

ORIGINAL RESEARCH PAPER

Analyzing solid waste management practices for the hotel industry

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ABSTRACT: The current study aims to analyze waste characteristics and management practices of the hotel industry in Hoi An, a tourism city in the center of Vietnam. Solid wastes from 120 hotels were sampled, the face-to-face interviews were conducted, and statistical methods were carried out to analyze the data. The results showed that the mean of waste generation rate of the hotels was 2.28 kg/guest/day and strongly correlated to internal influencing factors such as the capacity, the price of the room, garden, and level of restaurant. The differences in waste generation rate of the hotels were proved to be statistically significant. The higher the scale of hotels, the higher the waste generation rate. Moreover, the waste composition of the hotels was identified by 58.5% for biodegradable waste, 25.8% for recyclables and 15.7% for others. The relative differences in the waste composition of the hotels by climate, the features of hotels, and the types of the guest were explained. Whereby, the higher size of the hotels, the higher percentage of biodegradable and less proportion of recyclable waste. Also, this study revealed that the implementation status of waste management practices of the hoteliers initially reaped quite positive achievements with 76% for sorting, 39% for recycling, 29% for reduction, and 0.8% for composting. The rate of waste management practices was proportional to the scale of the hotel. This study provided information on waste management practice of hotel industry and contributed to the overall assessment of municipal solid waste management practices of Hoi An city.

KEYWORDS: *Hotel industry; Solid waste composition; Solid waste generation; Solid waste management; Solid waste practice; Vietnam.*

INTRODUCTION

Worldwide, tourism has firmly developed and become one of the most dynamic global industry (Shamshiry *et al.*, 2011; UNEP, 2009). Undoubtedly, tourism brings and sustains benefits on employment and economic value to society. However, tourism activities also have negative influences on the environment, in which solid waste is one of the most significant impacts (Ezio RANIERI *et al.*, 2014; Kaseva and Moirana, 2010; Mateu-Sbert *et al.*, 2013; Mihalič,

2000; Schianetz *et al.*, 2007; Teh and Cabanban, 2007; Zaei and Zaei, 2013). Sharma, (2016) indicated that solid waste accumulation and littering was a negative indicator which highly impacted on tourism industry of Kerwa, India. It should be considered formulating policies for the tourism development. In tourism business, the accommodation is considered as an essential element to attract tourists, and also a primary source of waste (Molina-Azorín *et al.*, 2009). Therefore, for tourism cities, the higher the number of arrivals, the more critical the solid waste management (SWM) of the hospitality industry. The establishment and gradual implementation of sustainable SWM

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(SSWM) framework to the hotels in developed countries spent a long time with different features. Before 2000, reducing waste in the hospitality industry was noticed as an urgent need in some European cities where the tourism commerce firstly boomed in the world. Thus, the global frame of waste minimisation was established to support the hotels in approaching SSWM (Cummings, 1992, 1997). However, the limited awareness about the benefits from improving SWM of the hoteliers and application of environmental regulations to the hospitality sectors were significant obstacles of the government at that time (Kirk, 1995). Until the first years of the 21st century, the perception of SSWM by the hoteliers was more positive, especially in chain-affiliated hotels (Bohdanowicz, 2005). However, in fact, from attitude to action in SSWM practice of the hotel industry was still a gap (Graci and Dodds, 2008). Therefore, finding out barriers that hindered SWM practices had been paying attention. The tourism SWM in the developed countries so far has been improving towards a comprehensive and integrated SWM system with the interconnection between society, environment and economy (Ezeah et al., 2015). In developing countries, on the other hand, SWM of the hospitality industry now is still a big problem. For example, in India, the lack of facilities, skills, methods, and regulation of SWM led to the poor of SWM system of hotels and municipality (Omidiani and Hashemi Hezaveh, 2016). Also, small hotels have not paid intention to SWM practice because of lack of funds and knowledge (MaLik and Kumar, 2012). A study on SWM practice of five-star hotels in Cairo, Egypt indicated that, although these hotels sorted waste at source successfully, reduce, reuse and recycle practices were not effective (Ball and Taleb, 2011). Furthermore, Ghadban et al., (2017) presented a crisis of waste in Lebanon in 2015, in which the hotels was the main producer of solid waste. This crisis was severely affected the tourism industry, which was the main income generator sector. This study also indicated that the majority of small hotels did not implement waste management program and Green Strategies to reduce waste. Likewise, SWM system of Vietnam is struggling to find a sustainable framework for accommodation business under pressure from quick development of tourism industry. Few studies only identified about waste audit and composition of the hotels (Byer et al., 2006; Otoma et al., 2013; Trung and Kumar, 2005), whereas the situation of hotel SWM practice and its roles in municipal SWM have not

mentioned yet. In another studies, the municipal solid waste generation (SWG) and composition in HAC were identified, in which waste from nine accommodations was mentioned as one of the waste sources (Giang et al., 2017; Hoang et al., 2017). Thereafter, analysis of affecting factors of SWG and prediction of SWG from household were mainly focused, and suggestions for improving sustainable municipal SWM were consequently made (Giang et al., 2017). Additionally, (Loan et al., 2017) presented waste sorting practice of residents, revealed some positive driving force and negative factors of separating behaviors. Also, this study suggested solutions to enhance the effectiveness of waste segregation at source from Hoi An's residents. After all, the accommodation business is one of the significant sources of waste, so that establishment of SSWM practices for the hotels is essential for building green tourism industry and improve the SSWM system for HAC. Thus, the current study aims are: i) identify in detail SWG rate and waste composition of the hotels, ii) determine factors affecting SWG rate, and iii) analysis the practices of SWM toward establishing the sustainability of SWM system for the hotel industry in HAC. The current study has been carried out in Hoi An, a tourism city in the center of Vietnam in 2016.

