



Research article

The role of food waste hierarchy as Thai hotels seek to fulfill their corporate social responsibility

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ABSTRACT

Although food waste reduction has been recognized as an important method for managing the environment in the past, it has not received much attention from the hotel business sector. This article reveals that food waste hierarchy is an important strategy for hotels, as it helps them to reduce food waste at the generation point, while reducing food costs and protecting the environment. The process of food waste reduction can be holistically integrated with the distribution process. The study found that there were significant differences related with hotel size in the 7-step food distribution process. The mean distribution process of large hotels is higher than the one of medium and small hotels. The results also show that the hierarchy of food waste management motivates the hotel business sector to implement food waste reduction by ensuring that hotel operations achieve Corporate Social Responsibility (CSR) goals in the form of Creating Shared Value (CSV). The primary goal of CSR is to align corporate and social values.

1. Introduction

Over the past decade, food waste has attracted global attention in developed nations, being seen as a serious but not intractable environmental problem. While it is tempting to put the blame for the growth of food waste around the world on rising populations, it has more to do with other factors like the growing expectations for convenience by consumers, the overproduction of food, and the decrease in the total cost of food as a consumer good (Bloom, 2011; Närvänen et al., 2019). Thus, many retailers and consumers choose to throw their leftover food away since it is easily replaceable at a low cost. While the world's population and prosperity continue to rise, food waste issues are also expanding. Similarly, many businesses that deal with food find it cheaper to dispose of excess food than to handle it properly, making sure that someone consumes it somewhere down the supply chain. These factors, at once economic, financial, social, and moral, are causing food wastage throughout the food supply chain, from the initial stage of agricultural production to the final stage of household consumption. According to the Food and Agriculture Organization of the United Nations (FAO), approximately one-third of the food produced for human consumption around the world is lost or wasted, amounting to approximately 1.3 billion metric tons per year (FAO, 2011). At the same time, millions of

people are struggling to secure enough food to survive. The number of undernourished people in the world has been continuously increasing. In 2020, between 720 and 811 million people faced hunger (FAO, 2021). It is believed that excessive food production discarded as “food waste” could be used to alleviate food shortages around the world. However, this requires a concerted effort to set up novel distribution channels, which probably cannot be developed without supports beyond the business sector.

The issue of discarded food has many different impacts. Food waste is a major sustainability challenge (as described by Thyberg and Tonjes, 2016), because it has a large impact on business revenue, public health, and the environment (Wang et al., 2017; Gössling and Peeters, 2015). In economic terms, food waste could be the cause of approximately \$2.6 trillion per year in financial damage (FAO, 2014). Moreover, food waste has an environmental cost of approximately \$700 billion per year and an estimated social cost of \$900 billion per year (FAO, 2014). Additionally, food waste has negative effects on the environment through the release of carbon dioxide (CO₂) and methane (CH₄), which are some of the greenhouse gases that are causing global warming.

The hotel sector generates a substantial amount of food waste every year (von Massow and McAdams, 2015). For example, US restaurants generated 11.4 million tons of food waste valued at \$25 billion (ReFED,

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2018). There are various options for dealing with food waste, such as using it to feed hungry people, to feed animals, or for composting. However, the most common “solution” all over the world is to dispose of food waste in landfills (FAO, 2013), a practice that is extremely hazardous to the environment and poses a risk to human health. Despite some progress over the last few years in finding alternatives, especially in developed countries (Garcia-Garcia et al., 2017), there is an urgent need for guidelines that effectively integrate each process in order to reduce food waste and improve food distribution in hotels.

Moreover, creating incentives for hotels to change their approach to food waste may promote their social image and improve the reputation of the industry amongst the wider public. While businesses are faced with the challenge of having to make profits, they also need to reduce the environmental impact of their operations (Claydon, 2011). For a company to be a good corporate citizen, it needs to consider its Corporate Social Responsibility (CSR) across its operations and not simply as an add-on after profits have been counted. Thus, Thai industries and companies that profess to be interested in CSR should increase the economic value of their business while at the same time reducing the environmental impact of their processes and operations. In the hotel industry, one way to achieve this is for companies to reduce food waste. This leads to the following research question: what approaches are effective in achieving a reduction of food waste in hotel operations while being at the same time good for their business?

The aim of this work is to present a model of food waste management for supporting Corporate Social Responsibility. This model focuses on the need to significantly reduce waste generation through a hierarchy of prevention, reduction, recycling, and reuse. In this sense, the best course of action is to prevent and reduce excessive food waste. Moreover, commercial concerns can be effectively combined with lower environmental impacts given that good food waste management saves costs. This provides incentives for hotel businesses to change.

2. Literature review

2.1. Waste hierarchy

Conventional food waste management practices focus on animal feed, anaerobic digestion, composting, recovery of energy, and landfill, but less on preventing food waste. Such practices have large effects on the environment. For instance, methane emissions generated in landfills accounted for 3% of the overall GHG emissions (Jain et al., 2018). The

purpose of waste hierarchy is to provide clear guidelines leading to better waste prevention and sustainable waste management. The principles underlying the hierarchy of waste management were adopted as part of the waste management policies of the European Union in the early 1970s and are now widely used as an important waste management framework around the world. Waste hierarchy identifies and evaluates the best waste management options for the environment (Papargyropoulou et al., 2014) (Figure 1). Recognizing the importance of environmental sustainability in the food sector, the Environmental Protection Agency (EPA) in the United States developed a new food recyclable waste hierarchy that closely resembles the waste hierarchy concept (EPA, 2016). The main objectives of the EPA are to educate both businesses and individuals about food loss prevention strategies and to provide a model to sustainably manage food waste in environmental, economic, and social terms (Papargyropoulou et al., 2014). The EPA model is guided by three important principles: prevention, reduction, and disposal. Prevention aims to reduce the loss of food at its origin. This step is appropriate and effective at reducing as much as possible food waste (Papargyropoulou et al., 2014; Kilibarda et al., 2019). The food waste hierarchy provides food management steps to prevent food waste and transform discarded food into other uses. Each step involves different management methods based on the principles of waste hierarchy (European Commission, 2008), specifying the waste management options that are likely to have the best environmental results. Thus, the first thing to consider is how to reduce food loss at the source by maximizing food use to help reduce both environmental and economic impacts. On the other hand, disposing of food waste in a landfill is considered to be the worst option.

