shower gel bottles, 40 pcs of bamboo handle toothbrush; 5 kg compostable plastic bags used during the pilot period (30 days).

The effectiveness of pilot activities is assessed by comparing the level of PW generation/reduction before and

after the pilot; comparing the generation/reduction of costs when replacing single-use plastic products and non-biodegradable plastic bags. In addition, the evaluation of effectiveness is also determined through the criteria of the response and commitment level to reduce the PW of these establishments.

### B. Consultation

The purpose of the consultation phase is to consult experts on the research objectives, methods, results, and recommendations. The consultation was conducted through a workshop held in Hanoi on September 28, 2021. About 50 people participated in this workshop, mainly scientists and managers (in central agencies and Sam Son city) in tourism and environmental fields.

## III. RESULT AND DISCUSSIONS

### A. Actual Situation of Plastic Waste Generation in Sam Son

#### 1) PW generated from tourism establishments and tourists

- **For tourism establishments:** Survey results from 59 hotels with 3,578 rooms (Phase 1) show that the mass of PW of each room in Sam Son is estimated at 0.35kg/day, of which a more significant proportion is plastic water bottles (32%), bowls, cups, disposable plastic spoons, and straws (17%); disposable shampoo and shower gel bottles (14%); toothbrush (14%), Plastic garbage bags 9%, and so on (Fig. 2). This result is higher than PW generated by hotels in Da Nang, Hoi An [43, 52]. One of the reasons is that hotels in Sam Son often serve both accommodation and meals.

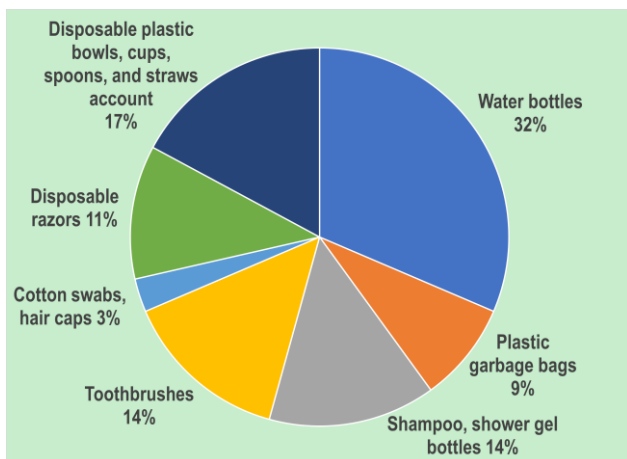


Fig. 2. The proportion of the plastic waste generated from accommodation establishments in Sam Son. (Source: Synthesized by authors from research's result)

- **For restaurants:** Survey data from 44 restaurants (the maximum number of guests that can serve is 16,420 guests/day) shows that the mass of PW of each dining table (6 guests) in Sam Son is calculated at about 0.286 kg/table. This value is higher than the amount of PW from restaurants in Da Nang [52]. This is explained by the majority of restaurants in Sam Son are low quality, and guests often stay

there long.

In terms of composition by weight, water bottles account for 53%; bowls, cups, spoons, and disposable plastic straws 27%; Plastic food packaging 12%; Plastic garbage bags 8% (Fig. 3). PW distribution from bowls, cups, spoons, disposable plastic straws is still significant because these are cheap products serving mass tourists.

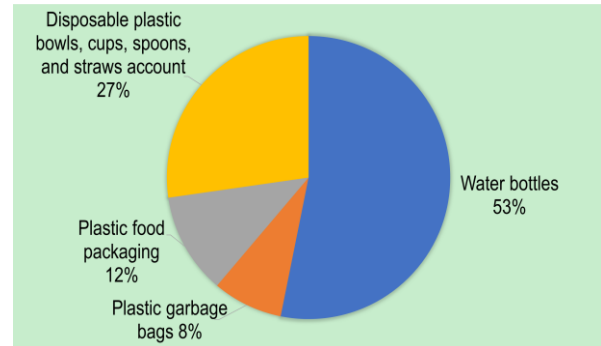


Fig. 3. The proportion of the plastic waste generated from restaurants in Sam Son. (Source: Synthesized by authors from research's result)

- **For PW generation from tourists:** Survey results from 302 tourists (from Phase 1) show that, on average, each tourist disposes of 0.38kg of PW/day, mainly food and drinks packaging (accounting for 34.17%); drinking water bottles accounted for 23.44% (Fig. 4).

