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Sustainable Food Waste Management Practices: Perspectives from Five-Star Hotels in Thailand

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Abstract: Although food waste management has been significant for all stakeholders from all industries globally, research in hospitality food waste management and practices still needs to be further studied, especially in five-star hotels in developing countries. Using the Food Waste Hierarchy, this study proposes to contribute to the knowledge of sustainable food waste management and practices in five medium and large five-star hotels to promote the United Nations Sustainable Development Goals (SDGs). Findings of in-depth structured questions from purposive and snowballing samplings show different aspects of sustainable food waste management and practices at these hotels supported by policies and implemented by practices at all levels, from top management to operations levels. The thematical analysis shows four emerging themes: food waste management policies; food service planning, procurement, and storage; food waste handling and operations in the kitchens, staff canteen and restaurants; and food waste management through reusing, recycling, donations, and disposal. The findings highlight these hotels' challenges and suggestions for sustainable food waste management and practices. By providing the current situation of sustainable food waste management and practices, this study embellishes the guidance and recommendations for the hotels' restaurants. It augments the industry practitioners with actual practices and solutions in implementing sustainable food waste management and practices in hotels' restaurants.

Keywords: sustainable food waste management practices; food waste hierarchy; hotels; hospitality

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1. Introduction

Tourism is not only a national revenue generation but also can be used as a pertinent and innovative tool in sustainable development and poverty reduction [1,2], which is related to the United Nations Millennium Development Goals (UNMDGs), especially 'Goal 1 No Poverty'. In addition, sustainable tourism development should take full responsibility for tourism's current and future economic, social, and environmental impacts and address the needs of visitors, the industry, the environment, and host communities [3]. As the United Nations' Agenda 2030 of 17 universal Sustainable Development Goals (UNSDGs) may not be comprehended by all stakeholders in the tourism and hospitality sector [4–7], this issue challenges to quantify the balance of its positive and negative impacts on local communities' economy, environment, culture, and society [4]. Additionally, the studies on the UNMDGs and UNSDGs are limited in tourism and hospitality (e.g., [4,6–8]), especially in sustainable food waste management in tourism and hospitality.

Food waste is a primary sustainability concern [9,10], especially in the accommodation and food service sectors [11,12]. Food waste is not only an issue for UNSDG #12 (Responsible consumption and product) in developed countries but also an issue for UNSDG #2 (Zero hunger) in less developed countries [13,14]. Concerning UNSDG #12 [15], there

is an increasing expectation regarding the sustainability of the tourism and hospitality industry. This industry comprises various businesses such as destinations, attractions, accommodations, restaurants, catering, festivals, and events. Additionally, hospitality's food and beverage demands are a notable proportion of global food procurement. The high pressure from customers' demands and the requirement for sustainable management of food and beverage value chains from the tourism and hospitality industry are significant to attend to, especially food waste management.

Food waste definition and inclusion journey vary among researchers. Food waste occurs through the food supply chain from agricultural production to the final household dining consumption [16] and out-of-home (hospitality) consumption [17] or at retail and consumption stages in the food supply chain [18]. Although the challenge of food waste generated at out-of-home dining in hospitality is often debated through media, the food waste in hospitality research is very scant [9,17,19,20]. Therefore, the academic research in food waste management and practices needs to be more varied. Two recent reviews of hospitality food waste by Dhir et al. [17] and Filimonau and De Coteau [20] highlight the limited food waste studies in hospitality, especially in developing countries. In addition, hospitality food waste research is divergent and segregated [17], lacks managerial mitigation [21] and is mostly conducted in developed countries [22].

Additionally, Filimonau and De Coteau [20] emphasise the complexity of the hospitality sector impacting distinct food waste management practices. Theoretically, Food Waste Hierarchy Model is applied widely in waste management, but only a few studies in hospitality food waste management [16]. For example, Srijuntrapun et al. [16]'s recent research highlights the significance of food waste hierarchy for small-, medium- and large-sized hotels in Thailand to reduce food waste and food costs and protect the environment through a corporate social responsibility lens. Food waste attracts attention from academics and practitioners globally as it challenges economic, financial, social, moral, and environmental issues in managerial practices due to consumers' growing expectations, excessive food production, lower consumer food cost, and high food waste handling cost [16,23,24]. In addition, food waste significantly impacts the environment, society, and economy [25,26] and has become a global challenge [27]. Food waste can financially and socially impact tourism and hospitality businesses. A vital societal challenge in tourism and hospitality management is under-researched [9,17,19,20].

Therefore, studying the current situations and good practices of sustainable food waste management operations in hospitality is crucial. This paper aims to fill the above research gaps by exploring and examining different aspects and levels of sustainable food waste management practices in the hospitality industry. Specifically, this paper provides the current managerial perspectives from five medium and large five-star hotels in Thailand, which guided the best sustainable food waste management practices towards advancing the UNSDGs. In addition, this paper applies the Food Waste Hierarchy and contributes to theoretical implications addressing and filling the gaps in sustainable food waste management in hospitality and tourism research. This paper is one of a few hospitality food waste research applying the Food Waste Hierarchy (e.g., [16]) and studying a five-star hotel context (e.g., [28]) to offer insights into the current situation of sustainable food waste management and guidance and recommendations for five-star hotels and restaurants. While the recent study by Srijuntrapun et al. [16] emphasises the application of food waste hierarchy to the different sizes of hotels in Thailand, our current study focuses on medium and large five-star hotels in Thailand only. Practically, this paper broadens the industry practitioners on actual practices and solutions in implementing sustainable food waste management in five-star hotels, which competitively benefits the distinct type of these hotels by emphasising the best practices in sustainable food consumption and food waste management towards advancing the UNSDGs and being part of Green Hotels (http://www.greenhotel.deqp.go.th/public/, accessed on 1 May 2023). This paper also facilitates relevant stakeholders such as governments, businesses, and local tourism and hospitality actors in managing food waste more effectively.

