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Research article

The Influence of Managerial and Operational Characteristics on Food Waste Reduction Practices Among the Restaurants Along the Andaman Coast of Thailand

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Abstract: The food service sector plays a substantial role in the food waste creation. Restaurants in Thailand, driven by tourist demand, substantially contribute to food waste. This study analyzes the managerial and operational attributes influencing restaurants' practices for reducing food waste in Thailand's Andaman coastal region. This quantitative research uses the Waste Hierarchy framework to investigate restaurants' food waste practices. Independent variables are divided into two categories: 1) Manager Characteristics, and 2) Restaurant Characteristics. In total, 353 questionnaires were distributed using proportional allocation. The data were collected via simple random sampling and analyzed using logistic regression. The results indicate that restaurants demonstrated a high level of compliance with prevention practices; however, they showed substantially lower adoption of reuse and recycling practices. The logistic regression models revealed that personal factors (education, age, interest in food waste reduction, and restaurant experience), along with the number of meals served at the restaurant, significantly influence food waste practices. The multiple logistic regression model showed a good fit (model chi-square = 72.78, df = 6, $p < .0001$) and explained 25.2% of the variance. This study offers valuable insights and practical implications by highlighting that manager characteristics, rather than operational attributes, are important in shaping food waste reduction. This insightful information can be used to design and implement policies on human capacity development related to food waste reduction.

Keywords: Food waste management; food waste reduction; hospitality waste; Thai restaurants; the Andaman Coast of Thailand

1. Introduction

Food waste is a global societal issue, and reducing it is one of the Sustainable Development Goals (SDG 12.3) [1]. The 2024 food waste index report from the Food and Agriculture Organization (FAO) of the United Nations and the United Nations Environment Programme (UNEP) [2] revealed that about 19% of all food produced, or approximately 1.05 billion tons, is wasted. Of this total, 60% is household food waste, 28% is from the food service sector, and 12% is from retail. In Thailand, food waste is a significant issue, accounting for about 64% of total municipal solid waste [3]. This substantial amount of organic waste

consists of food waste, with each Thai person producing an average of 86 kilograms annually, or approximately 0.2 kilograms daily [3], exceeding the global average of 79 kilograms per person per year [2]. The excessive edibles discarded cause negative implications for the economic, social, health, and environmental dimensions [4], such as the high cost of waste management [5]; the paradox of food wastage in the presence of starvation and malnutrition [4]; and the increase of global greenhouse gas (GHG) emissions [2]. All challenges highlight the importance of empirical research into the determinants of food waste mitigation, especially in the foodservice industry, which contributes significantly to consumer-generated food waste [6].

Food waste is characterized as the reduction in the quantity or quality of consumable food resulting from the choices and actions of food producers and consumers [7]. Food waste happens throughout the food supply chain process [8], from agricultural production [9] to final household [10-11] or hospitality (out-of-home) consumption [12-13]. The majority of food waste studies have focused on households, while research within the hospitality industry remains limited [4]. Furthermore, most research on food waste management in hospitality has been conducted in developed countries [14]. Consequently, academic research on food waste management and practices requires more diversity. More theory-driven studies are needed, particularly on the factors influencing pro-environmental behavior among hospitality and foodservice stakeholders [15], especially in developing countries such as ASEAN nations [16].

Tourism is a crucial driving force of the Thai economy. The World Bank's Thailand Economic Monitor [17] forecasts that visitor arrivals will rise to 41.1 million in 2025, surpassing pre-COVID-19 levels. Particularly, the Southern Region of Thailand, especially the Andaman Coast, is a significant component of the national economy. It has the highest percentage of international visitors, at about 50.1%, compared to the central (about 18.8%) and northern (around 12.5%) regions [47]. Consequently, there is greater concern about food waste generated by hospitality and foodservice provisions within the tourism industry, particularly in restaurants and catering, due to the growing number of tourists. The complex nature of the hotel and restaurant industry influences various food waste management practices [14]. The food waste hierarchy—a framework to identify and prioritize strategies for minimizing and managing food surplus and waste—is extensively utilized in waste management [18, 48]. However, there are only a few studies on food waste management within the hospitality and foodservice sectors, especially in a developing economy like Thailand. Kattiyapornpong et al. [13] is one of the few recent studies to highlight the food waste hierarchy for five-star hotels and restaurants in Thailand, demonstrating sustainable food waste management and corporate social responsibility. Recent research by Koiwanit and Filimonau [6] reveals that Bangkok restaurant managers view food waste mitigation as the norm, based on frequent personal observations, peer reports, and media coverage. However, there is a need to investigate other relevant factors, such as the personal attitudes of restaurant owners or managers who are responsible for the development and implementation of business strategies and operations [16].