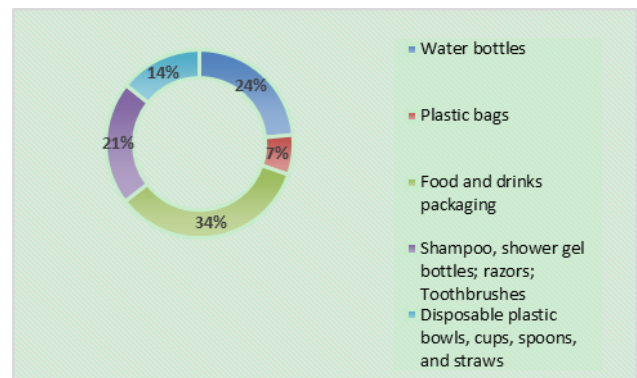


Fig. 4. The proportion of plastic garbage generated by tourists in Sam Son. (Source: Synthesized by authors from research's result)

#### 2) PW generated from local people

Survey results from 108 people, representing 108 households with 382 people, show that each resident's total amount of PW generated in a day is about 0.13kg/person/day, mainly from food packaging, utensils, and other plastic products (accounting for 81%); plastic bags (12%) and water bottles (7%) (Fig. 5).

The amount of PW generated by local people in Sam Son is equivalent to that in some other coastal cities of Viet Nam with developed tourism activities such as Phu Yen: 0.15 kg/day, Rach Gia: 0.134 kg/day, Da Nang: 0.17 kg/day, Phu Quoc: 0.103 kg/day, etc. [53–56].

#### Combination of PW sources

For calculation convenience, this study combined PW from hotels, restaurants, and tourists. Accordingly, the amount of PW generated from tourism activities in Sam Son can be determined based on the number of tourists and the PW generated by each tourist after combining the PW sources.

The PW generated by tourists equals the PW from tourists

(determined by the survey in Phase 1) plus the PW from hotels and restaurants after deducting the PW directly from tourists discharged. Thus, the combined PW generated by each tourist is estimated at approximately 0.4 kg/day.

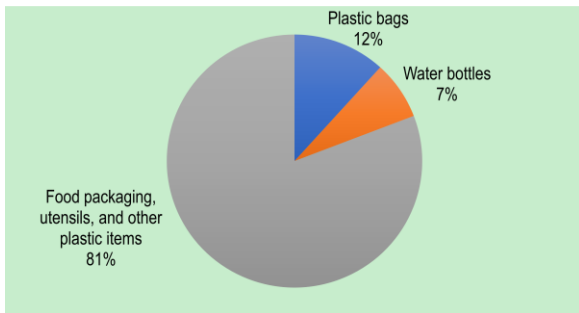


Fig. 5. The proportion of the plastic waste generated by Sam Son residents. (Source: Synthesized by authors from research’s result)

3) Mass and composition of PW generation sources in Sam Son coastal tourist city

• Before the COVID-19 pandemic

According to a report of Sam Son Urban Environment and Tourism Services Joint Stock Company - The responsible unit for collecting, transporting, and treating waste in Sam Son City, in 2019, the average daily-life mass of waste in Sam Son was about 105 tons/day, of which, PW accounts for 24%, equivalent to 25.2 tons/day. Domestic waste is generated from two primary sources: households and tourism activities.

In 2019, on average, Sam Son received 26,716 guests per day [51]. According to the survey results, if the PW generated from tourists is 0.4kg PW/day, the total amount of PW discharged from tourism activities is about 10.69 tons PW/day.

According to survey data, each resident disposes of 0.13 kg of PW/day on average for local people. In 2019, the total population of Sam Son was 108,320 people [50]. Accordingly, local people in Sam Son discharged 14.08 tons/day (Table I & Fig. 6).