In the past, food waste management in the hotel sector was fragmented (Pirani and Arafat, 2016). Common practices included the design of new kitchen processes (Duursma et al., 2016; SRA, 2010), regular checking of stocks using the First In First Out method (Charlebois et al., 2015), offering *à la carte* service instead of buffets (Gössling et al., 2011), making stakeholders aware of the measures taken to reduce food waste (Papargyropoulou et al., 2016), redistributing unsold or excess foods (FAO, 2015; WRAP, 2017), and recycling food that cannot be further distributed (Hu et al., 2013). Moreover, the hotel sector has often viewed food waste management as a marketing mechanism (Pearson and Perera, 2018). Food has been redistributed by selling it at a lower price, donating it to the underprivileged, reusing it for employee consumption, or as takeaways for pets (Filimonau and Delysia, 2019; Kilibarda et al., 2019). Leftover food that can no longer be consumed has also been processed into fish food (Cheng et al., 2014; Wong et al., 2016) or used for composting. In Thailand, most food waste has been disposed in landfills specifically designed for this purpose (Srisuwannaket and Liumpetch, 2019). This research paper applies the waste hierarchy approach to hotel food distribution, in order to provide a useful reference for hotels.

2.2. Corporate social responsibility

CSR is concerned with the role of business organizations in society and with society's expectations about the operational ethics of organizations in terms of their social and environmental responsibilities to achieve sustainable development (Behringer and Szegedi, 2016). Organizations can apply CSR principles to create a positive corporate image through public relations (Boulstridge and Carrigan, 2000) by considering three important dimensions: economy, environment, and society. Although the foremost concern of business management is profit (Hill and Gale, 2009), consumers are increasingly aware of environmental issues (Binder and Blankenberg, 2017). This might especially be applicable to foreign visitors staying in Thai hotels. If an organization is not proactively applying CSR to improve its environmental impact, the valuation of its products and services by customers might be negatively affected (Becker-Olsen et al., 2006). Moreover, an organization committed to CSR must demonstrate that it takes socially responsible actions, not just as part of its legitimate business operations but also

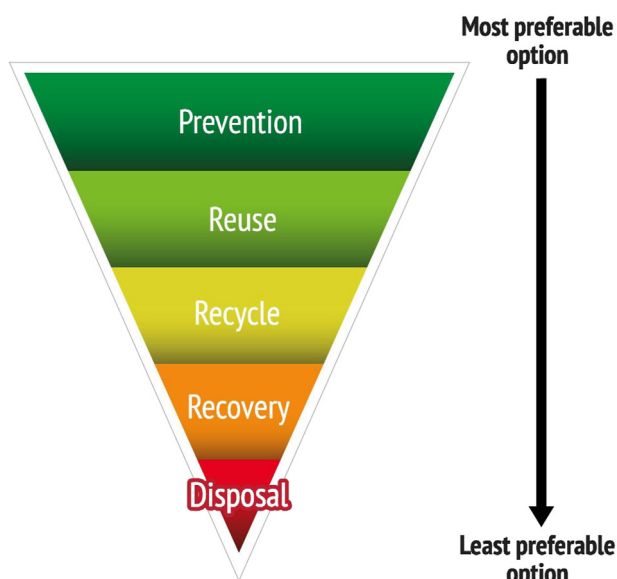


Figure 1. Waste hierarchy. Source: European Commission (2008).

Table 1. Hotel policies concerning food waste management.

Policy	Large-sized hotels			Medium-sized hotels			Small-sized hotels		
	continued	discontinued	no policy	continued	discontinued	no policy	continued	discontinued	no policy
Food waste management	19 (67.9%)	7 (25.0%)	2 (7.1%)	8 (36.4%)	11 (50.0%)	3 (13.6%)	2 (16.7%)	7 (58.3%)	3 (25.1%)
Encouraging customers to reduce food waste	8 (28.6%)	9 (32.1%)	11 (39.3%)	5 (22.7%)	1 (4.5%)	16 (72.8%)	2 (16.7%)	0 (0.0%)	10 (83.3%)
Educating employees on food waste reduction	19 (67.9%)	5 (17.9%)	4 (14.2%)	7 (31.8%)	6 (27.3%)	9 (40.9%)	3 (25.0%)	2 (16.7%)	7 (58.3%)
Collecting food waste data	13 (46.4%)	6 (21.4%)	9 (32.2%)	1 (4.5%)	6 (27.3%)	15 (68.4%)	1 (8.3%)	2 (16.7%)	9 (75.0%)

according to the needs of society as determined by its members (Uhlir et al., 2020).

CSR actions should provide both social and organizational benefits. In the hospitality industry, there is some evidence showing the positive impact of CSR on a company’s performance in specific dimensions. One positive impact of CSR on the environment is that allows the company to achieve monetary benefits in the long-term. On the other hand, only a few studies have investigated the impact of CSR towards employees and communities (Rhou and Singal, 2020). Restaurant businesses generally waste about 25% of the food they buy. However, some restaurants engage in CSR by reducing their food waste. For example, Accor Hotels in eastern Europe began to reduce food waste in June 2016 by taking two steps. First, the company raised the awareness and engagement of its employees through workshops and presentations. Then, it weighed food waste using an external digital system and required its kitchen teams to regularly analyze the source of food waste. Initially, the company was collecting around 700 kg of food waste per week. This was reduced by 30% after three months. This action decreased the environmental impact of the company, while at the same time generating savings of EUR 28,580 (Hospitality ON, 2021).