2. Literature Review

2.1. Food Waste and Sustainability

Food loss and food waste (FLW) often refer to overlapping terms in the literature as they occur at each stage throughout the food supply chain from farm to fork [29]. Many researchers (e.g., [30,31]) refer to food loss as any food loss during preparation and post-harvest processes and food waste as any food wastage during distribution and consumption processes. In addition, many researchers refer to food waste as part of food loss and define food waste as food that is deliberated to discard or left to spoil or expire and is unsuitable for human safe and nutritious consumption [16,29,32].

Despite the expanded studies of food loss and food waste (FLW) in the past years, they still need profound knowledge [33] that is limited by time, geographic coverage, and inconsistent data [29]. Studies (e.g., [12,34–37]) claim that catering and food service operations may engender an appreciable amount of food waste and delay achieving the UNSDGs. Applying the Social Practice Theory (SPT) in a recent systematic literature review by Munir [38] highlights the need to explore practices on reducing kitchen waste (meanings) and managerial knowledge (competencies); and the interaction of these elements with a practice-oriented approach in the future studies and policy frameworks. Therefore, it is of significance to urgently study this research topic.

2.2. Food Waste Management and Waste Hierarchy Model

Typical food waste management primarily practices animal feed, anaerobic digestion, composting, recovery of energy, and landfill, but less on preventing food waste [16,39]. The waste hierarchy principles by European Commission [40] include prevention, reuse, recycling, recovery, and disposal, ranging from the most preferable to the least options. Many relevant organisations, researchers and practitioners have developed, adopted, and adapted this model as waste prevention and sustainable waste management guidelines (e.g., [41–44]). For example, a new food recyclable waste hierarchy developed by the US Environmental Protection Agency (EPA) guides food loss prevention and waste management strategies for individuals and businesses [16,41,42]. There are some principles of this particular model, and most of them overlap around these four essential foundations: prevention/reduction (to reduce food surplus/loss and avoidable food waste at source); reuse (edible food for human consumption); recycle (feeding animal, compost) and recover (creating energy); and disposal (landfill/incineration), which prevention and reduction are much more appropriate and effective in food waste management by reducing food loss at the source and maximising food use [16,41,42,45].

Although the food waste hierarchy model is beneficial, very few studies apply this model to food waste management in hospitality [16]. Srijuntrapun et al. [16] highlight that applying the food waste hierarchy model can help reduce food waste at every step of hotel food distribution and operation. In addition, through the application of the food waste hierarchy model, the "hotels can adopt effective food waste management practices to achieve zero food waste, such as preventing the generation of food waste, recirculating food waste for recycling, and using food with maximum efficiency" ([16], p. 8).

2.3. Food Waste Management in Hospitality

Despite the gradual research development on food waste management in restaurants in developed countries, there is still a need to bridge a gap between sustainable innovations and recycling practices in hospitality [46] in the context of developing and transitional economies [20]. Although most food waste research in food service operations conducts in restaurants setting, the research gaps in different types of restaurants may contribute to distinct food waste management practices [17,20,47,48]. In addition, food waste reduction has received little attention from the hotel business sector [16], and food waste in restaurants still needs to be researched [20,49].

Past research highlights good food waste management practices and sustainable initiatives by responsible hospitality and food service operations. For example, the hotel

can redesign a new kitchen process at the planning stage to reduce food waste [50,51]. At the handling stage, storage should be regularly checked to ensure the First-In-First-Out (FIFO) stock method is implemented, unused, unsold or excess food is redistributed by selling it at a lower price or donating it to staff or other needed organisations or reusing it by cooking it for employee consumption at the staff canteen [20,45,52–54]. At the restaurant operations, a la carte service should be offered rather than buffets [55], inedible leftover food can be provided to customers in a doggy bag for pets, recycled and processed into fish food or used for composting [56–58], and any food waste should be measured to reduce food waste [59]. Even though food waste studies in hospitality and food service operations gradually increase these days [49,60–65], the hotels' food waste management is still disintegrated [16,66].

Good practices are presented, the businesses in hospitality and food service operations, especially hotels, they however still face some challenges, such as insufficient resources in handling food waste and changing recycling behaviour in restaurants [65], the influence of corporate policies and procedures for FW prevention [67]. Interestingly, Srisuwannaket and Liumpetch [68] and Srijuntrapun et al. [16] highlight that most food waste in Thailand has been disposed of in landfills, the last effective option of the food waste hierarchy model. Hence, this study aims to fill the gaps by exploring and examining different aspects and levels of sustainable food waste management in the hospitality industry using food waste hierarchy-guided questions to understand to what extent the five-stars hotels in Thailand pursue the best current practices in sustainable food waste management towards advancing the UN Sustainable Development Goals (SDGs) to provide insights of the current situation of sustainable food waste management and guidance and recommendations for the restaurants in hotels.

3. Materials and Methods

This qualitative research applies an exploratory approach by conducting structured in-depth interviews with five top-management executives from five medium and large hotels to achieve the study aim. Structured interviews were selected due to their flexible design appropriate to collect detailed data from nuanced practices among these selected hotels [67,69,70]. This exploratory qualitative research method is appropriate for this study as it seeks to understand food waste management practices through the top management's experiences and perspectives [67,71,72].