The 20-year strategy (years 2018–2037) of Thai national policies emphasizes zero-waste management, believing that waste has economic value and can be reused and that it is essential to minimize waste and its disposal through effective technology [19]. The Andaman Coast region of Southern Thailand was selected as the pilot study area for its natural ecological beauty and unique culinary offerings. These distinctive features serve as a major attraction for both domestic and international eco- and food-culture tourists. Local restaurants play a significant role in tourism, which, in turn, leads to an increase in food waste. There are 4,064 registered food establishments in the five provinces of the Andaman Coast; specifically, Phuket has the highest number of registered restaurants, totaling 3,308, followed by Krabi with 506 establishments [20]. Consequently, this research aims to address the need for more theory-driven investigations into the factors that influence food waste mitigation. The research objectives are to examine the characteristics of managers and restaurants that influence food waste practices along the Andaman Coast of Thailand. Specifically, this study examines the demographics of restaurant managers or owners and restaurant operational settings in the food waste hierarchy practices of restaurants located in the Andaman coastal area, a major tourist destination in Thailand. The findings will inform practical guidelines and recommendations for restaurants and relevant agencies to develop strategic planning and policies that facilitate food waste reduction. This study provides useful insights

to aid relevant stakeholders, including governments, businesses, and local hospitality entities, in more effective food waste management.

2. Literature Review

The Food and Agriculture Organization of the United Nations (FAO) [21] (p. 2) defines "food waste" (FW) as "the decrease in edible food occurring at the end of the food chain (retail and final consumption), which relates to retailers' and consumers' behavior." Normally, food waste from the hospitality and food services sector (HaFS) is organic waste generated by immediate consumption outside the home, including hotels, restaurants, catering, healthcare, and education [22]. Food waste from the HaFS encompasses any food discarded during processing, including peels from preparation, waste from serving dishes, and leftovers from guests' plates [23].

2.1 Theoretical Framework: The Waste Hierarchy in Food Management

The theory of waste hierarchy, originating in 1979, provides a structured prioritization for sustainable waste management through five key levels: prevention, reuse, recycling, recovery, and disposal [24]. Researchers and practitioners have developed, adopted, and adapted the waste hierarchy principles as general guidelines for waste prevention and sustainable waste management [13, 24]. However, limited research has applied this framework to food waste management in the hospitality sector [13]. The food waste hierarchy can enable hospitality businesses to implement effective food waste management strategies to prevent food waste generation, recycle food waste, and maximize the efficiency of food use [25]. The waste hierarchy, therefore, can serve as a strategic guide that helps hospitality businesses manage their food waste more sustainably. Specifically, the food waste hierarchy (FWH) prioritizes options for waste management based on their environmental, economic, and social sustainability by establishing a clear order of preference: prevention, through minimization of food surplus and avoidable waste, is the most sustainable choice, followed by the redistribution of surplus to food-poor groups and the conversion of food waste into animal feed [48]. In addition to reducing food waste at the sources, lowering food costs, and safeguarding the environment in the hospitality and food services sector (HaFS), the FWH is an important instrument for cost control and corporate social responsibility (CSR) [49].