TABLE I: THE SCALE OF PW GENERATION SOURCES IN SAM SON TOURIST DESTINATION

	Generation sources			Total
	Tourism activities	Livelihood activities	Other	
Volume generated (tons/day)	10.69	14.08	0.43	25.2
Percentage (%)	42.42%	55.87%	1.71%	100%

(Source: Synthesized by authors from research’s result)

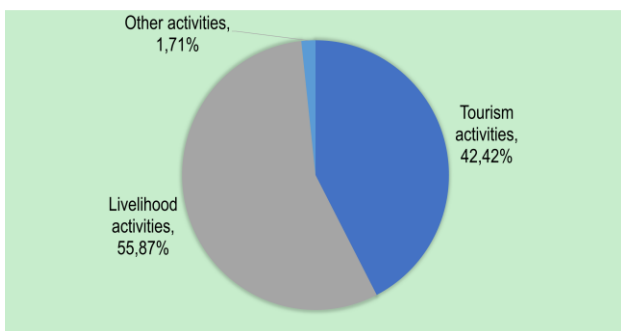


Fig. 6. Plastic waste generation sources in Sam Son tourist destination. (Source: Synthesized by authors from research’s result).

The data in Table I show that, when it was not yet affected by the COVID-19 pandemic, the source of PW generation from the local people had the most significant proportion, accounting for 55.87% of the total PW in Sam Son. The second is the source of PW generation from tourism accounting for 42.42%. Other sources are from agencies, public places, beaches, etc. (about 1.71%).

• During the COVID-19 pandemic (2020–2021)

From 2020 to 2021, the tourism industry in the world and Viet Nam will be heavily affected by the COVID-19 pandemic [57]. In 2020, Sam Son received 16,164 guests per day [58]. Accordingly, the amount of PW from tourism activities was about 6.46 tons PW/day. Sam Son’s population in 2020 was estimated at 110,000 people [59], according to which the daily amount of PW discharged from local people was about 14.3 tons/day, 2.21 times higher than that of tourism activities. Thus, compared to 2019, the amount of PW from tourism activities decreased by 4.23 tons/day, equivalent to 1,544 tons/year.

4) Types of PW in Sam Son

Based on analysis and assessment of the mass, composition, and characteristics of waste sources and weight, it is possible to determine the types of PW in Sam Son. The proportion of PW components in Sam Son is determined based on the proportion of PW generated from tourists, locals, and other sources (Table II).

TABLE II: MAIN TYPES OF PUBLIC WASTE IN SAM SON

No	Type of plastic waste	Generation sources	Proportion (*)
1	Non-biodegradable plastic bags	- Local people (6.60%) - Tourism activities (2.90%) - Other activities (0.12%)	9.62%
2	Plastic water bottles	- Local people (4.10%) - Tourism activities (9.9%) - Other activities (0.1%)	14.1%
3	Disposable shampoo containers, shower gel, razor, shower cap, cotton swab, etc.	Tourism activities	9.03%
4	Food and beverage containers (cakes, candies, snacks, packaged foods, etc.) and other plastic-based packaging.	- Local people (45.0%) - Tourism activities (14.0%) - Other activities (0.52%)	59.52%
5	Disposable bowls, chopsticks, spoons, cups, straws	- Tourism activities (6.0%) - Local people (0.02%)	6.02%
6	Other	Waste sources	1.71%

Note: (\*) Proportion of each type of PW compared to that of Sam Son in 2019. (Source: Synthesized by authors from research’s result)

In conclusion, PW, including food and beverage containers such as cake, candy, snacks, packaged foods, etc., and other plastic-derived packaging, is the main type of PW in Sam Son, accounting for 59.52%. The typical PW for tourism activities is the disposable personal care products equipped in the hotel, such as shampoo containers, shower gel, razors, shower caps, cotton swabs, etc., accounting for about 9.03%. Other types of PW: include plastic water bottles, accounting for 14.1%; non-degradable plastic bags accounting for 9.62%; disposable

bowls, chopsticks, spoons, cups, and straws, accounting for 6.02%. Besides, many types of domestic waste are generated from other activities, accounting for about 1.71% (Fig. 7).

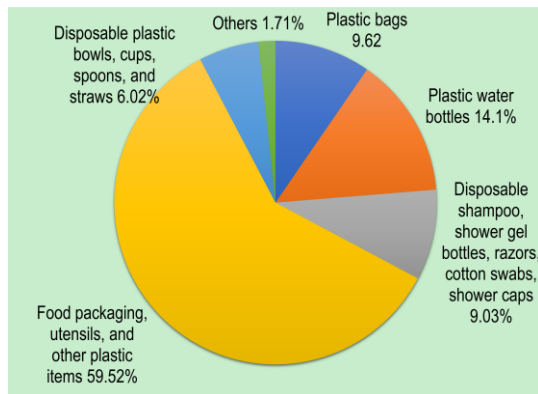


Fig. 7. Main types of plastic waste in Sam Son. (Source: Synthesized by authors from research's result)