Choosing the right CSR model can increase pride and loyalty within the organization, while contributing to enhance organizational value to all stakeholders. It also improves brand communication and marketing, and can even reduce costs for the organization. There are three main patterns of Corporate Social Responsibility, based on how companies implement CSR in their processes. First, businesses may take operational actions that affect their stakeholders and their environment, such as seeking forms of production that are not harmful to the environment. Second, businesses may engage in CSR actions that are not directly related to the organization’s operations, such as promoting afforestation, offering scholarships, or helping victims of unfortunate events. Finally, CSR might also involve not-for-profit actions aimed at helping society and the environment, such as creating foundations or charitable associations.

In the food business, CSR actions often deal with food safety, food security, as well as social and environmental sustainability (Fuchs and Kalfagianni 2009). Food waste management is one of the most common CSR concerns of large food manufacturers (Hartmann, 2011), supermarkets (Devin and Richards, 2018), and hotels (Duursma et al., 2016; Kilibarda et al., 2019; Wong et al., 2016). However, scarce attention has been devoted to devise a model that integrates the concept of waste hierarchy, which focuses on food prevention, with CSR, which deals with stakeholder engagement. Such a model can help to integrate and improve

the performance of food waste reduction initiatives while boosting business incentives.

3. Methodology

The study presents in this paper uses a transformative mixed method. It was conducted after obtaining the approval of the Human Research Ethics Committee of Mahidol University (certificate of approval number 2017/179.2208). Before collecting the data, researchers explained the research objectives and the methods of data collection to participants in order to obtain their consent. The study examined which food waste reduction model is most appropriate for hotel food distribution in Bangkok and the Bangkok Metropolitan Region. Framed by the concept of waste hierarchy, it had two main objectives: (1) to study food waste management in the hotel distribution process, and (2) to establish effective guidelines for reducing food waste in hotels.

3.1. Data collection and characteristics of participants

In the first part of the research, postal questionnaires (quantitative method) and in-depth interviews (qualitative method) were used to study hotel food waste management processes during distribution between November 2017 and March 2018. Both quantitative and qualitative data was collected at the same time. Data analysis was done separately, and integration was achieved at the moment of interpretation to obtain comprehensive answers to the research question.

First, the study relied on questionnaires as a tool for collecting primary data (Cohen et al., 2017) from a sample of a larger population (O’Leary, 2014). The questionnaires were developed based on the waste hierarchy approach and a 7-step food distribution process that consisted of executive policy, hotel operations planning, food storage, handling in the kitchen, reuse operations, donations, and food waste recycling. The lists of measures in the questionnaire are presented in Tables 1, 2, 3, 4, 5, 6, and 7.

They were validated by three experts within the field of food services and hospitality management. Samples were selected using intentionally stratified sampling. The population were consisted of 325 hotel managers from hotel located in Bangkok and the Bangkok Metropolitan Region. The initial sample size of respondents included 179 hotel managers, calculated using Taro Yamane’s formula (Yamane, 1973) with a confidence level of 95%. However, after sending the questionnaire to the hotel managers by post, only 62 letters were returned to the researchers. Thus, the response rate was 34.6% (which lies within the acceptable response

Table 2. Hotel planning concerning food waste management.

Planning	Large-sized hotels			Medium-sized hotels			Small-sized hotels		
	continued	discontinued	no planning	continued	discontinued	no planning	continued	discontinued	no planning
Reducing food waste	19 (69.8%)	8 (28.6%)	1 (3.6%)	4 (18.2%)	13 (59.1%)	5 (22.7%)	1 (8.3%)	7 (58.4%)	4 (33.3%)
Stocking raw materials with suitable quantity	22 (78.6%)	4 (14.3%)	2 (7.1%)	14 (63.6%)	6 (27.3%)	2 (9.1%)	10 (83.4%)	1 (8.3%)	1 (8.3%)
Purchasing raw materials with less leftovers	20 (71.4%)	5 (17.9%)	3 (10.7%)	15 (68.2%)	3 (13.6%)	4 (18.2%)	9 (75.0%)	1 (8.3%)	2 (16.7%)

Table 3. Food storage.

Storage	Large-sized hotels			Medium-sized hotels			Small-sized hotels		
	continued	discontinued	no storage	continued	discontinued	no storage	continued	discontinued	no storage
Arranging food with First In First Out	23 (82.1%)	2 (7.1%)	3 (10.8%)	10 (45.5%)	11 (50.0%)	1 (4.5%)	6 (50.0%)	6 (50.0%)	0 (0.0%)
Storing food at an adequate temperature and location to delay food spoilage	24 (85.8%)	2 (7.1%)	2 (7.1%)	13 (59.1%)	3 (13.6%)	6 (27.3%)	9 (75.0%)	0 (0.0%)	3 (25.0%)
Checking expiration date regularly	25 (89.3%)	2 (7.1%)	1 (3.6%)	12 (54.5%)	3 (13.6%)	7 (31.9%)	9 (75.0%)	1 (8.3%)	2 (16.7%)

Table 4. Food handling in the kitchen.

Handling	Large-sized hotels			Medium-sized hotels			Small-sized hotels		
	continued	discontinued	no handling	continued	discontinued	no handling	continued	discontinued	no handling
Trimming with less leftovers	20 (71.4%)	5 (17.9%)	3 (10.7%)	10 (45.5%)	10 (45.5%)	2 (9.0%)	5 (41.7%)	4 (33.3%)	3 (25.0%)
Asking for cooperation in reducing food waste	19 (67.9%)	7 (25.0%)	2 (7.1%)	10 (45.5%)	7 (31.8%)	5 (22.7%)	6 (50.0%)	3 (25.0%)	3 (25.0%)
Using nearly expired food for cooking	21 (75.0%)	4 (14.3%)	3 (10.7%)	10 (45.5%)	2 (9.0%)	10 (45.5%)	6 (50.0%)	0 (0.0%)	6 (50.0%)

Table 5. Reuse operations.