2.1.1 Prevention: The Role of Managerial Characteristics

The literature has identified various factors influencing the food waste reduction in the HaFS. The human element is the key element in the hospitality industry and strongly dictates the most desirable tier of the waste hierarchy—prevention. Several studies have identified that personal characteristics of restaurant managers impact food waste reduction practices. The literature suggests a strong consensus that educational background and age are primary drivers of waste reduction awareness. For example, higher levels of education consistently correlate with improved waste separation and heightened recycling behaviors across both Thai and Chinese hospitality contexts [11, 26, 27]. Specifically, older individuals prioritize resource efficiency and the reduction of unnecessary food waste [11, 31], which is attributed to their distinct attitudes and understanding of food value [32-34]. However, Lang et al. [35] found that younger restaurant owners exhibited greater awareness of food waste recycling than older restaurant owners in Gansu Province, China. Research also indicates that learning and self-development contribute to reducing waste generation in restaurants and households [10, 28-30]. The literature also identifies that interest in reducing food waste and working experience are essential for the effectiveness of food waste management in the hospitality service industry. Internal factors, particularly the degree of interest and sustainability knowledge among managers and employees, are essential to the implementation of waste reduction methods. Prior studies have shown that strong interest and comprehensive awareness of sustainability significantly improve proactive waste-reduction practices in the restaurant sector [11, 27, 36, 37]. Work experience in the restaurant industry also plays a crucial role. Recent research found that managers or restaurant owners with extensive experience usually have effective communication and motivation skills that help staff understand how to reduce food waste, especially in planning, buying, managing inventory, purchasing, controlling inventory, and adjusting menus to utilize surplus or near-expiry ingredients [38], as well as promoting recycling food-waste behavior [27].

2.1.2 Operational Context and Implementation

In the context of FWH's focus on reuse and recycling, several studies have indicated that the physical and operational characteristics of the restaurant establishment impact waste management practices. For example, the size of a restaurant influences its awareness and behavior related to food waste recycling [27]. Furthermore, restaurants offering multiple meals per day are typically well-planned to reduce food loss and waste [39-41]. However, research in the Thai hospitality industry indicates that although managers may wish to implement recycling initiatives, the absence of local waste management infrastructure in certain areas often leads businesses to rely on less sustainable disposal practices [49]. This issue is especially important for businesses located on the coast or on an island, where logistical challenges make it harder to redistribute food surpluses [14]. While there is no evidence linking award-winning restaurants to food waste reduction, various award schemes, including the Michelin Green Star and Food Made Good awards, incorporate waste reduction into their evaluation criteria [42].

While the waste hierarchy in the HaFS is theoretically robust, its practical application in the tourism environment's geographic context remains underexplored. Most studies focus on stable urban environments, ignoring the unique geographic context of coastal tourism and the influence of personal and operational factors in the food waste hierarchy. Based on the reviewed literature, Figure 1 summarizes and illustrates the variables and hypotheses used to investigate factors influencing restaurants' food waste reduction. Specifically, the selection of the variables was based on established food waste and hospitality literature, ensuring they represent both the human (managerial) variables, including age [11, 31 - 35], education [10, 11, 26, 27, 29, 30], work experience [27, 36, 38], and interests in learning about waste reduction [11, 27, 36 - 38], and operational (restaurant) attributes, including location [14], period of operation [50], number of employees [27], number of meals served [39 - 41], and awards received [42].