MATERIALS AND METHODS

Study area

Hoi An city (HAC) is known as a world cultural heritage and a world biosphere reserve area recognized by UNESCO, is a small ancient town in the center of Vietnam. During the last ten years, the tourism industry of HAC rapidly developed with the growth rate of arrivals was 243% and reached 2,517,217 tourists in 2016 (Fig. 1-a), led to the number of the hotels increased by 3.3 times and got 446 accommodations with 7,795 rooms (Fig. 1-b). Consequently, the tourism commerce has been gradually affirming not only as a major industry but also a potential labor market and has been increasingly getting the vital economic sector that accounted for 69.8% of the total economic revenue of HAC in 2016 (DOCTHAC, 2017). Nevertheless, the dark side of the dramatic tourism development in HAC was the climb of the enormous amount of waste from 19,282 tonnes in 2009 to 30,131 tonnes in 2016, while the population growth in the last seven years was almost negligible from 93,808 to 94,331 people (Fig. 1-a). From a city point of view, SWM in touristic business is a significant part of municipal SWM, and

sustainable SWM for the hospitality industry should be the primary task.

446 accommodations of HAC were encrypted with five groups such as high-scale hotels (HSH), mid-scale hotels (MSH), low-scale hotels (LSH), villas (VIL) and homestays (HOM) base on the capacity of the hotels (Table 1). According to the proportion of types of the hotel, the number of accommodation in each hotel group was identified for sampling (Table 1), which accounted for approximately 27% of the total.

Sampling method

Solid waste generation of the hotels is the total waste produced from all departments of the hotels such as from the rooms, garden, restaurants, kitchen, laundry, offices, stores, repairing stores, and from other services. All of waste are collected and stored in the trash at a gathering point in the hotels. As the regulation, the green trash contains the biodegradable waste and inorganic waste was stored in the orange trash. Total waste from two kinds of trash is the total

waste generated from the hotels. Depending on the amount of waste of the hotels, the volume of trash is different. The small waste of HOM, LSH or VIL is contained in plastic buckets or bags. The sampling process conducted by students of Danang College of Technology, Vietnam in two weeks of December 2016. Training of sampling, checking of measuring methods, and setting up sampling plan were the main tasks in the first week. Then, solid waste from organic and inorganic trash of 120 hotels was collected separately in seven consecutive days of the second week. The waste of HSH and MSH (more than 1 m³ of waste) was transferred by trucks and weighed by electrical bridge scale of waste treatment facility. The waste of other hotels was moved by bikes to the waste treatment area. Here, the weight of the samples was determined by handy electronic scales such as BONSO-393 (the capacity: 50 kg, the graduation: 0.05 kg) and DRETEC-KS-221 (the capacity: 2 kg, the graduation: 0.001 kg). Next, the composition of the organic waste and inorganic waste of each hotel

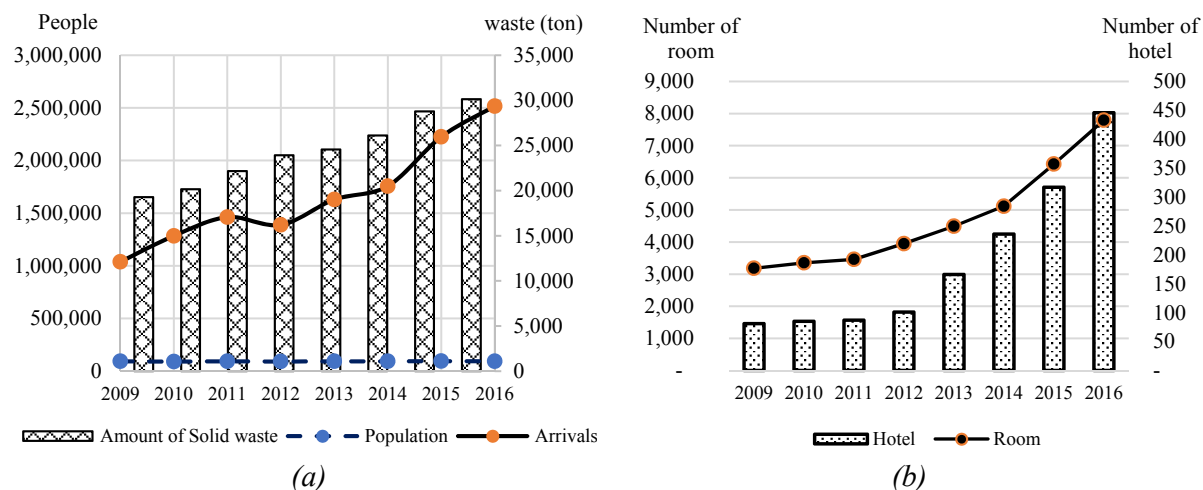


Fig. 1: The development of tourism sector and amount of waste recently (DOS, 2017; HAPWC, 2017)

Table 1: The number of hotels in Hoi An city and the number of collected hotel for sampling

N ^o	Types of hotels	Description	Total number of the hotels	Proportion of the hotels	Number of hotels for sampling
1	HSH	> 80 rooms	27	6%	7
2	MSH	20 – 80 rooms	81	18%	22
3	LSH	< 20 rooms	38	9%	10
4	VIL	Villas	80	18%	22
5	HOM	Homestay	220	49%	59
6	Total		446	100%	120

group was mixed detachedly, reduced the volume to around 120 kg by coning and quartering methods and sorted into 18 categories as in [Table 2](#).