Questions were adapted from past literature (e.g., [16,20,40–42,45,50–59,73]) on food waste management regarding related policy, planning process, storage, handling, operations, donations, recycling, resources, local partnership, and cooperation, and validated by three academics from Hotel and Restaurant Management School and three hotel top-management executives [67]. Purposive and snowballing sampling was applied due to limited access to critical informants and the nature of the study, which was highlighted in previous research (e.g., [16,17,67,72]). For example, the recent studies on the food waste hierarchy role in Thai hotels by Srijuntrapun et al. [16] and restaurant food waste [17] revealed the difficulty in getting information from the selected informants due to a busy schedule and potential future problems to provide information without any permission from the management team. This present research's main recruitment criteria for the hotel selection and critical informants were sustainability and food waste involvement, and the hotels are part of the Green Hotels. At present, there are 83 Green Hotels in Thailand (http://www.greenhotel.deqp.go.th/public/, accessed on 1 May 2023). After an Ethics approval, out of 15 contacted hotels, a researcher conducted structured interviews with five five-star hotels in Bangkok, Thailand, from February to March 2023. Referring to Munir's recent systematic literature review on sustainable food waste management strategies in hospitality and food services [38], most qualitative-related research includes a range of 1–195 hospitality sub-sector, specifically 1–45 hotels or hotel restaurants. For example, [59] included one hotel, and [74] included three hotel restaurants in the qualitative studies. Table 1 presents the respondent's profile. Each interview lasted approximately between

45 and 60 min. Each data set runs word count and word cloud using Nvivo to compare, discuss and check the quality and validity of data before thematical analysis (see Figure 1).

Table 1. Respondent's Profile.

Hotel	Type of Hotel Ownership	Size	No. of Rooms	Stars Rating [1]	No. of Restaurants
Hotel 1	self-managed	Large	512	5	5
Hotel 2	self-managed	Large	511 [2]	5	6 [3]
Hotel 3	chain-owned	Medium	231	5	4
Hotel 4	chain-owned	Medium	281	5	10
Hotel 5	chain-owned	Medium	266	5	1

[1] Star rating based on Agoda.com, https://partnerhub.agoda.com/wp-content/uploads/2021/07/star-rating-checklist-thailand-properties-only.pdf, accessed on 1 May 2023, [2] This hotel's total capacity is 511 rooms, but currently only operates 336 rooms; therefore it is categorised as a large size hotel. [3] This hotel has six restaurants, but only five are currently running.

	Word	Length	Count	(%)	Similar Words
2	food	4	206	8.30	food
3	waste	5	116	4.67	waste, wasted, wastes
4	hotel	5	54	2.17	hotel, hotels
5	managemen	10	40	1.61	manage, management
6	restaurant	10	34	1.37	restaurant, restaurants
7	customers	9	33	1.33	customer, customers, customers'
8	use	3	30	1.21	use, used, using
9	employees	9	29	1.17	employee, employees
10	yes	3	27	1.09	yes
11	local	5	26	1.05	local, locally, locals
12	left	4	22	0.89	left
13	donate	6	20	0.81	donate, donated, donating, donation, donations
14	staff	5	18	0.72	staff, staffs
15	community	9	17	0.68	communicate, communication, communities, communities', community
16	materials	9	16	0.64	material, materials
17	reduce	6	16	0.64	reduce, reducing
18	sell	4	16	0.64	sell, selling, sells
19	training	8	15	0.60	train, training, trainings, trains
20	animal	6	14	0.56	animal



Figure 1. Nvivo's word count and word cloud.

The data analysis followed Filimonau et al. [67]'s research method using thematic analysis and the NVivo program. Two remaining researchers listened to the recorded interviews and transcribed and coded the interviewed data independently. Table 2 summarises the key themes of data coding. All research team members then compared, discussed, and finalised the data (see Table 3). The final data analysis summary was confirmed by those key informants for data codification, verification, and validation [67,75].

Table 2. Summarised key themes of data coding.

Examples of Translated Interviews Codes	First-Order Categories	Second-Order Categories	Emerging Themes
"Sustainability is the main policy in all of our businesses, and our hotel just received Sustainability Award 2023." [Hotel 4]	zero-waste sustainability	Internal cooperation	Food waste management policies
"Our operational staffs work together. For example, event salespersons have to work with the kitchen staff in event planning and then present the idea to customers to help them minimise the cost, especially in their food operation and handling to minimise waste." [Hotel 3]	Cost management's effectiveness		
"We applied for ISO 20121: 2012 [76] Event sustainability management system and food waste management are one of the ISO main criteria; therefore, we implemented the zero-waste policy, which requires all departments to work together to reduce waste to nearly zero." [Hotel 3]	ISO 20121 [76]	External participation	
"We received a gold level of Green Hotels as we implement every angle on food waste. We have the green team committees, staff internal green competition on reducing food and other waste." [Hotel 1]	Green Hotels awards participation		
"We usually send our employees to waste management training organised by the external organisations such as the universities, and then our staff have to share the knowledge and train other hotel staff." [Hotel 1]	Partnerships with other organisations	External partnerships	
"We order ingredients from local farmers for the salad bar in our restaurants. The ingredients are fresh. It shortens time and less food waste." [Hotel 4]	Partnerships with local farmers		
"We have a committee from different units to plan our services together by checking bookings, such as the number of special events and meetings, and we also estimate walk-in customers from statistics in our database." [Hotel 1]	Holistic internal planning team	Internal planning	Food service planning, procurement, and storage
"We don't cut and trim raw ingredients. We only order the ready-to-use, which causes less waste and saves time." [Hotel 5]	Waste reduction control		
"Raw materials stored with the FIFO policy, storages are separated according to the type of raw materials. Our chef will check the expiration date, and we have technicians to check the equipment and temperature every month." [Hotel 2]	First-In-First-Out (FIFO) and labelling		
"We order just the right amount of dried ingredients for a week and fresh produce on Mondays, Wednesdays and Fridays. If we need more over the weekend, the suppliers agree to deliver just in time for us, so there's nothing left." [Hotel 5]	External suppliers—a flexible stock ordering strategy with a short circle	Education and communication	
"Our hotel uses the Green-menu planning with visual symbols or pictures for the Coffee Shop and Room Services to help reduce food waste in case our guests are unsure about the food taste, e.g., spicy or not spicy". [Hotel 1]	Customer's food ordering decision-making indicating their food taste preferences		