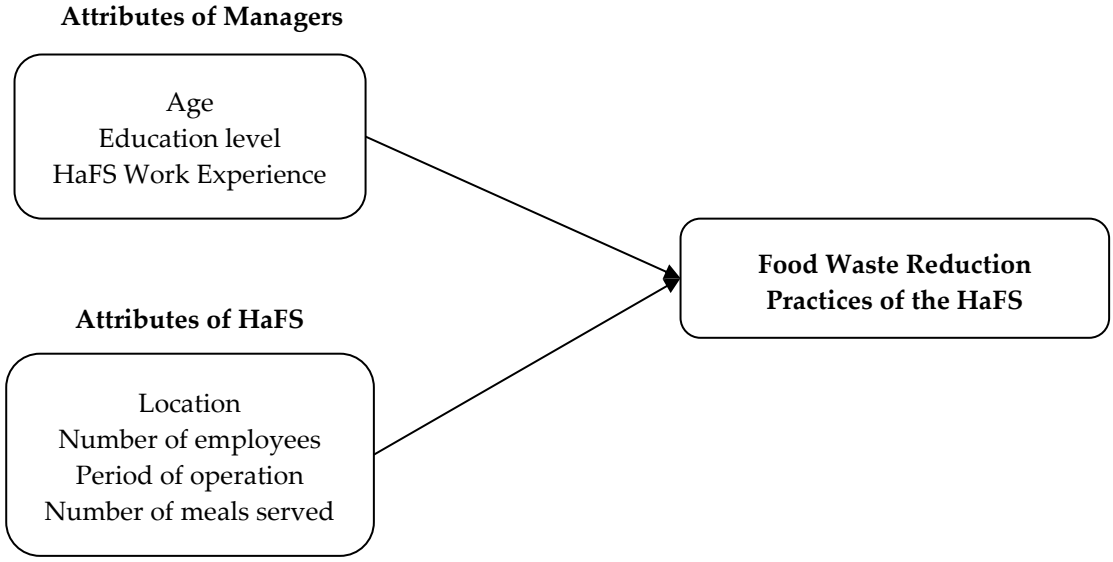

Figure 1. Research Framework of the manager's and restaurant's characteristics influencing the HaFS's food waste reduction practices.

3. Methods

3.1 Research Design

The principles of the waste management hierarchy have been widely applied as a framework for waste reduction strategies [43]. Recently, Kattiyapornpong et al. [13] adopted this framework to investigate food waste management practices among five-star hotels in Bangkok, Thailand. Accordingly, this research adopts these principles as the theoretical framework to investigate the influence of food waste reduction on various

restaurants along the Andaman coast in Southern Thailand. Table 1 illustrates the waste hierarchy concept in waste management and the practices used in HaFS food waste management.

Table 1. The waste hierarchy with the practices of food waste management of the HaFS

The waste hierarchy concept	Practices of the HaFS's food waste management
Reduce: Prevent food waste.	**Policy:** The food waste management policy includes awareness programs, staff training, and clear duty delegation. **Planning:** The process of planning food waste reduction and purchasing to limit food loss through effective procurement management. **Storage and preservation:** The process of storing and preserving food helps minimize food loss due to expiration. **Operation:** Activities related to food preparation, customer services, and earnings that influence food waste control and management efficacy.
Reuse: Redistribution for human consumption.	**Donation for humans:** The restaurant donates the excess food or raw materials suitable for human consumption to local charities or their staff.
Animal feed	**Donation for animal feed:** The restaurant donates the food waste as animal feed.
Recycle: Extraction of compounds of interest; Industrial use; Anaerobic digestion; Composting; Thermal treatment with energy recovery.	**Utilization within the restaurant:** The process of applying controlled processing techniques to food waste to recover residual material, biological value, or energy value
Disposal: Thermal treatment without energy recovery/landfill	**Budgets and expenses for food waste disposal:** The restaurant establishment's budget and actual costs for the collection, transportation, treatment, and ultimate disposal of food waste are referred to as food waste disposal budgets and expenses. **Disposal:** The process of the collection, transportation, and final treatment through landfill or incineration without energy recovery. Thai restaurants do not manage waste on-site; their involvement is limited to budgeting for bins and paying disposal fees to the LAOs [51].

[1] This framework is adapted from Garcia-Garcia et al. [43] and Kattiyapornpong et al. [13].

3.2 Data Collection

This study used a quantitative research design and a Thai-language questionnaire. The questionnaire consisted of three parts. The first two parts reflected the independent variables. The first part consisted of four variables: age, education level, restaurant work experience, and interest in learning about food waste reduction. In the second part, the questions reflected the attributes of HaFS, which consist of five variables: location, period of operation, number of employees, number of meals served, and general awards received. The last part of the questionnaire measured the dependent variables, namely food waste reduction practices. The questionnaires were crafted as checklist questions according to the three-dimensional framework of waste management prioritization: 1) reduction, 2) reuse and recycling, and 3) disposal. Additionally, the survey was developed based on the HaSF's practices for managing food waste, encompassing all three dimensions: Prevention and Reduction (Policy, Planning, Storage and Preservation, and Operation); Reuse and Recycling (Donation and Reuse); and Budgeting and Expenditure for the management and disposal of food waste. The questionnaire survey was submitted to the Songkhla Rajabhat University Human Research Ethics Office and