The SWG rate of the hotels was identified by diving the solid waste amount produced from the hotels with the number of guests stayed there in a day. By separately analyzing waste composition from biodegradable and inorganic waste, segregation efficiency of each waste category was identify by diving the amount of this waste in the correct trash with the total amount of this waste generated. Whereby, the negative values of efficiency were explained by the misclassification of waste.

Questionnaire method

In the third week, the face to face interview was conducted. Whereby, 120 hoteliers or managers of the hotels were asked to collect information on the properties, current SWM practices in their hotels, and the barriers of SWM practices. Notably, the information of the features of facilities, type and level of services of the hotels were collected. Also, the implementation of waste separation a source, reduction, recycling and composting in their hotels was checked and asked by questionnaire survey. For the hotel sectors, waste reduction practice is the deployment of activities aim to reuse materials and reduce the amount of waste. For examples, reuse of one-side printed paper in offices, or leftover food for livestock in bar and restaurants. Whereas, waste recycling and composting practices were identified as the operation of recycled activities

in the hotels, in which dry recycled materials were separated for recycling or the organic waste was sorted for composting at their hotels or not.

Statistical analysis methods

All data were synthesized into excel files to conduct statistical analysis by R software. Firstly, aims to verify the compatibility of the data for statistical tests, the combination between a normal bell-shaped as a graphical method and Shapiro-Wilk as a sensitive test used for testing the significant differences from normal. Shapiro-Wilk test is known as the most powerful test for all kinds of distribution ([Nornadiyah Mohd Razali, 2011](#)). Also, the differences in means of SWG rate between 5 independent groups of the hotels overall were compared and analyzed by ANOVA to determine whether there are statistically significant differences. Besides, Tukey-HSD (Tukey Honestly Significant Difference) test was executed to clarify which groups have significant differences by comparing all pairs of the means of SWG rate. Finally, four influencing factors of SWG rate of the hotels ([Table 3](#)) were analyzed individually by three corresponding tests.

In the current study, the objective influencing factors of SWG rate were internal characteristics of the hotels. The first factor is the number of rooms in each accommodation in HAC, which does not change according to demand ([Ayia-Koi and Sackle-Sackey, 2015](#)), was arranged from 2 to 217 rooms corresponds to the scale of the hotels. Besides, the price of the room, which shows the quality of service and facilities

Table 2: Categories of waste composition

N ^o	Categories	Description
1	Paper	Print paper, newspaper, magazine
2	Cardboard	Paperboard, containerboard, cardstock
3	Garden waste	Leaf, grass, flower
4	Kitchen and food waste	Leftover food, vegetable.
5	Tissues	Tissue and toilet paper
6	PET	PET bottles
7	Nylon	All kind of nylon bags
8	Metal	All kinds of metal (iron, aluminum, copper, lead, ...)
9	Plastic	All kind of plastics do not contain toxic substances
10	Glass	All kinds do not contain toxic substances
11	Leather	-
12	Rubber	-
13	Textile	Tablecloths, clothes
14	Wood	Wooden furniture, branches
15	Nappy	Sanitary napkins, diapers,
16	Ceramic	Ceramic, minerals, light bulbs
17	Chemicals	Soap, cosmetic residues
18	Hazardous waste	Paint, varnishes, oils, pesticide, insecticide, fertilizer.

of the hotels (Hung *et al.*, 2010), was also considered the effect to SWG of the hotels. Additionally, garden and restaurant are the leading standards for ranking hotels in Vietnam and also the primary sources of waste (Karim Zein *et al.*, 2008; Omidiani and Hashemi Hezaveh, 2016; Pirani and Arafat, 2014). Depending on the scale of the hotels, the food service is different. In HAC, 25% of the hotels had restaurants with full service (includes breakfast and dining), while food service for only breakfast accounted for 55%. On the other hand, garden and green area are considered as an essential factor of accommodation business, also a waste source (Wong and Kim, 2012). In HAC, 46% of the hotels have a garden, mainly are HSH, VIL, and MSH. Aims to identify the influence of these objective factors to SWG rate of the hotels, the statistical methods were used depending on the characteristics of factors. Notably, the correlation between SWG rate as the continuous numeric variable and the capacity of hotels or the price of the room as the dependent numeric variables were tested by simple linear regression. Whereas, Kruskal-Wallis was used to test the difference between 3 restaurant service levels and SWG rate. Likewise, Wilcoxon Rank-Sum test was

used to identify whether SWG rate of the hotels with garden and without garden was different or not.