Table 2. *Cont.*

Examples of Translated Interviews Codes	First-Order Categories	Second-Order Categories	Emerging Themes
"Our chef will use some veggies to make stock" [Hotel 2]	Food preparation—cutting and trimming	Kitchen	Food waste handling and operations in the kitchens, staff canteen and restaurants
"We don't sell nearly expired food to our customers but recreate the dish for our staff at their cafeteria" [Hotel 1].	Recreate new menus and serve at the staff cafeteria	Staff canteen	
"Our staff will gradually release food in the buffet to reduce inedible leftovers from being left at inappropriate temperatures. Our staffs observe and ask customers about food quality, so we can improve recipes and minimise leftovers." [Hotel 3]	minimise uneaten food waste	Restaurants	
"doggy bags are only provided upon customers' request." [Hotel 1]	waste from customers' leftover food	Edible food waste management	Food waste management through reusing, recycling, donations, and disposal
"Leftovers in the buffet will be provided to the staff canteen, and the chef will use precooked food to design new menus for the next meals." [Hotel 5]	leftovers from buffet or banquet		
"Fish or other animal bones are unsuitable for animal feed, we recycled them as compost" [Hotel 4]	waste from customers' plates and buffet or banquet	Inedible food waste management—	
"Lemon peel and pineapple are used to make EM fermented water used in kitchen surfaces." [Hotel 1]	excess pre- and post-cooked food		

Table 3. Summary of Food waste Practices at Five five-star Hotels.

Practices	Description	Hotel 1	Hotel 2	Hotel 3	Hotel 4	Hotel 5
Food waste management Policies	Having general policies on food waste management.	/		/	/	
	Having policies on encouraging customers to reduce food waste.	/		/	/	
	Having policies on educating employees on food waste reduction.	/		/	/	
	Having policies on collecting food waste data.	/		/	/	
	Promoting food waste management to employees.	/	/	/	/	
	Promoting food waste management to customers.	/		/	/	
	Promoting food waste management to partners.			/		
	Promoting local communities' quality of life regarding food waste management.	/				
	Organising food waste management seminars/training for employees.	/	/	/	/	/

Table 3. *Cont.*

Practices	Description	Hotel 1	Hotel 2	Hotel 3	Hotel 4	Hotel 5
	Organising food waste management seminars/training for customers.					
	Organising food waste management seminars/training for partners					
Food service planning, procurement, and storage	Planning on reducing food waste.	/	/	/	/	/
	Planning on stocking raw materials with suitable quantities.	/	/	/	/	/
	Planning on purchasing raw materials with fewer leftovers.	/	/	/	/	/
	Arranging food with first in, first out (FIFO).	/	/	/	/	/
	Storing food at an adequate temperature and location to delay food spoilage.	/	/	/	/	/
	Checking expiration date regularly.	/	/	/	/	/
Food waste handling and operations	Trimming food materials with fewer leftovers	/	/	/	/	/
	Asking for cooperation in reducing food waste.	/	/	/	/	/
	Using nearly expired food for cooking.	/	/	/	/	/
	Food cutting to make new food products.	/	/	/	/	/
	Giving excess food to employees.	/	/	/	/	/
	Offers doggy bags to customers.	/	/	/	/	/
	Selling food waste as animal feed.		/	/	/	/
Food waste management through reusing, recycling, donations, and disposal	Donating excess food to external organisations.			/	/	
	Donating excess food to staff for free.					
	Donating food waste for animal feed.		/	/	/	
	Using food waste to make compost.	/				
	Using food waste to make bio-fermented water.	/				
	Using food waste to ferment into biogas.					
	Recycling the hotel/restaurants' kitchen oil.	/		/		
Food waste budget and resource allocation	Having a budget to manage food waste in the hotel/restaurant.	/		/		
	Having equipment(s) to manage food waste in the hotel/restaurant.	/		/		/
	Having technology applications to manage food waste in the hotel/restaurant.					

Table 3 summarises the checklist of the food waste practices based on structured interview questions adopted from previous research [16,20,40–42,45,50–59,73]. The checklist demonstrates different aspects and levels of food waste management practices at those five-star hotels, regardless of the types of ownership and size. The typical food waste practices among these hotels are providing food waste management seminars and training to their employees, planning on reducing food waste, stocking suitable quantities of raw materials, purchasing raw materials with fewer leftovers, implementing a First-In-First-Out storage approach, storing food at the right temperature and location to delay food spoilage, checking expiry date regularly, handling food with fewer leftovers in the kitchen, asking staff cooperation in reducing food waste, using nearly expired food for cooking for staff canteen, reusing food cutting to make new food products/menus, giving excess food to employees, offering doggy bags to customers when request.

4. Findings and Discussion

The main aim of this study is to explore and examine hotel practices towards sustainable food waste management. This section starts with a summary of the four main thematic findings on how the hotels implement food waste prevention and reduction. Figure 2 demonstrates four themes of food waste management practices among those five five-star hotels related to the four Food Waste Hierarchy Principles. The thematical analysis highlights four emerging themes: (1) Food waste management policies, (2) Food service planning, procurement, and storage, (3) Food waste handling and operations in the kitchens, staff canteen and restaurants, and (4) Food waste management through reusing, recycling, donations, and disposal.