Operations	Large-sized hotels			Medium-sized hotels			Small-sized hotels		
	continued	discontinued	no operation	continued	discontinued	no operation	continued	discontinued	no operation
Using food cuttings to make new food products	17 (60.7%)	2 (7.1%)	9 (32.2%)	5 (22.7%)	9 (40.9%)	8 (36.4%)	1 (8.3%)	3 (25.0%)	8 (66.7%)
Giving excess food to employees	11 (39.3%)	6 (21.4%)	11 (39.3%)	5 (22.7%)	7 (31.8%)	10 (45.5%)	1 (8.3%)	1 (8.3%)	10 (83.4%)
Offering doggy bags to customers	8 (28.6%)	9 (32.1%)	11 (39.1%)	1 (4.5%)	9 (41.0%)	12 (54.5%)	1 (8.3%)	3 (25.0%)	8 (66.7%)
Selling food waste as animal feed	14 (50.0%)	4 (14.3%)	10 (35.7%)	2 (9.1%)	11 (50.0%)	9 (40.9%)	7 (58.3%)	0 (0.0%)	5 (41.7%)

Table 6. Donations.

Donations	Large-sized hotels			Medium-sized hotels			Small-sized hotels		
	continued	discontinued	no donation	continued	discontinued	no donation	continued	discontinued	no donation
Donating excess food to external organizations	9 (32.1%)	8 (28.6%)	11 (39.3%)	2 (9.1%)	9 (40.9%)	11 (50.0%)	0 (0.0%)	5 (41.7%)	7 (58.3%)
Donating excess food to staff for free	6 (21.4%)	6 (21.4%)	16 (57.2%)	4 (18.2%)	5 (22.7%)	13 (59.1%)	1 (8.3%)	4 (33.3%)	7 (58.4%)
Donating food waste for animal feed	5 (17.9%)	9 (32.1%)	14 (50.0%)	2 (9.1%)	6 (27.3%)	14 (63.6%)	0 (0.0%)	3 (25.0%)	9 (75.0%)

Table 7. Food waste recycling.

Recycling	Large-sized hotels			Medium-sized hotels			Small-sized hotels		
	continued	discontinued	no recycling	continued	discontinued	no recycling	continued	discontinued	no recycling
Using food waste to make compost	6 (21.4%)	3 (10.7%)	19 (67.9%)	2 (9.1%)	8 (36.4%)	12 (54.5%)	0 (0.0%)	2 (16.7%)	10 (83.3%)
Making bio-fermented water	5 (17.9%)	4 (14.2%)	19 (67.9%)	0 (0.0%)	6 (27.3%)	16 (72.7%)	0 (0.0%)	4 (33.3%)	8 (66.7%)
Using food waste for fermentation into biogas	3 (10.7%)	5 (17.9%)	20 (71.4%)	0 (0.0%)	6 (27.3%)	16 (72.7%)	0 (0.0%)	3 (25.0%)	9 (75.0%)
Recycling of kitchen oil	6 (21.4%)	4 (14.3%)	18 (64.3%)	1 (4.5%)	4 (18.2%)	17 (77.3%)	0 (0.0%)	2 (16.7%)	10 (83.3%)

rate range of 20–60% defined by Cobanoglu et al., 2001; Hickner et al., 2014, and others). The low response rate might have been due by the fact that the questionnaire asked commercial managers to take time away from their activities and because reducing food waste is not a main concern of many hotels. The sample consisted therefore of 62 hotels, with the following composition: (a) 12 small hotels with less than 60 rooms (19.4% of the sample); (b) 22 medium hotels with 60–149 rooms (35.4%

of the sample); and (c) 28 large hotels with 150 rooms or more (45.2% of the sample).

Additionally, in-depth interviews were conducted with participants selected using purposive sampling, a deliberate strategy for selecting participants with the experience and knowledge required by researchers (Neuman, 1999). Groups of six participants were chosen according to the size of the hotel. For each hotel, three people with the ability to give

information on the path of food waste were selected for interview. Participants consisted of (1) policymakers, (2) head chefs, and (3) staff procuring waste management of food leftovers. In total, 54 people were interviewed. The semi-structured interviews tried to collect information-rich cases that could illustrate the causes of food waste generation and management occurring during the distribution process of the hotels. Participants answered questions freely in their own words, without having to choose an answer from fixed responses (Mack et al., 2005).

The second part of the study focused on the search for an effective approach to food waste management in hotels using the method of qualitative case study (Yin, 2017). This involved an in-depth and critical analysis of a single case (Eisenhardt, 1989) that highlighted the belief that food waste could be eliminated. Due to its complex and diverse knowledge about food waste reduction, **Hotel A** was chosen for the case study (purpose sampling). **Hotel A** was certified for its good practices in food waste reduction by LightBlue Environmental Consulting Co. Ltd. Moreover, this hotel was able to reduce food waste to zero while operating its business, saving around 2 million Baht in food purchasing costs during the first year of operations. Participants were (1) policymakers, (2) head chefs, and (3) staff procuring waste management of food leftovers. Data was collected through both semi-structured interviews and direct observations, taking place separately but simultaneously.

3.2. Measures

In the first part of the research, the food waste management of each hotel was assessed over a 7-step distribution process. A postal questionnaire was used with a confidence interval of 95% and a Cronbach's Alpha coefficient of 0.981, which demonstrates that the tool was reliable. Quantitative data analysis was conducted to obtain descriptive statistics displaying frequency, percentage, mean, and standard deviation. Moreover, one-way ANOVA was employed to compare the mean of 3 groups of more. In this study, it was employed to examine how the various hotel sizes (large, medium and small) affected the 7-step distribution process.

Content analysis was used to analyze primary data from semi-structured interviews, paying particular attention to the interpretation of the context of waste hierarchy processes. The coding of the data was based on the themes obtained from interviews, in accordance with the overall framework. The analysis relied on reflective and repeated readings of the translated transcripts and notes. In addition, SWOT analysis was used to identify the strengths, weaknesses, opportunities, and threats of hotel food waste management.

The second part of the research involved a search for effective guidelines in hotel food waste management using a case study with semi-structured interviews to collect data. Content analysis was conducted, interpreting the data in terms of the waste hierarchy approach. Triangulation of multiple data sources (interviews, reports, observations) was used to ensure that the data collected with the qualitative approach was trustworthy (Fusch et al., 2018; Yin, 2017).