RESULTS AND DISCUSSION

Solid waste generation rate

Graphical methods, numerical methods and formal normality test used to check the normality assumption of the data. Fig. 2 showed the SWG rate density of five groups of hotels liked the normal bell-shaped curve with various features. The SWG rate distribution curve of Villa group closed to mesokurtic distribution and be left-skewed (kurtosis coefficient: 2.94 and skewness coefficient: -0.56). While the SWG rate distribution shapes of HSH, MSH were platykurtic and LSH, HOM were leptokurtic. However, Shapiro-Wilk test reaffirmed that SWG rate distribution of 5 groups of the hotel closed to the normal distribution with W values approximately 1 and P-value higher than 0.05. Therefore, the SWG rate density of the hotels came from a normally distributed population.

Several studies reported that the daily SWG from a hotel guest varied with the wide range from 0.23 to 13 kg (Edmundo Mufioz, 2015; Jonathan F.K. Earle and Jo M. Townsend, 1991) and differed at the various

Table 3: Influencing factors of solid waste generation rate of the hotel industry and statistical testing methods

N ^o	Objective factors	Describe	Methodologies
1	Capacity of hotels	Number of room	Simple linear regression
2	Price of room	Room price (US\$)	
3	Garden	0: No 1: Yes	Wilcoxon Rank-Sum Test
4	Restaurant	0: No restaurant 1: Only breakfast 2: Breakfast and dining	Kruskal-Wallis

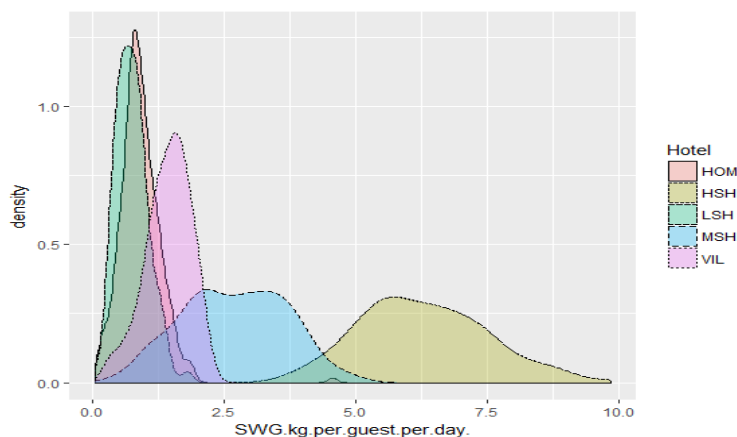


Fig. 2: Density of solid waste generation rate

durations and regions (Daniel Hoornweg and Perinaz Bhada-Tata, 2012). Notably, while the range of solid waste amount daily produced by European hotels was 1.5 to 3.1 kg per guest (Bohdanowicz, 2005), that by Asian hotels was 0.59 to 9.2 kg/guest/day (Tang, 2004; Chan and Lam, 2001). For HAC, the previous survey revealed that SWG rate of the hotel in the dry season ranged from 0.05 to 6.07 kg/room/day (Giang et al., 2017), while that in the wet season ranged from 0.04 to 7.02 kg/guest/day and mostly distributed between 0.8 and 3.33 kg/guest/day. In brief, the hotel industry in HAC generated averagely 2.28 kg/guest/day in the rainy season which was higher than waste produced in the dry season (0.6 kg/room/day) and slightly lower than the median value of SWG from the hotels in the world.

Additionally, SWG rate from different types of accommodation is not the same (Edmundo Mufioz, 2015; Pirani and Arafat, 2014). Trung and Kumar (2005) mentioned that the overall benchmark of SWG rate of high-size hotels in Vietnam was about 13.5 to 32.3 kg/guest/day, while the SWG rate from mid-scale hotels ranged from 0.7 to 17.9 kg/guest/day. For HAC, the preliminary survey indicated that in dry season four-stars hotel generated averagely 4 kg/room/day, and the smaller hotels produced about 0.35 kg/room/day (Giang et al., 2017). Therefore, SWG rate from all kinds of the hotel in the rainy season was newly identified. In particular, Fig. 3 indicated that the interquartile and dispersion ranges

of SWG distribution in HSH and MSH groups were wider than other ones, while median and mean of SWG in each group of data were slightly similar. This was explained that the range of capacity of HSH (80 to 217 rooms) and MSH (20 to 80 rooms) were bigger than the others. Hence, the more abundant the accommodation, the larger the interquartile ranges. Moreover, the box plot in Fig. 3 also illustrated that the mean of SWG rate per day of HSH (6.29 kg/guest) was higher than such of MSH and VIL with 2.69 and 1.34 kg/tourist, respectively. Also, HOM and LSH generated daily with the SWG rate by 0.88 and 0.74 kg/guest, respectively. Moreover, the statistically significant differences in SWG rate between these groups of hotels in HAC were confirmed by the results of ANOVA Test. Notably, P-value was less than 0.05, and the signal was much higher than noises with 1,187 of F-value. The variation of facilities, the level of the hotels, quality and quantity of services may lead to the differences in SWG rates of hotel groups.

Furthermore, the graphical display in Fig. 4 showed that 95% family-wise confidence interval in the second row, which was comparing LSH and HOM went from -0.413 of low range to 0.088 of up range and contained 0 (dotted circle). Hence, the means of SWG rates of hotel-groups were all detectable differences from each other except for a pair of LSH and HOM. The similarity in SWG rate of LSH and HOM could be caused by the resemblance in lodging commerce as the individual household businesses.