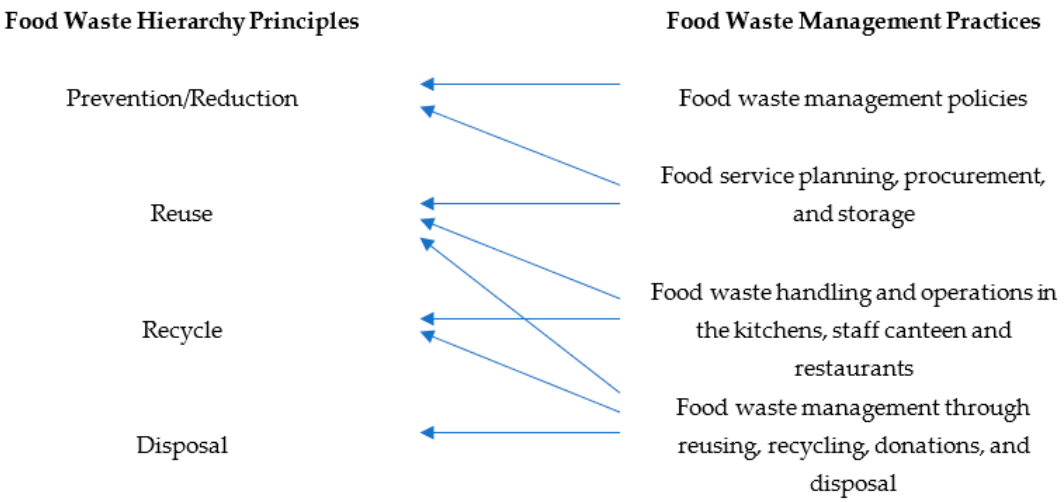


Figure 2. Summary of food waste management practices related to the four Food Waste Hierarchy Principles.

Beyond the common practices from previous studies, these hotels emphasise prevention and reduction as parts of policies and operations. For example, the hotels only order fresh food, raw ingredients, and other food according to short-term planning from daily estimation and weekly booking. They only partner with local farmers and suppliers that comply with their requirements on procurement, such as short-notice delivery and pre-cut ingredients. Working with local farmers and suppliers and using local ingredients allow the hotel clients to comprehend local culture through local cuisine with fresh local ingredients in its original place [77]. Increasing customer satisfaction with service quality is important for fostering loyalty and enhancing the likelihood of repeat business and word-of-mouth referrals [78].

This research's findings also complement previous food waste issues on unfavourable climatic conditions, ineffective operational and managerial procedures, and logistical

issues in many developing countries [20,59,79]. Furthermore, these hotels pay attention to ordering the right amount of food ingredients at the right time and storing them at the right temperature and location to avoid food waste. In addition to food waste, food safety is also highlighted. The hotels may offer doggy bags for customers when requested, with food safety instructions such as keeping the food at the right temperature for re-consumption. At the end of this section, we also provide the aggregated findings of the key informants' perspectives on challenges, especially in budget and resource allocation, and suggestions for sustainable food waste management practices.

4.1. Food Waste Management Policies

The research findings highlight that the types of these five-star hotel ownerships influence hotel policies regarding food waste management. The chain-owned hotels usually have specific guidelines for waste management. The chain-owned hotels emphasise the holistic sustainability policy, and food waste management is one of the key dimensions of sustainability. Similar to the recent study [16], specifically, the zero-waste policy has been implemented to promote food waste management from all managerial levels to operational staff, especially in the kitchen and food and beverage, as chain-owned hotels usually comply with international standards and awards. Srijuntrapun et al. [16] accentuate the usefulness of food waste hierarchy model in food waste reduction as a holistic approach to procuring zero food waste; however, the model principles may only convince some hotels to be on board.

> "Refer to the waste hierarchy principles by European Commission (2008) [40], they're usually applied for water and hydropower management. They are not implemented for food waste recycling nor preferable in Thailand." [Hotel 1]

> "Sustainability is the main policy in all our businesses, and our hotel just received Sustainability Award 2023." [Hotel 4]

> "We applied for ISO 20121: 2012 [76] Event sustainability management system and food waste management are one of the ISO main criteria; therefore, we implemented the zero-waste policy, which requires all departments to work together to reduce waste to nearly zero." [Hotel 3]

One of the chain hotels emphasises that cost management is the central policy to minimise waste. Cost management's effectiveness helps them reduce food waste, especially in organising an event or customer meeting. The hotel prioritises teamwork, cost control, and food waste management in all processes.

> "Our operational staffs work together. For example, event salespersons have to work with the kitchen staff in event planning and then present the idea to customers to help them minimise the cost, especially in their food operation and handling to minimise waste." [Hotel 3]

Partnership with local farmers is another important policy influencing food waste management. Regarding the interview findings, one of the chain hotels specified that their restaurants only use ingredients from local farmers. Thus, all components are fresh, have less downtime and low transportation cost. Importantly, fresh ingredients cause less waste in food preparation and operation.

> "We order ingredients from local farmers for the salad bar in our restaurants. The ingredients are fresh. It shortens time and less food waste." [Hotel 4]

Compared to chain hotels, the waste management policy differs among self-managed hotels. Like chain ownership, awards participation influences self-managed hotels' sustainability and food waste management policy.