**B. Piloting Public Waste Reduction in Some Accommodation Establishments in Sam Son**

The system of accommodation establishments is a specific object of the tourism industry, which uses many single-use plastic products and non-degradable plastic bags. According to the study, each occupied room generates 0.35 kg of PW, and the annual average occupancy rate is 67% [51]. Accordingly, the operation of tourism accommodations in Sam Son generates about 4.68 tons of PW/day, accounting for 43.78% of the solid waste of tourism activities and 18.57% of the waste generated daily in Sam Son, which is not a small number. Therefore, replacing single-use plastic products and non-biodegradable plastic bags for accommodation establishments plays a vital role and effectively reduces PW in the coastal tourist city of Sam Son.

• *About the level of PW reduction during the pilot period*

The research team piloted to reduce PW generation at 10 Sam Son hotels by supporting replacing some single-use plastic products. The evaluation results show that, when hotels apply alternative measures, the PW generated from single-use plastic products and non-biodegradable plastic bags decreased significantly to only 0.21 kg/room/day, 40% lower than before (Table III). If all the hotels in Samson practice in all guest rooms, the amount of PW from accommodation establishments in Sam Son only generates about 2.81 tons of PW/day, accounting for 31.86% of that in tourism activities and 12.04% of the waste generated every day in Sam Son (Fig. 8).

TABLE III: COMPARISON OF PW GENERATION/REDUCTION OF EACH OCCUPIED ROOM AFTER REPLACING DISPOSABLE PLASTIC PRODUCTS AND NON-DEGRADABLE PLASTIC BAGS

Unit: kg

Components of PW	Volume generated before piloting (*)	Volume generated after piloting (**)
Water bottles	0.11	0.11
Plastic bags for garbage	0.03	0
Bottles of shampoo, shower gel	0.05	0
Toothbrush	0.05	0
Cotton swabs, shower caps	0.01	0.01

Disposable razor	0.04	0.04
Disposable cups, spoons, plastic straws	0.06	0.05
<b>Total</b>	<b>0.35</b>	<b>0.21</b>

Note: (\*) Calculations based on the survey's results of the current sources. (\*\*) Calculations based on the survey's results & evaluation of pilot effectiveness. (Source: Synthesized by authors from research's result)

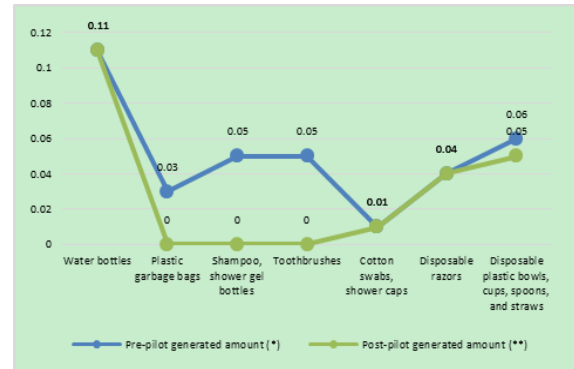


Fig. 8. Comparison of the pre-and post-pilot amount of plastic garbage generated/reduced from each occupied room. (Source: Synthesized by authors from research's result)

Additionally, this pilot activity only replaces minimal and basic products. If all disposable plastic products (plastic water bottles, razors, cotton swabs, shower caps, etc.) had been returned, the amount of PW from tourism accommodation would have been significantly reduced.

• *About the costs incurred for PW reduction*

Statistics on the cost of plastic products and substitutes used in hotels show that the use of substitutes increases the price from 12,800 VND/room/day to 18,100 VND/room/day (increased by 41%), equivalent to about 5.3 thousand VND/person/day (Table IV).

The replacement of all disposable plastic products and non-biodegradable plastic bags at tourism accommodations in Sam Son incurs initial costs (ranging from VND 10 million to VND 50 million (~425–\$2,127) depending on the hotels' scale and a small number of daily costs. However, these solutions reduce 4-5 tons of PW per day, providing significant environmental benefits, especially since Sam Son has no waste treatment plant but is mostly burying [60].