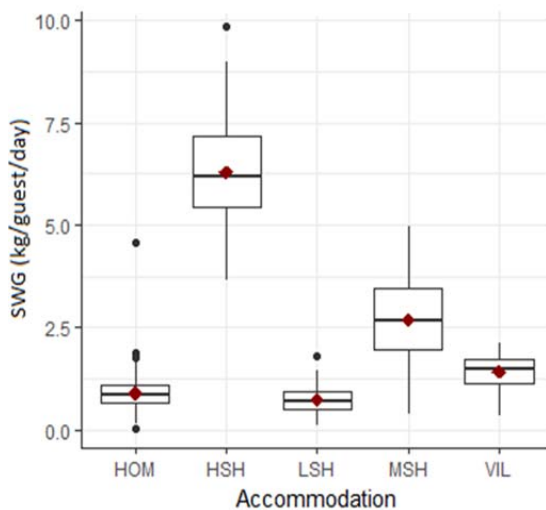


Fig. 3: Boxplot of Solid waste generation rate

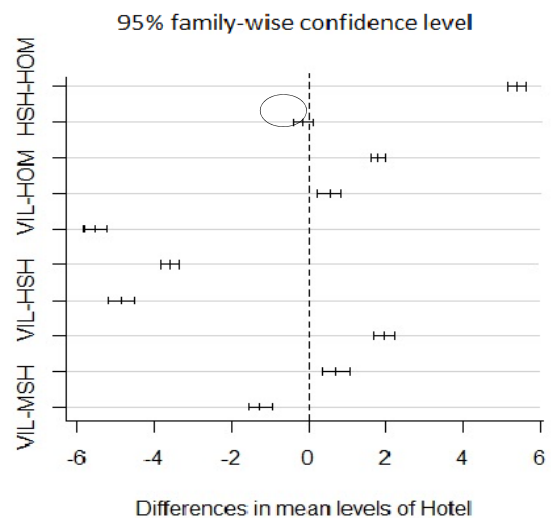


Fig. 4: The difference in solid waste generation rate of the hotel pairs

Physical solid waste composition (SWC)

Fig. 5 described in detail the waste composition of HAC's hotel industry. Notably, biodegradable waste accounted for the highest percentage of 58.5%, includes kitchen waste (35.5%), garden waste (15.5%) and tissue paper (7.5%). Also, recyclable waste accounted for about one-fourth of total waste which consists 1.2% of metal, 4.2% of cardboard, 12.9% of plastic including plastic bags, 0.8% of PET bottles, 2% of glass and 4.7% of the paper. The other components belong to combustible and incombustible waste with the proportions less than 3.5% for each element.

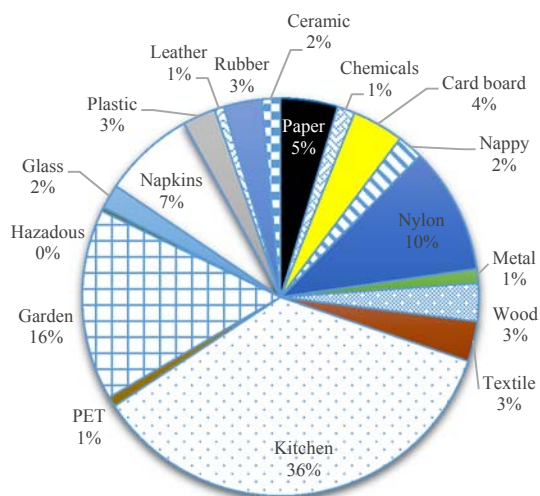


Fig. 5: Solid waste composition of the hotel industry

Taking an overview of the hotel's SWC, Table 4 presented that differences in SWC of the hotels were not only influenced by geographical location, economic level, cultural norms and climate but also may be explained by the specification of tourism business. In comparison with other countries in the world, the biodegradable waste of the hotels in HAC was higher than that in developed countries and lower than that in cities of Asia. Also, the hotel business in developed countries has the higher rate of recycling waste for two times. Whereas comparing to SWC in the lodging business in Vietnam, the differences in components of waste were relative. These differences could be caused by regional tourism characteristics as a type of guest or the culinary. Moreover, this study also revealed that in the wet season, the proportions of garden waste and recycling waste of the hotels in HAC were higher and kitchen waste was lower than that in the dry season (Giang et al., 2017). HAC's hotel industry achieved on average 95% of occupancy capacity in two tourism seasons, in which international guest accounted 82% in the wet season and 38% in the dry season. The differences in living culture, foods, and enjoyment of services of the guest may be explained that the more the number of the foreign guest, the higher the rate of recycling waste and the less the proportion of food waste. Consequently, in addition to climate, the variety of the arrivals and tourism activities by seasonality could be the reasons for these differences in SWC.