4. Results

4.1. Food waste management occurring during the distribution process

a) **Executive policy:** The analysis revealed that 67.9% of the sampled large hotels have a continuous food waste management policy, while only 36.4% of medium and 16.7% of small hotels have a continuous food waste management policy, as shown in Table 1. The food waste management policies of these hotels mainly focused on cost control without taking into account environmental protection. Furthermore, a large proportion of hotels of all sizes, especially medium (83.3%) and small hotels (72.8%), lacked specific policies to encourage customers to reduce food waste. Most hotels focused on providing services and maintaining their image, trying to ensure that customers were satisfied during their stay. As stated by a hotel manager,

"We can't speak to customers about this issue, because the hotel is in a service industry. Customers have the right not to finish their food because they paid for it. If the hotel says something about this, it doesn't give a good image of the hotel."

However, one of the hotels had created a campaign to raise customer awareness by placing a sign in front of the restaurant to tell customers how much food waste was being generated each day or month and how much waste could be used to feed a person. This led to a shift in customer behavior without negatively affecting the image of the hotel. In addition, 67.9% of large hotels actively educated employees on food waste reduction, while 46.4% collected food waste data. These policies were much rarer in medium and small hotels, as shown in Table 1.

b) **Hotel operations planning:** Hotels of all sizes prioritized the purchase of raw materials for food production that were suitable for the quality, quantity, and price specified by hotel policy, including stock control. Planning to ensure that raw materials or inventory was not too low or overstocked was undertaken by 78.6%, 63.6%, and 83.4% of large, medium, and small hotels, respectively (Table 2). The reason for this is that hotel businesses are mainly concerned about the cost factor and try not to stock an excess of raw materials, which would lead to higher costs. At the same time, they avoid having a shortage of inventory, which would lead to insufficient food and would have a negative effect on the quality of service.

Large hotels had a large inventory of raw materials (stock control) because they had to import them from abroad, needed to provide goods and services to satisfy customer expectations, and had enough space to store them. On the other hand, medium and small hotels did not have as much stock control but planned the purchase of sufficient amounts of raw materials for daily use. These actions were mainly focused on controlling food costs, not on reducing food waste.

However, 69.8% of large hotels were making efforts to reduce food waste. In contrast, 59.1% of medium and 58.4% of small hotels had discontinued their operations to reduce food waste (Table 2). Large hotels that had been certified for environmental management standards in business operations had a purchasing style that was more meticulous and concerned with environmental impacts than other hotels. This involved actions like ordering trimmed vegetables and peeled fruits to reduce waste, as shown in the following statement:

"It's the environmental issue. Actually, in terms of cost, the costs are higher for us, because the pre-cut type is more expensive. We are worried about the cost, but we are also worried about the garbage. In order to maximize the use of everything, we probably have to accept a higher cost so that we don't have to throw anything away. It's worth the cost."

c) **Food storage:** Hotels of all sizes were aware of food storage procedures that prioritize food circulation. Thus, many hotels followed the principle of "First In First Out" (FIFO), including regularly checking food expiration dates. This was especially the case for large hotels that systematically and continuously stored food. As shown in Table 3, 82.1% of large hotels used FIFO, while 85.8% provided the right temperature or location to delay spoilage, and 89.3% regularly checked food expiration dates. Results demonstrate that hotels of all sizes had implemented food storage. Similarly, the information gathered from in-depth interviews to participants indicate a high degree of food storage implementation, as shown in comments like the following:

"The hotel follows the procedure of First In-First Out. It's the chefs' responsibility to check the expiration date of products. If an expired product is randomly detected, chefs will be warned."

d) **Food handling in the kitchen:** 75.0% of large hotels, 45.5% of medium hotels, and 50.0% of small hotels maximized the use of nearly expired food for cooking. Moreover, 71.4% of large hotels, 45.5% of medium hotels, and 41.7% of small hotels prioritized continuous “trimming” (Table 4), as illustrated by the following statement:

“We don’t peel vegetables and fruits too much. We keep the portions that are still usable. Anything that can’t really be used is discarded.”

In addition, in-depth interviews revealed that the planning of food menus was one mechanism used to control costs and reduce food waste in consumption and distribution. Large hotels had chefs with basic knowledge of the costs of raw materials used to produce food. Thus, they could plan food menus and suggest raw materials for replacements. Furthermore, they used raw materials at a seasonal price, based on their suitability for the guests using the service, as well as on the requirement of appropriate utensils and serving equipment. This facilitated the delivery of food and reduced food waste, while also having a psychological effect on customers. For example, using small dishes ensured that customers did not take too much food-

e) **Reuse operations:** Large hotels were more likely to reuse food through different means, such as giving excess food to employees (39.3%) or using cuttings to make new food products like kimchi or jam (60.7%) (Table 5). On the other hand, medium and small hotels did not reuse food so often. A chef in a large hotel commented on this process of reusing food:

“I have a degree in hotel management. When I studied, there was a lesson on how to make soup from fruit peel. Carrot peel and onion peel can be used to cook a European sauce.”

The study also found that very few hotels, regardless of size, offered a doggy bag service to customers bringing home the leftovers of their meals (Table 5).

f) **Donations:** The study found that 39.3% of large hotels, 50.0% of medium hotels, and 58.3% of small hotels did not donate excess food to external organizations, such as relief centers or temples (Table 6). One reason for this might be that they have to consider potential hygienic problems, such as causing food poisoning in recipients. Hotel food waste was donated on some occasions, but not regularly, as illustrated by the following statement:

“We rarely donate the excess of food. And if we are going to donate, we will cook new food.”

Table 8. One-way ANOVA results based on hotel size and the distribution processes of food waste management.

Distribution process	Mean			F	p
	Large-sized hotel	Medium-sized hotels	Small-sized hotels		
Policy	5.5*****	1.8***	1.9**	4.707*	.01
Planning	6.5*****	3.8***	3.9**	4.068*	.02
Food storage	6.3**	3.9**	4.5	3.553*	.03
Handling in kitchen	7.6**	4.6**	4.5	3.29*	.04
Reuse operations	5.6*****	2.8**	1.7***	4.321*	.01
Donations	3.2	1.6	1.1	1.926	.15
Food waste recycling	3.2	1.3	0.9	1.460	.24
Total process	5.4*****	2.8***	2.7**	4.293*	.01

*p < .05, ***** LSD (equivalent to no adjustments).