TABLE IV: COST COMPARISON BEFORE AND AFTER REPLACING SINGLE-USE PLASTIC PRODUCTS AND NON-BIODEGRADABLE PLASTIC BAGS

Unit: VND/room/day

Pre-pilot cost		Post-pilot cost	
Plastic bags for garbage	800	Environmentally friendly plastic garbage bags	1,100
Shampoo & shower gel pair	4,000	Container and shampoo, shower gel	5,000
Toothbrush	3,000	Environmentally friendly toothbrush	4,000
Cotton swabs, shower cap	1,000	Shower cap, cotton swab (*)	2,000
Disposable razor	4,000	Razor made of environmentally friendly materials (*)	6,000
<b>total</b>	<b>12,800</b>	<b>total</b>	<b>18,100</b>

Note: (\*) Average estimate based on the market price in Viet Nam, 2021 (Source: Synthesized by authors from research's result)

- *About the level of response to PW reduction methods*

*For accommodation establishments:* The survey results show that 100% of establishments selected for the pilot believe that replacing single-use plastic products and non-degradable plastic bags with environmentally friendly products contributed to improving the service quality of the guest rooms. 50% of establishments intend to take this action, of which 40% choose not to increase the room rate. The rest of the establishments plan to replace only some plastic products, and they have yet to decide. In addition, 80% of establishments plan to develop and implement plans to reduce PW at their hotels and ask tourists to cooperate with them.

*Of tourists,* 203 staying at ten establishments selected for the pilot show that 96.55% choose to use alternative products instead of other disposable plastic products. A few tourists do not use alternative products because they habitually use disposable products for convenience. In addition, alternative products are few and incomplete; tourists still have to use products that need replacing (combs, cotton swabs, shower caps, etc.). Regarding cost, 83.25% of tourists are willing to pay an extra 2–5% of the room rate to replace single-use plastic products. At the same time, 93.6% of tourists confirmed their willingness to implement waste reduction methods in Sam Son. However, 6.4% of tourists are not ready to take action due to their disinterest, and restrictions on bottled water and disposable personal care products such as combs, toothbrushes, soaps, etc., cause discomfort during their stay.

#### *C. General Assessment of the PW Generation and Reduction Potential in the Tourism Sector in Sam Son*

*Regarding PW generation,* in general, the proportion of PW in domestic solid waste generated in Sam Son is quite large (24%), higher than the national average (10–12%) [61]. The amount of PW generated in a day by each local person is about 0.13 kg/person/day, equivalent to other secondary coastal cities in Viet Nam, where the main types of waste are from packaging, accounting for 59.5%.

The tourism industry accounts for a relatively large proportion of the PW generation in Sam Son, accounting for about 42.42% (i.e., 10.2% of the total solid waste generated in Sam Son), of which the generated PW types are arranged in descending order as follows: water bottles (32% from hotels, 53% from restaurants, and 23.4% from tourists), single-use plastic products for eating and drinking, such as bowls, cups, straws, forks, etc. (17% from hotels, 27% from restaurants, 14.2% from tourists), packages (34.17% of PW from tourists; shampoo, and shower gel shells, accounted for 21.3% from tourists) and single-use plastic bags (about 9% of hotels, 8% of restaurants, and 6.89% of tourists).

*Pilot results show many positive opportunities about the potential to reduce PW in the Sam Son tourism industry.* 100% of hotels plan to replace single-use plastic products, and 80% will develop and implement a PW reduction plan. The number of tourists supporting it is also very high: 96.55% chose to use alternative products, 83.25% were willing to pay extra room rates, and 93.6% were ready to implement PW reduction methods.

#### *D. Result of Consultation*

The experts in the workshop agreed with the research

methods, the results, and the proposed recommendations. In addition, there were some suggestions to raise awareness to reduce the use of single-use plastic products and non-biodegradable plastic bags in the tourism area and invest in recycling plastic waste in Sam Son.

#### IV. RECOMMENDATIONS

Based on the survey's results, the pilot PW reduction, and the consultation results, in the context of Viet Nam's policy, some recommendations are proposed to reduce waste in the tourism sector in Sam Son as follows:

*Promoting collection and recycling of plastic bottles from hotels, restaurants, and other tourism facilities through implementing the extended producer responsibility (EPR) mechanism.* As found by the survey, plastic bottles account for the most significant share of PW in the tourism sector in Sam Son. The Law on Environmental Protection 2020 and Decree No. 08/2022/ ND-CP stipulates that manufacturers and importers must collect and recycle six types of packaging and discarded products, including plastic packaging (plastic bottles included). Tourism establishments, Sam Son citizens, as well as tourists need to participate in collecting plastic bottles. There should be solutions to promote investment in plastic recycling activities in Thanh Hoa province.