Table 4. Comparison of solid waste composition in Hoi An city and other cities

Main categories	Vietnam			Asia		Developed countries ⁽⁶⁾	
	HLC ⁽¹⁾	DNC ⁽²⁾	HAC ⁽³⁾	PPC ⁽⁴⁾	NDC ⁽⁵⁾		
Organic waste (%)	64.3	62.8	56.2	58.5	61.2 - 70	61.2	37 - 46
Recycling waste (%)	5.7	23.7	33.4	25.8	22.64 - 28.33	3.8	43.7 - 54.4

HLC: Ha Long City, DNC: Da Nang City, PPC: Phnom Penh City, NDC: New Delhi City,

⁽¹⁾: (Byer et al., 2006), ⁽²⁾: (Otoma et al., 2013), ⁽³⁾: (Giang et al., 2017), ⁽⁴⁾: (Mongtoeun et al., 2014),

⁽⁵⁾: (Omidiani and Hashemi Hezaveh, 2016), ⁽⁶⁾: (Pirani and Arafat, 2014).

Table 5: Waste composition of 5 groups of hotels in Hoi An city

N ⁰	Categories (%)	HSH	MSH	LSH	VIL	HOM
1	Paper	3.02	3.7	9.51	2.41	5.8
2	Cardboard	0.64	6.51	1.68	3.3	6.75
3	Kitchen + food	33.97	44.04	36.82	37.35	24.43
4	Garden	27.7	13.78	0.69	12.97	13.7
5	Tissue paper	6.91	7.24	5.26	6.45	8.47
6	Plastic	8.32	12.95	14.92	17.13	19.79
7	Combustible	14.95	6.41	27.23	14.85	15.26
8	metal	0.24	2.05	0.64	2.41	1.4
9	Glass	0.95	1.96	2.75	2.54	2.62
10	Ceramic	3.24	0.98	0.11	0.43	1.27
11	Hazardous	0.06	0.38	0.39	0.16	0.51

Furthermore, Table 5 indicated that SWG of five groups of hotels were not same. The majority of HSH, MSH, and VIL are located in rural and suburban areas, have the substantial green area. Besides, the higher the scale of hotels, the more the services. Consequently, the differences in organic waste and recyclable waste could be caused by the features of the hotels as facilities and services. Whereby, the bigger hotels, the higher proportion of biodegradable waste and the less recycling waste percentages. These characterizations of the waste composition of the hotel industry in HAC may be considered for minimising SWG by suitable composting and recycling practice.

Influencing factors of waste generation of the hotel industry in HAC

Fig. 6 showed the linear correlation charts between the capacity of hotels, the price of the room and SWG rate of the hotels in HAC. In this study, this significant correlation once again was confirmed by linear correlation equations with P-value less than 0.05. Whereby, the SWG rate of the hotels was expected to increase by an average of 0.035 kg/guest/day of waste for every additional room with R^2 of 0.82. Likewise, the SWG rate of the hotels was explained that would be higher 0.048 kg/guest/day if the price of the room is higher every \$US 1 ($R^2 = 0.76$). Therefore, the capacity of hotels and the price of the room significantly influenced SWG rate of the hotels. Also, these correlations were strongly positive.

The results of Kruskal-Wallis Test showed that there was a statistically significant difference with X^2 of 80.875 and p-value less than $2.2 \cdot 10^{-16}$ among the means of SWG rate of hotels serving either no food, breakfast

only, or breakfast and dinner. Notably, the more complete the dining services, the higher SWG rate of the hotels in the same size of the hotels. The difference in the means of SWG rate between the hotels with gardens and without gardens was proved to be statistically significant by P-value of 3.4×10^{-12} . Particularly, the SWG rate of the hotels with a garden was higher about 1.5 times than that of the hotels without gardens in the same group. As a result, the capacity, the price of the room, garden and restaurant services could influence SWG rate of the hotels in HAC.

Solid waste management practices

SWM practices are the fundamentals of SWM hierarchy (Cummings, 1992). The Fig.7 illustrated the situation of SWM practices of the hotels in HAC with four activities such as segregation, reduction, recycling and composting. In particular, waste separation at source, which conducted from 2012 had the highest practice rate with 76%. However, the proportions of waste sorting practice in the hotels were different with 100% for HSH, 87% for MSH, 83% for VIL, 36% for LSH and 21% for HOM (Fig. 7). These data indicated that the higher the scale of the hotels, the higher the proportion of waste sorting practice. Additionally, this study also revealed that the waste sorting efficiencies were proportional to the percentages of waste sorting practice by 64.6% for HSH, 37.3% for MSH, 33.4% for VIL, 7.7% for HOM and 6.9% for LSH.

According to the waste sorting guideline of HAC, kitchen waste, garden waste and paper are the components of organic waste, which accounted for 58.5% of total waste. The rest of waste is the inorganic waste. In general, most of the waste categories were

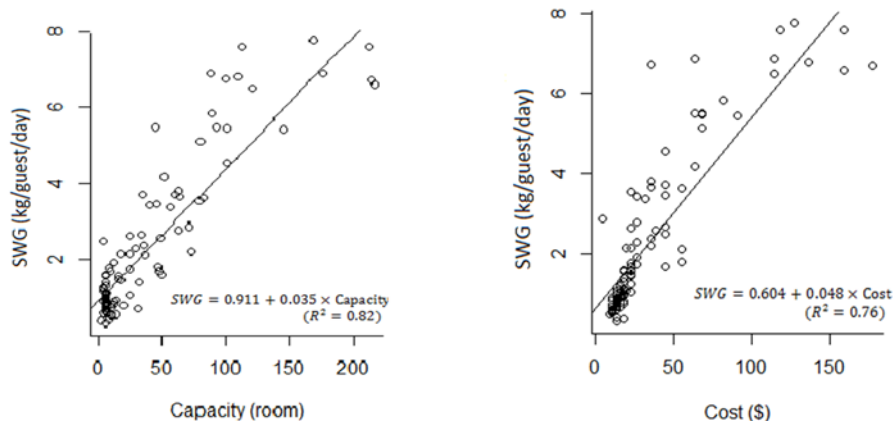


Fig. 6: Correlation between Capacity or the price of the room and solid waste generation rate in the hotels