> "We received a gold level of Green Hotels as we implement every angle on food waste. We have the green team committees, staff internal green competition on reducing food and other waste." [Hotel 1]

> "Although, we don't have a clear food waste policy. Our hotel receives a bronze award from green hotels, as we practice waste segregation. We also received Thailand Tourism Award called the 'Kinnaree Award' concerning holistic environmental sustainability." [Hotel 2]

Despite unclear policies on food waste management at self-managed hotels, they have a minimum concern regarding food waste management for various reasons, such as less food waste and manageable food waste reduction.

> "The hotel can manage food waste by many methods, including policy, planning, storing, handling, operations, donations, and recycling. We make bio-fermented water (EM, Effective Microorganisms) from leftover vegetables and fruits such as lime and pineapples for kitchen and surface cleaning. We make the compost for our vegetable gardens. We also donate food waste for animal feed when requested." [Hotel 1]

> "We stopped using vegetables to decorate the plates, and we offer more on a la carte menus, so food waste is less." [Hotel 2]

The collection of food waste data is practised in some hotels regardless of the types of ownership. These hotels usually weigh their food waste daily before disposal to monitor their food waste management, assess the effectiveness of the policy, and purchase planning.

> "We record food waste daily for monitoring and our ingredient purchased planning." [Hotel 1]

> "We weigh food waste daily before disposal." [Hotel 5]

Waste separation and sorting are seen as the heart of food waste management. Regardless of the size, chain-owned and self-managed hotels prioritise waste sorting. Waste shorting is significantly promoted within the organisation. Mainly, all hotels implement classified waste bins using colour coding for waste sorting. In Thailand, a green trash bin is used for organic and food waste; a yellow trash bin is for recyclable waste disposal; a red trash bin is for toxic or infectious waste disposal; and finally, general waste should be disposed of in a blue trash bin. The hotels' waste separation and sorting add food waste categories for reusing, recooking, recycling, donating and disposal. Finally, the interview findings show the existence of employee waste segregation training. The training is usually provided internally, or sometimes the hotels encourage and allow their employees to participate in the training offered by external organisations (e.g., universities and governments).

> "Waste segregation is the heart of food waste management." [Hotel 4]

> "We place importance on training, especially in cost management including waste sorting and thus we achieve the minimum level of food waste." [Hotel 2]

> "We usually send our employees to waste management training organised by the external organisation such as the universities, and then our staff have to share the knowledge and train other hotel staff." [Hotel 1]

4.2. Food Service Planning, Procurement, and Storage

The findings highlight that food service planning is critical to reducing food waste. All hotels indicate that they usually plan their food services based on the number of bookings, especially the number of events, meetings and customers and potential walk-in customers. The hotels also adopt a flexible stock ordering strategy with a short circle (one-seven days). These strategies help the hotels purchase raw materials with fewer leftovers and stock raw materials in suitable quantities. Two out of five hotels state that they only work with suppliers that comply with their policies and strategies on procurement and storage.

> "We order raw ingredients from our local suppliers daily, so we have no stock." [Hotel 4]

> "We have a committee from different units to plan our services together by checking bookings, such as the number of special events and meetings, and we also estimate walk-in customers from statistics in our database." [Hotel 1]

> "We order just the right amount of dried ingredients for a week and fresh produce on Mondays, Wednesdays and Fridays. If we need more over the weekend, the suppliers agree to deliver just in time for us, so there's nothing left." [Hotel 5]

In addition, some hotels employ ready-to-use raw materials in purchasing. Although this purchasing strategy increases their cost, the pre-cut and trimmed ingredients reduce waste and time in food preparation.

> "We order ready-to-use/cook fresh produce at a higher price. When compared to the time and cost we have to manage food waste, the higher price we pay seems reasonable". [Hotel 1]

> "We don't cut and trim raw ingredients. We only order the ready-to-use, which causes less waste and saves time." [Hotel 5]

Importantly, food storage is critical concerning food waste management. The chain-owned and self-management hotels reported that arranging food with First-In-First-Out (FIFO) and labelling food ingredients that show the product expiry dates and storage instructions are the procedures used to avoid spoilage of raw food ingredients the storage. Standard hotel practices are checking expiration dates regularly and storing natural ingredients and food at an adequate temperature and location to delay food spoilage. Finally, the hotels place importance on maintaining food storage in good condition.

> "Raw materials stored with the First-In-First-Out (FIFO) policy, storages are separated according to the type of raw materials. Our chef will check the expiration date, and we have technicians to check the equipment and temperature every month." [Hotel 2]

> "We use First-In-First-Out (FIFO) and labelling and usually check expiry date daily... we focus on taking care of raw ingredients and food before storing them separately to avoid contamination and at the right temperature." [Hotel 3]

The important guidelines for the hotels to reduce food wastage during distribution and consumption processes, especially food ordering, was implemented by relevant personnel. For example, the Executive Chefs work with the Restaurant Managers to design "Green Menu Planning" that will help customers make food ordering decisions, indicating their food taste preferences, such as using the symbols of chillies to determine how spicy the customers wish to eat.

> "Our hotel uses the Green-menu planning with visual symbols or pictures for the Coffee Shop and Room Services to help reduce food waste in case our guests are unsure about the food taste, e.g., spicy or not spicy". [Hotel 1]

4.3. Food Waste Handling and Operations in the Kitchens, Staff Canteen and Restaurants

Food handling is one of the critical factors in controlling food waste, especially during food preparation. The hotels indicate that they use a trimming technique with fewer leftovers. The leftovers from the cutting and trimming are reused to make new food products. For example, small pieces of meat, bones, and the peel of the fruits and vegetables are reused to make stock and brown source. The bread crust is reused in menus such as crispy bread in Caesar Salad and other menus with breadcrumbs. Traditional plate decoration using vegetables and fruit cravings that generate food waste is also avoided in the kitchen. Instead, the hotels encourage chefs to learn a new skill of modern food cutting and decorating to minimise waste.