*Promote phasing out single-use plastics (bowls, cups, straws, forks, etc.) from hotels, restaurants, and other facilities.* Single-use plastics are found to account for a significant share of the tourism sector in Sam Son. The Law on Environmental Protection 2020 and Decree No. 08/2022/ ND-CP have regulated that from 2026, non-degradable plastic bags and single-use plastic products will be banned in supermarkets, commercial centers, resorts, and hotels. Therefore, hotels, restaurants, and Sam Son tourist areas must gradually apply methods to replace single-use plastic products with environmentally friendly ones. At the same time, the production of sustainable and environmentally friendly products should be promoted.

*Promote hotel refill models to reduce plastic packaging, such as shampoo containers and shower gel shells.* This plastic packaging also accounts for a particular share of PW in the tourism sector in Sam Son. The refill model is to be applied by all hotels and guest houses through the setting and supplying chain from producers to tourism enterprises.

*Promoting PW reduction campaign by the hotels and restaurants in Sam Son through implementing their PW reduction plan.* It has been found that 80% of hotels are very committed to PW reduction plans. Therefore, it is recommended that the Thanh Hoa province authority develop an action plan for reducing marine pollution in Thanh Hoa province, requiring every hotel to develop and implement a PW reduction plan. It is also necessary to carry out separation at the source of domestic solid waste (DSW) and start charging a fee based on the quantity of waste according to the Law on Environmental Protection 2020 by December 31, 2024. At the same time, it is recommended to propagate and raise awareness on reducing the use of single-use plastic products and non-biodegradable plastic bags.

## V. CONCLUSION

Plastic pollution has become an emerging issue worldwide, and the UNEP started negotiations for an international agreement to be adopted by 2025. In Viet Nam, the Law on Environmental Protection and Decree 08/2022/ND-CP has regulated a roadmap for PW reduction. The National Action Plan for Ocean Plastics Waste Management has also been approved, in which the decrease of PW in the tourism sector plays an important role.

As one of the coastal tourist cities of Viet Nam with millions of tourists every year, the generation of PW in Sam Son is becoming an urgent environmental problem, with about 25.2 tons/day, of which 42.42% comes from tourism activities. For tourism activities, PW is mainly generated from accommodation establishments, primarily plastic bottles, followed by disposable plastic products for dining, packaging, and non-biodegradable bags. The estimated average rate of PW generation per visitor is about 0.4kg/person/day. The COVID-19 pandemic has had a significant impact on tourism in Viet Nam in general and Sam Son in particular, so it is estimated that there has been an estimated 40% reduction in the amount of PW generated in this sector.

If single-use plastic products with reusable and environmentally friendly products can be uniformly replaced, at least 40% of PW from tourism accommodation can be reduced. However, replacing these products will also cost about 1.4 times more than current products. Despite the higher cost, tourism businesses and tourists have positively responded to activities to reduce PW.

To reduce single-use plastic products and non-biodegradable plastic bags in the coastal tourist city of Sam Son, it is necessary to implement the EPR mechanism and implement a roadmap to eliminate single-use plastic products according to the Law on Environmental Protection 2020 regulations. At the same time, it is essential to build the technical infrastructure for waste classification, collection, and treatment; develop a plan to reduce PW in Thanh Hoa province; propagate and raise awareness and understanding about PW. To carry out these actions, efforts from authorities, tourism enterprises, and communities and financial resources for investment will be needed.

This research has determined the PW generation rate in Sam Son City and readiness for replacement by alternatives and solutions. Due to many reasons, this study also has certain limitations in terms of sample size, survey methods, and analysis of tourists' consumption behavior. In the coming time, it is necessary to carry out more detailed and comprehensive studies on PW in Sam Son and/or other locations and Viet Nam to have more thorough and complete assessments and solutions for the tourism sector.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

## AUTHOR CONTRIBUTIONS

T. S. Vinh and N. T. Van proposed research methods, analyzed and processed data, and gave results; Sunil Herat researched the overview and reviewed the content; N. T. Thang analyzed data and recommendations. All authors had

approved the final version.

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