The study also found that 50.0% of large hotels, 63.6% of medium hotels, and 75.0% of small hotels did not donate food waste for animal feed (Table 6). The reason is that hotels have unnecessary burdens when donating or dealing with food waste buyers. Hence, most hotels chose to dispose of their food waste.

g) **Food waste recycling:** Most hotels of all sizes did not implement recycling. For instance, 71.4% of large hotels did not use food waste for fermentation into biogas, 67.9% did not use it to make compost, 67.9% did not make bio-fermented water, and 64.3% did not recycle the kitchen oil (Table 7). Results for medium and small hotels were similar. Interviews also showed that most hotels did not bring food waste for recycling.

“There is no waste separation, and we don’t use waste to make bio-fermented water. Food waste is just thrown away with other types of garbage.”

and

“Waste is not used to make compost or bio-fermented water. Actually, I would like to make bio-fermented water, because there is a bad smell coming from the drain when I cook a lot. I have studied that bio-fermented water can reduce the bad smell from the drain. But I don’t do it.”

To sum up, it was found that most large hotels continuously implemented all aspects of food distribution. Meanwhile, medium and small hotels only implemented food storage and handling. Very few hotels, regardless of size, implemented donation and recycling. In addition, the results of ANOVA show that there were significant variations between hotels of different sizes in the distribution process. In particular, the distribution process of large hotels has a higher mean than the distribution process of medium or small hotels. Additional LSD analysis was done to address that the mean score distribution process of large hotels is higher than medium hotels and small hotels, medium hotels are higher than and small hotels. Moreover, there were significant differences between large and medium hotels in terms of policy, planning, food storage, and handling in the kitchen. There were also significant differences between large and small hotels in terms of reuse operations. However, there were no significant differences between hotels of various sizes in terms of donation and recycling (Table 8). The next section presents a model of food waste management that illustrates the relationship between the hotel distribution process and the food waste hierarchy.

4.2. Guidelines for reducing food waste at Hotel A

While searching for an effective approach to food waste management in hotels with the method of qualitative case study, **Hotel A** was identified as one company that successfully manages its food waste.

1) **Purchasing food from the local community in proper amounts:** **Hotel A** procured food ingredients was different from other hotels that also bought their raw materials directly from farmers. Informants explained that they were able to determine the quality of the raw materials needed to obtain ingredients with the least amount of food waste. Moreover, they also bought agricultural raw materials produced through organic farming. The hotel also promoted knowledge and understanding of the benefits of planting organic vegetables among farmers, such as the safety benefits of using less chemicals. This helped to establish trust in the hotel’s commitment to purchase the products at the price set by the farmers. Moreover, by developing cooperation based on sustainability, fairness between both parties (hotel and farmers) could be checked. In this sense, the hotel was different from other hotels, as it communicated with its customers to enhance confidence. The hotel served organic food and the customers knew the source of the raw materials, who had planted them, with which production model, and with which planting steps. This helped to build consumer confidence.

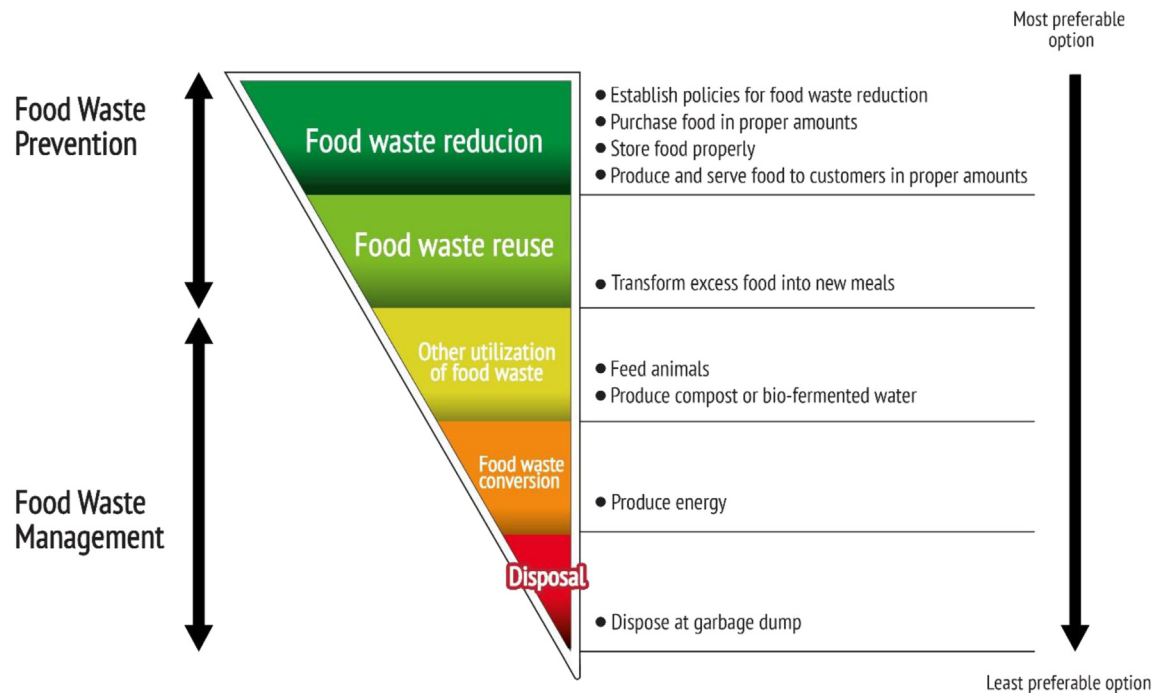


Figure 2. A model of food waste hierarchy in hotels modified from waste hierarchy. Source: Adapted from waste hierarchy (European Commission, 2008).