sorted into the correct trash with the efficiency ranged from 34.7% to 93%. Specifically, the separation efficiency of the chemical residue was the highest (93%), followed by glass (77.5%), textile (77.0%), metal (74.8%), PET bottle and garden waste (72.2%), which were mainly recyclable waste. This was the advantages of improving recycling practice in the hotels. In contrast, 73.1% of tissue paper and 73.9% of paper were detected in the inorganic trash, while wood, ceramic waste, and rubber had sorting efficiencies of - 93.2 %, -47.0% of - 25.8 %, respectively. These misclassifications were the obstacles to recycling practice and treatment. Thus, training separation skills for the hoteliers is one of the solutions should be considered. The restriction of waste sorting practice and efficiency in the hotel industry in HAC could be caused by some specific barriers. Notably, 65% of the hoteliers misunderstood the way of sorting waste by composition led to the misclassification of waste. Besides, most of LSH and HOM said that segregation for a small amount of waste is unnecessary and do not affect to sorting efficiency of the city. In fact, the daily waste of these sectors was wrapped in a small plastic bag and directly dumped to the trucks. Consequently, the proportions of waste sorting practice of LSH (6.9%) and HOM (7.7%) were low. Moreover, the inappropriate collection system and the odors from the waste storing (especially hotels with no garden or negligible garden) were the significant barriers to sorting waste.

Moreover, waste recycling and reduction are the momentous solutions of waste management hierarchy and bring many benefits to business sectors and society (Milanez *et al.*, 2015). However, the proportions of the hotels in HAC implemented waste recycling and reduction were still low with 39% and 29%, respectively. This study indicated that 60% of MSH and 53% of HSH deployed recycling, followed by VIL (33%) and HOM (30%). The lowest percentage of recycling practice belonged to LSH (7%). Furthermore, waste reduction practice of HAC's hotels was responded by 50% of MSH and HSH, around 10% to 20% of the hotels in LSH, VIL, and HOM. Although the majority of hoteliers understood the social and environmental roles (62% of hoteliers) and economic benefits (83% of hoteliers) of recycling, the rate of recycling practice was still low. This could be explained by 37% of the hoteliers did not care about income from selling recycling materials, especially family businesses as LSH, HOM, and VIL. Moreover,

the unfavorability from recycling which shown in Fig. 8 against recycling practice at the hotels. Notably, 72% of hoteliers said that they disliked storing waste in their hotels, while 58% of the hotels thought that they lacked information and skills of recycling. Moreover, a part of hotel's managers explained that recycling practice occupied the significant area (50%), took more time and labors (42 and 22%) and was unsanitary (18%). These obstacles may be due to the unspecific recycling plans, the unconvinced recycling motivations of the hoteliers, and unclear recycling instructions from the government. The composting, the organic waste recycling solutions, is a process of sorting, storing and biological treatment of the organic waste for a long time. In HAC, composting in place did not