> "The chefs will monitor food waste to ensure that they are efficiently cut and cost efficiency such as fruit peel is used to make stock, scraps of meat, and bones

are for making brown sauce or soup. It's depended on chefs' creativity, and this reduces our food cost." [Hotel 2]

"We don't do extravagant decorations such as carving but encourage our chefs to learn how to decorate dishes with the least unappetising items." [Hotel 1]

Using nearly expired food for cooking is strictly prohibited from preparing food for customers. However, each hotel uses different strategies to handle the best before or almost past the food and ingredients expiry date. One hotel uses the nearly expired food to recreate new menus and serve at the staff cafeteria, and the other two sell them at cost for employees.

"We don't sell nearly expired food to our customers but recreate the dish for our staff at their cafeteria" [Hotel 1].

"When we have nearly expired food or ingredients, the storage team will circulate an internal email to employees so they can buy it at cost." [Hotel 4].

"We sell the best before or nearly expired food at cost to the employees." [Hotel 5]

Others report no nearly expired foods/ingredients due to their First-In-First-Out (FIFO) implementation and monitoring effectiveness. Interestingly, the findings show four hotels adopting different strategies to prevent food waste caused by customers' leftovers on their plates. One hotel only serves buffet service for breakfast and uses smaller plates aiming to reduce food waste because the customers take too much food on their plates and leave it uneaten on their plates. Another hotel gradually serves food at the buffet occasionally to maintain fresh and appropriate temperatures for customers and reduce food waste because of being left at inappropriate temperatures. They also emphasise continuously improving food quality to minimise uneaten food waste because of the unfavourable taste. Finally, the two hotels offer a standard menu based on the customer preferences in their database and have a special dish promotion monthly or seasonally to increase the variety of their menu.

"We downsize the plates in the morning breakfast buffet, so the customers have less food on their plates and thus fewer leftovers." [Hotel 2]

"Our staff will gradually release food in the buffet to reduce inedible leftovers from being left at inappropriate temperatures. Our staffs observe and ask customers about food quality, so we can improve recipes and minimise leftovers." [Hotel 3]

"There is a standard menu, but we will add more promotional dishes for special occasions, festivals and seasons." [Hotel 5]

4.4. Food Waste Management through Reusing, Recycling, Donations, and Disposal

These hotels categorise food waste into two types: edible and inedible food waste for human consumption. These two types can also be divided into three sources of food waste: waste from customers' leftover food on their plates, safely edible leftovers from the buffet or banquet, and excess pre- and post-cooked food. Hotels use various strategies regarding drivers, disposal routes and practical solutions/alternatives to disposal regarding the two types of food waste and its three primary sources.

Inedible food waste from customers' leftover food on their plates, such as fish or other animal bones, is unsuitable for animal feed and can be recycled as compost. While other edible leftovers on customers' plates but unfit for human consumption can be sold or donated for animal feed to animal farms, other organisations or CSR partners. Additionally, two hotels recycle inedible food waste by making compost and bio-fermented water part of their food waste management practices which aimed to achieve zero food waste generated in the hotels (no food waste is being disposed in landfills), similar to the results from Srijuntrapun et al. [16]'s study.

"Lemon peel and pineapple are used to make EM fermented water used in kitchen surfaces." [Hotel 1]

> "Food waste is used to make compost using the hotel, such as greenhouses and gardens for guest activities such as cutting vegetables for a cooking workshop. We also sell food scraps as animal feed" [Hotel 4]

Edible leftovers in the buffet or banquet and excess pre-cooked food are managed similarly. Most hotels give surplus food to employees in their staff cafeteria except Hotel 4, which does not allow employees to eat food prepared for customers. Recreating new menus from leftovers from the buffet and excess pre-cooked food is also a common practice in hotels. For example, the exclusive chef will design the lunch menus from the edible leftovers or pre-cooked food from the morning buffet.

> "The chef will process the leftovers for the next meals or take them to the staff cafeteria." [Hotel 2]

> "Leftovers in the buffet will be provided to the staff canteen, and the chef will use pre-cooked food to design new menus for the next meals." [Hotel 5]

Alternatively, some hotels donate excess food from the buffet or special events to external organisations in their CSR program. Interestingly, doggy bags are only provided upon customers' request to avoid taste changes, or spoiled food may cause by different temperatures after customers leave the restaurants.

> "Leftover food such as cakes and desserts from the functions or banquet may be taken away by the host customers or donated to various foundations or local community if the host customers allow. We can deliver leftovers to the organisations, or they can pick them up." [Hotel 1]

> "If there are leftovers in catering, we will wrap them for the customer, if the customer allows, it will be donated. Our hotel has a CSR program with the community. However, dogging bags are not encouraged because the food may be spoiled during the journey." [Hotel 3]

4.5. Challenges and Suggestions for Sustainable Food Waste Management

Nevertheless, the claims and past research indicate hospitality and food service operations generate great quantify of food waste which causes a challenge to achieve the UNSDGs; not all hotels in this study have food waste management written in their policies. Despite that, these hotels still practice food waste management in their everyday roles and duties as they believe the practices suit everyone.