- 2) Storing food properly: The hotel used a standard storage method based on the FIFO system. This means that the materials and products that were stored first had to be used first. FIFO ensured that there was little food waste and few items were damaged during storage. This process needs to be strictly controlled and inspected to prevent spoilage due to expiration. This includes inspecting the packaging of raw materials for tearing, leaking, cracking, and rusting to prevent mistakes that may affect their quality and cost. In addition, chefs carried out regular inspections, including looking into the refrigerator. The chef and the officer responsible for raw materials worked together to reduce food waste.
- 3) Cooking: The hotel controlled production quality to ensure that the food served was fresh, tasty, and worth the price. They also focused on food production methods using seasonal organic ingredients that benefited the health of customers. The hotel used organic raw materials in about 80% of its ingredients, but bought the remaining 20% from the general market, in particular things like flavoring products, fish sauce, soy sauce, and meat.

The hotel focused on two other issues. First, they avoided cooking too much food by adjusting the quantities to the number of customers. This was conducted by adding 10% to the number of customers booked and stocking only a proper amount of food. Moreover, when they had to cook or stir-fry vegetables, they only prepared small portions and did not make too many backups. Additionally, employees understood that there was no need to prepare spare food because this increased costs. When there was excess food, it could be sold to staff and the money collected was kept as a welfare benefit for all employees. Additionally, the hotel adhered to standard management principles, such as using remaining food or food near expiration before using newly purchased food to prevent raw materials from spoiling, deteriorating, or expiring. The hotel generally purchased seasonal raw materials, but made adjustments if there was a shortage of materials. In this case, the hotel informed first their customers and this required a highly skilled chef. Another useful action was the trimming of raw materials to maximize profit and diminish waste.

- 4) Transforming excess food into a new type of food: The hotel's policy was to try to transform excess food into new types of food, such as vegetables to be put in bread. These new products were then tested. Only if they were good, they were served to customers. Many products from the farmers participating in the Hotel A's project were processed in this way. For example, the hotel used fresh pineapples to make pineapple juice, bananas to make Tom-Yum flavored chips, and grape and passion fruit to make jam.
- 5) Recycling: Waste from the distribution process or from plates amounted to about 140 kg of food per day. This could be recycled in a variety of forms depending on the type of food waste: (1) daily food waste could be composted into fertilizer to be used for the maintenance of the trees at the hotel; (2) food waste could be fermented with sweeteners, such as molasses, sugar, and honey, to produce bio-fermented water used to nourish the garden surrounding the hotel; (3) sour fruits could also be fermented to produce a multipurpose liquid used for cleaning, for example for scrubbing bathrooms or washing dishes; and (4) good quality food waste, such as vegetable scraps, were used as food for earthworms, whose cast was then dried or used fresh to add to fermenting, producing fermented earthworms that killed the fungi causing root rot. The study found that the various methods mentioned above could allow the hotel to reach zero food waste operations.

These methods may be synthesized in the model of food waste hierarchy shown in Figure 2. This depicts the various operations involved in the process of waste hierarchy from beginning to end. Besides helping the hotel to reduce food waste throughout its entire process, the implementation of the waste hierarchy also enhanced the image of the hotel as a business that conserved the environment and reduced food waste. A lot of evidence shows that conducting business in parallel with environmental conservation has a positive effect on promoting the image of companies.

The analysis of this hotel's food waste management process allowed us to identify opportunities to improve food waste management in other hotels. These findings are summarized in the SWOT analysis of Table 9.

Table 9. SWOT analysis of food waste management in hotels.

Strengths (S)	Weaknesses (W)
<ul style="list-style-type: none"> • Food waste reduction can reduce food costs. • Food waste reduction can create a socially and environmentally responsible image. • Chefs have skills for transforming excess food into new types of food. • Food waste reduction can reduce waste collection costs. • Compost from waste can be used in the hotel gardens as plant fertilizer. 	<ul style="list-style-type: none"> • Environmental concerns are not yet the primary consideration of hotels. • Chain hotels have very strict hygienic standards and centralized decision-making systems. • Hotels have a negative perception of food (fruit, vegetables, etc.) that is at or past the sell date or that is blemished. • Some hotels have improper storage facilities, such as lack of refrigeration, food waste storage space, or composting areas. • Some food waste reduction measures such as doggy bags can diminish the luxury image of hotels. • Food waste reduction demands more labor and awareness. • Composting causes odor problems and visual pollution.
Opportunities (O)	Threats (T)
<ul style="list-style-type: none"> • SDG 12.3 focuses on global food loss and waste. • Food waste reduction is an important point in the national agenda. • Reducing food waste attracts tourists concerned by environmental protection. 	<ul style="list-style-type: none"> • Environmental factors are not yet the primary consideration for consumers. • Emerging risks like the coronavirus pandemic cause unpredictable supply chain disruptions, leading to wasted food. • The throwaway culture and industrialized food system discourage behavior to prevent or reduce food waste.

4.3. Components of the successful implementation of food waste reduction operations at Hotel A

This study found that **Hotel A** has been continuously reducing food waste. The food waste reduction steps of this hotel are consistent with the food waste hierarchy concept shown in [Figure 2](#). An in-depth analysis of the **Hotel A** case was conducted in order to obtain empirical evidence for investigating the problems and success factors in reducing food waste. Several important factors contribute to the successful reduction of food waste:

- 1. Systematic operations:** Collecting food waste data for the purpose of analysis, planning, improvement, and development, especially from the perspective of the customers who use the service.
- 2. Raising awareness:** Raising awareness within the organization that food waste reduction is not the duty of a specific party but the duty of everyone who is connected to the hotel, including executives, chefs, and staff. Hotels should provide training on food waste to all employees. It should not be just the kitchen or the garden department taking waste for processing but all employees in various departments should know that the organization prioritizes such matters.
- 3. Promoting participation:** First, both employees and customers should participate in reducing food waste. In the case studied, there was a campaign aimed at reducing food waste in the employee's dining room and rewards were given to employees who ate up all their food (food lovers). There was also a campaign sign in the restaurant showing customers how much food waste was generated each day or month and how much waste could be used to feed a person. Second, executives need to be involved at every step. It helps to make them knowledgeable of all areas, from the sourcing of raw materials to the separation and utilization of food waste. Most importantly, they should be required to communicate clearly and concretely the management policies and to participate in the food

waste reduction actions of the hotel. Lastly, it is important to have a good partner to exchange food waste knowledge and practices.