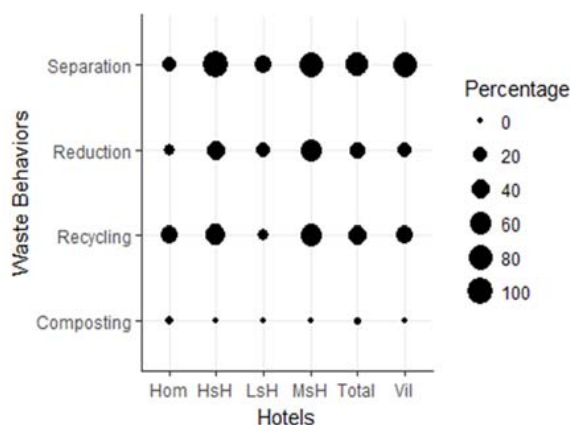


Fig. 7: The status of waste management practices

Barriers of recycling and composting

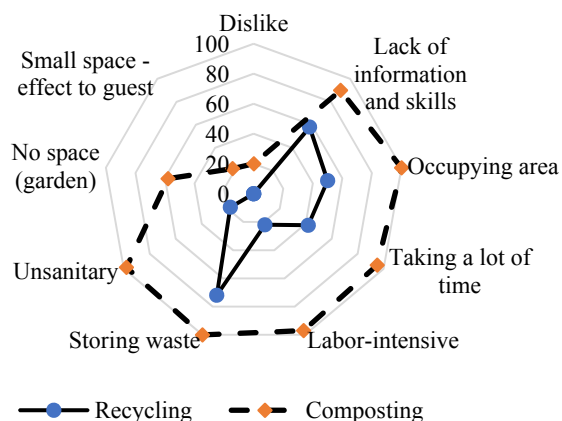


Fig. 8: Barriers to recycling and composting practices

get the consensus from hoteliers (0.8% of the hoteliers) and was justified by unfavorability of implementation of composting. Notably, the majority of the hoteliers said that composting could not be implemented because of the lack of skills and information (90%). Also, significant occupancy of the area (100%), loss of time (95%), labor-intensiveness (97%), indisposition of waste storing (99%) and unsanitariness (98%) are shown in Fig. 8 were the main reasons why the hoteliers refused to do composting in place. In fact, the hotel waste was collected door-to-door and moved to waste treatment area by trucks for composting, incineration and landfilling. However, the composting facility does not operate well. Therefore the compost product is not used by farmers. Also, the incinerator can burn about 30 tons of waste per day and is encountering many technical problems. Whereas, the landfill site has been full. SWM system in HAC is facing urgent problems. In general, SWG from the hotel industry which accounted for about 22% of total waste is a significant waste source in HAC. With the rapid development of arrivals and tourism business, SWM of accommodation business is playing an essential role in sustainable municipal SWM. Therefore, establishing and applying 3Rs program (Reduce – Reuse – Recycle) towards sustainable SWM are the long-term strategy of SWM for the hotel industry. However, depending on the situations of SWM, the SWM strategy for the hotel industry in the near future is minimisation of SWG by improving waste segregation efficiency and developing recycling and composting practices. Thence, some issues of SWM for hotels should be considered to study. According to the 07/2016/QĐ-UBND regulation of waste collection fee for accommodation businesses of Quang Nam province, VIL and HOM pay the lower fee as a household has a business than that for LSH, MSH, and HSH (Quang Nam Province, 2016). Whereas, the SWG rate of VIL was higher than such of HOM and LSH. Therefore, this study provides the information for decision makers to consider adjusting the appropriate tipping fee for the hotels. Also, with the high proportion of biodegradable waste (58%), especially in HSH, MSH, and VIL, composting in the hotels is a potential solution should be studied and encouraged to reduce waste generation. Besides, regulation and other integrated solutions for enhancing waste sorting rate and efficiency in small hotels, HOM and VIL should be considered to promulgate by the government. Simultaneously, cost-benefit analysis for recycling practice should be studied to promote

the recycling motivation of the hotels. Furthermore, support and incentive policies, as well as recognition as a “Green Hotel Certification” by the government may bring positive impacts to development of sustainable SWMPs for the hotel industry in HAC.

CONCLUSION

The tourism industry in HAC, Vietnam contributed considerably to the environmental issues, especially the solid waste problem. This study analyzed in detail and indicated some critical findings of SWM status and practices of the hotel industry in HAC which are outlined below.

(1) The average SWG rate of the hotel’s industry in HAC was 2.28 kg/guest/day. Besides, the difference in SWG rate between types of the hotels was statistically significant. Whereby, the higher the scale of the hotels, the higher the SWG rate. This study also proved that internal objective factors as the capacity of the hotels, cost of the room, garden, and restaurant were highly correlated with SWG rate.

(2) 84.3% of hotel waste were organic and recyclable waste. Also, SWC of the hotels in the wet season compared with the dry seasons was slightly different. Mainly, in the wet season the percentages of kitchen waste (35.5%), glass (2%) and plastic (13.8%) were lower, and the rate of garden waste (15.5%), combustible waste (13.8%) and incombustible waste (1.5%) were higher than such of the dry season. Furthermore, this study also revealed that the waste composition of various hotels was little different. Whereby, the higher scale hotels, the higher percentage of biodegradable waste, the less proportion of recyclable waste.

(3) SWM of the hotels in HAC initially reaped quite positive achievements with the rate of hotels that deployed SWM practices were 76% for sorting, 39% for recycling, 29% for reduction and 0.8% for composting. Whereby, the higher the scale of hotels, the more attention in SWM practices. Moreover, the performance of sorting practice of the hotel was pretty high for chemical residue (93%) followed by glass (77.5%), textile (77.0%), metal (74.8%), PET bottle and garden waste (72.2%) except for some misclassifications for paper and combustible waste.

(4) The situation of SWM practices of the hotels was explained by many subjective and objective causes by hoteliers such as unfavorable waste storing, lack of SWM information and skills, occupying the significant area, taking more time and labors, and being unsanitary.

The results of this study provided information on current SWM practices of hotel industry that contributes to the overall assessment of municipal SWM practice of HAC. Furthermore, this study suggested that waste recycling and composting potential of the hotel's SWM should be analyzed, assessed in detail and planned explicitly for deployment, aiming to minimise waste generation.

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CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this manuscript.

ABBREVIATIONS

<i>ANOVA</i>	Analysis of Variance
<i>HAC</i>	Hoi An City
<i>HOM</i>	Homestays
<i>HSD</i>	Honestly Significant Difference
<i>HSH</i>	High scale hotels
<i>LSH</i>	Low scale hotels
<i>MSH</i>	Middle scale hotels
<i>PET</i>	Polyethylene terephthalate
<i>SSWM</i>	Sustainable solid waste management
<i>SWC</i>	Solid waste composition
<i>SWG</i>	Solid waste generation
<i>SWM</i>	Solid waste management
<i>UNEP</i>	United Nations Environment Programme
<i>UNESCO</i>	United Nations Educational Scientific and Cultural Organization
<i>VIL</i>	Villas
<i>WMPs</i>	Waste management practices
%	Percentage
<i>\$US</i>	United State Dollar
R^2	Coefficient of determination
m^3	Cubic meter
m^2	Square meter

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