> "Everyone gets benefits. Customers get fresh food with quality. Local communities/farmers get to sell their produce. Encourage local economy. Create jobs for animal feed for locals. We separate waste into categories. We train our staff on this food waste as our organisational culture; they can bring this knowledge to practice at home." [Hotel 4]

> "Staff are aware of and know about food waste which can apply at home. The F&B can design effectively to avoid food waste. Chefs can save costs on food waste, e.g., a raw material can make three menus/dishes. Stakeholders can save cost money and control the budget." [Hotel 5]

Regarding budget and resource allocation to manage food waste, the findings reveal that Hotel 1 is the only hotel that allocates resources to support food waste management. This hotel has a small waste shredder and local staff who are in charge of making compost from food waste. Nonetheless, Hotels 2 and 5 said they plan to allocate a budget concerning food waste management soon. The findings highlight similar concerns of insufficient resources in developing countries to reduce food waste in past research [16,20,80].

> "We manage food waste by recycling and reusing, which are very important issues concerning the size, location, technology and space. Our hotel will cooperate with a university and set a budget for students' projects to help us manage food waste in 2023." [Hotel 1]

> "There is a policy to purchase a food waste management software program, but we have not set a budget yet." [Hotel 4]

Besides needing more policies, budget and resources, food waste from customers is the biggest challenge in food waste management practices. The hotels cannot directly tell customers to reduce food waste or only take what they need because they pay money to eat at the restaurants. Despite different views on this issue, some customers know and understand the importance of food waste issues. The findings may extend to other related factors, such as political, economic, and socio-cultural factors that influence customers' food waste cultural habits when dining outside their homes [81–83].

> "People do not see the negative impacts yet. People do not think about its impacts. The buffet trains people to do food waste." [Hotel 3]

> "The challenge of the food waste reduction in the hotel and restaurant business sector is "How to increase customer satisfaction on the food waste reduction practice? because of all practices will concern about guest's expectation and satisfaction." [Hotel 4]

> "Customers are willing to participate in food waste. They do not take excessive food at the buffet. We cannot do much without customers' cooperation, engagement, and participation. Waste is mostly from customers. So, the chefs will further create menus to avoid food waste. We do not need to have many menus. We only need a few to encourage and avoid food waste. Many hotels stop buffets and offer only a la carte." [Hotel 5]

Based on all perspectives, food waste issues should not be blamed only on hospitality and food service operations. It relates to all food, especially food safety. Therefore, all stakeholders, businesses and industries should work together to tackle this issue. Eriksson, Giovannini, & Ghosh [44] emphasise that national food safety policies can limit food waste management and mitigation. In addition, stakeholders have an impact on all stages of food waste. Therefore, it is crucially essential for stakeholders to actively engage and collaborate in effective food waste prevention [34,47,84].

> "This topic should be discussed at an early age in every stage of life. The awareness and knowledge of sustainability and food waste should be emphasised at a young age, from home, school, and university to the workplace. Different awareness, knowledge, and mindset from different generations for different reasons. Same thing as for employees when they leave food. We showed them food waste videos to create a conscious mindset about it. These days more organisations have their campaigns on food waste." [Hotel 1]

> "There is a lot of information but no emphasizing on the benefits of food waste reduction, and how to change people's behaviour toward food waste. They must be aware, do, and practice until it becomes routine. There is a lack of support, money, and labour investment outside the hotels. Awareness is important. Organisations must keep their promises. At the end of the day, it is all about profit and loss." [Hotel 2]

5. Conclusions

This study aims to fill the under-studied gaps in food waste management practice, especially its geographical coverage [17,35]. Responding to the call for solid evidence on preventing food waste in the food service sectors [35] and capturing food waste at the various stages [17], this study provides insights into current food waste management practices at five five-star hotels in Thailand at planning, procurement, storage, processing, production, and post-consumption. Thailand is one of the developing countries concerning food waste from out-of-home consumption like dining at hotel restaurants [85,86] and inefficient resources [20,80]. The findings of this study highlight different aspects and levels of sustainable food waste management practices in five-star hotels aiming to facilitate the

achievement of the UN Sustainable Development Goals (SDGs). It, therefore, bridges the theoretical framework of Food Waste Hierarchy Principles with the food waste practical operation in the hotel industry, especially five-star hotels (see Table 3) in a developing country. Additionally, this study collected data during post-COVID-19, which presents the updated situation of food waste management practices in a developing country like Thailand.

This study contributes to theoretical implications addressing and filling the gaps in sustainable food waste management practices in hospitality and tourism research. Based on the waste hierarchy model, it exhibits different aspects and levels of food waste management practices ranging from policy, planning process, storage, handling, operations, donations, recycling, resources, local partnership, and cooperation between five-star hotels and their stakeholders. Due to the revealed challenges, especially budget, costs and resources, applying the waste hierarchy model emphasises the vital food waste management principles of prevention and reduction rather than disposal.

This study provides practical insights into the updated sustainable food waste management practices at five-star hotels in Thailand. It also imparts restaurant guidance and recommendations to hotel industry practitioners in implementing sustainable food waste management that could benefit hotels that emphasising the best practices in sustainable food consumption and food waste management towards advancing the UNSDGs. In addition, this study highlights the importance of active engagement and cooperation among relevant stakeholders such as the governments, businesses, and local tourism and hospitality actors in managing food waste more effectively.

6. Future Studies and Limitations

Although this study warrants the theoretical contribution of the Food Waste Hierarchy Principles model and practical implications on food waste management and practices at five-star hotels in Thailand, it has some limitations. The first limitation is the nature of exploratory research that cannot be generalised. The second limitation concerns a small sample size of five five-star hotels collected post-COVID-19 while other hotels are still recovering from the COVID-19 impacts. Lastly, the third limitation can be the key informants involved in food waste management at those hotels recruited through purposive and snowballing sampling.

Quantitative studies may be further studies to quantify the findings. Further studies should consider more key informants at different management and operational levels. Other study settings, such as other tourism, hospitality and food service operations in other developing countries, could give more knowledge and fill in the gaps in this area.

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