5. Discussion

The findings of this research suggest that the model of food waste hierarchy ([Figure 2](#)) is a way to reduce food waste in operationally integrated hotels. This model reflects the reduction of food waste at every step of food distribution to enable hotels to implement a holistic and concrete approach. Furthermore, the results of phase 2 (section 4.2) clearly indicate that the management of food waste at the **Hotel A** follows a waste hierarchy strategy to achieve zero food waste. Zero food waste does not mean that there is no food waste generated in the hotel's distribution process; it only means that no food waste is being disposed in landfills. This case shows that hotel businesses can operate without disposing food waste in landfills if their operations are systematic, like the ones in many overseas hotels such as the Silo Hotel in Brighton, England ([Singh, 2017](#)). 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.

However, the implementation of some steps in these guidelines may be limited in certain areas. For example, although recycling and production of fertilizers is the last option in proactive food waste management, it is not popular in Europe due to the strict laws preventing the use of food scraps for animal feed services in countries like the United Kingdom as a result of a foot-and-mouth disease outbreak in 2001 ([Bates, 2016](#)). Also, the findings show that most medium and small hotels do not use food waste to produce compost, bio-fermented water, or biogas due to limitations such as lack of awareness, lack of workers, or lack of food waste storage space. This fits with the conclusions of a study conducted in Taiwan that showed that the adaptation process to become a green facility is difficult and has high costs for small hotels ([Chang et al., 2014](#)).

At the same time, the finding of phase 2 (section 4.2) also suggest that the model of food waste hierarchy can be used by hotels as a strategy to overcome these limitations, focusing on food waste prevention rather than composting and other waste management actions. This strategy can also motivate hotels to reduce food waste as a by-product of CSR actions. These actions involve taking responsibility for social and environmental problems that have already occurred ([Porter and Kramer, 2006](#)), helping local communities ([Ismail, 2009](#)) to create better lives for people ([Sharma, 2019](#)). Hotels can implement actions to reduce food waste at various stages of their operations, focusing on prevention before food waste problems occur, while at the same time controlling costs.

Furthermore, the findings indicate that CSR through food waste hierarchy should be conducted by all groups of stakeholders, including staff, raw material suppliers, customers, partners, and the local community. This is in line with sustainable CSR practices, which take into account all stakeholders rather than focusing only on the interests of the owners and shareholders of the organization ([Barić, 2017](#); [Morsing, 2006](#)). This is also a key strength of implementing food waste management using new concept. Moreover, this strategy demonstrates that social responsibility in the case of hotels is different from CSR processes that focus on donations. In hotels, CSR is mainly focused on the operations. It uses the potential and expertise of business owners to find and respond to concrete social problems, by taking operational actions that differ from competitors and have a positive impact on society. At the same time, such actions can create a competitive advantage for the business. For example, hotels may support the implementation of organic farming in suppliers and then go on to buy organic raw materials from the farmers at a guaranteed price. Food ingredients can also be bought already trimmed so that the discarded parts do not become food waste. An example of these practices is the opening of a market area in the **Hotel A** where local farmers could sell organic products every Saturday and Sunday. Such a market attracted around 1000 tourists a day, circulating approximately 2



Figure 3. A model of food waste management for supporting Corporate Social Responsibility.

million Baht per month, and generating an estimated income for farmers at the fair of 35,000 Baht per week (8 days of sales).

In summary, actions implemented according to these new concepts could promote the integration of the mission and social contribution of hotels by identifying points of intersection (Porter and Kramer, 2006, 2011) between the business, stakeholder groups, and the whole of society, while developing hotel business operations as inside-out linkages. This method creates economic growth that has a positive effect on the lives of people. Interestingly, hotels tend to address social issues that are related to their mission. Food waste management through hierarchies does not just contribute to society and the environment; it is at the same time good for business. This is a positive impact of CSR on the environment (Rhou and Singal, 2020) It reinforces the operational strategy of organizations, while promoting strategic philanthropy that creates a competitive advantage in social terms. It stems from the interrelations between society and businesses in the form of social impacts on the value chain, while minimizing the negative effects of hotel operations on society. These considerations can be synthesized in the model of food waste management for supporting Corporate Social Responsibility shown in Figure 3.

6. Conclusion

The present study contributes to the body of knowledge on waste hierarchy by considering how to use this model to reduce food waste, helping to address environmental problems and reduce costs (Figure 2). However, these benefits are not attractive enough to motivate hotel businesses to reduce food waste by using the waste hierarchy. The model proposed here allows us to explore successful hotel operations and highlights the key strengths derived from reducing hotel food waste at each step of food distribution. Furthermore, this model serves as a means

of disseminating good CSR practices and allows companies to take socially responsible actions without incurring in additional costs, which makes the strategic case for CSR more compelling (Figure 3). Social responsibility is implemented by creating shared value (CSV) with the primary goal of combining business with social values (Porter and Kramer, 2011).

7. Limitation and future research

This study was limited by the scarcity of information obtained from the questionnaires. Accessing hotels in the sample and getting them to provide information was very difficult. Selected informants had a busy schedule and did not have time to give information or did not dare to do it without permission from the hotel's management team, as they were afraid of potential problems in the future. Although the key informant in the case study provided useful insights, future research should include quantitative studies in order to verify and confirm these concepts and to obtain additional empirical evidence of successful experiences.

Declarations

Author contribution statement

Dr. Patranit Srijuntrapun: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Dr. Patinya Sukwong: Conceived and designed the experiments; Performed the experiments; Wrote the paper.

Dr. Alan Marshall: Analyzed and interpreted the data; Wrote the paper.

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The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

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