was approved under Order 045/2023, effective from 8 December 2023 to 7 December 2024. Three environmental specialists carry out content validity testing of the questionnaire. 30 sets of questionnaires were sent to a sample group that did not originate from the target areas to test reliability. The reliability value was then calculated using the alpha coefficient formula according to Cronbach's alpha method, yielding a score of 0.7. The data were collected from representatives of employees and restaurant owners who registered as legal entities, one individual per restaurant in the provinces of Satun, Krabi, Trang, Phang Nga, and Phuket. The total number of restaurants in the area was 4,064, of which the majority are small- and medium-sized businesses (SMEs) [20]. A sample size was therefore estimated using the Krejcie and Morgan [54] table and a quota sample equivalent to the entire population of 360. The samples were chosen using simple random sampling, which was conducted by drawing lots and by recruiting volunteers. The questionnaires were collected both online and on-site; 353 questionnaires (98%) were returned. Data was collected proportionally, with Phuket having the highest number of restaurants at 3,308, or about 81.4% of the total number of the Andaman coastal restaurants [20]. In this study, 293 restaurants were included (83%); followed by Krabi, the second-highest number of restaurants at 506; and 45 restaurants were used as samples (11%). The rest of the sample group is from Phang Nga, Trang, and Satun. 12 samples came from Phang Nga (3%), while Trang and Satun contributed 1% each (4 and 6 samples, respectively). Additionally, the participants were small- and medium-sized restaurants that served dishes on demand rather than buffet style.

3.3 Data Analysis

The independent variable consists of two main parts: the attributes of managers and the attributes of the HaFS (restaurant). The dependent variable is food waste reduction practices. Questions related to food waste reduction practices are multiple-choice. If the answer is "Yes or often/regularly" = 1, and if the respondent marks "No or sometimes" = 0. The score for the food waste reduction practice is calculated from 46 questions related to seven food waste management practices across the three aspects of the waste hierarchy. The criteria for good practice are set at 1, while the non-practice score equals 0. Table 2 shows the scores for each item, determined using criteria set by three experts in environmental management and tourism. The results were analyzed using descriptive statistics and a two-step statistical analysis (simple logistic regression and multiple logistic regression) in R to identify the most influential attributes. Specifically, a simple logistic regression was conducted to examine each managerial and restaurant characteristic (independent variables) in relation to food waste management (dependent variable). Variables that showed statistical significance were then entered into a multiple logistic regression to combine factors and determine predictive models for specific characteristics.

Table 2. Criteria for assessing the practice of food waste management

Waste Hierarchy Concept	Practice of Food Waste Management
Reduce: Prevention of food waste generation (31 Items)	1. Policy: (12 Items): practice score = 1 (if total score = 6) 2. Planning: (4 Items): practice score = 1 (if total score = 2) 3. Storage and preservation: (5 Items): practice score = 1 (if total score = 3) 4. Operation: (10 Items): practice score = 1 (if total score = 5) Total score >= 2
Reuse/Recycle: Redistribution for human consumption/animal feed and Extraction of compounds of interest (12 Items)	5. Donations: (8 Items) practice score = 1 (if total score = 4) 6. Utilization within the restaurant (4 Items): practice score = 1 (if total score = 2) Total score >= 1
Disposal: landfill (3 Items)	7. Budgets and expenses for disposal: (3 Items): practice score = 1 (if total score = 3)

[2] *overall practice score =1 (if total score >= 4)*

Notes: 4 scores or above are needed for overall calculation, with conditions as follows:

A score over 50% is required in either question 1, 2, 5, 6, or 7.

A score over 50% in numbers 3 and 4.

4. Results and Discussion

4.1 The Practice of Waste Reduction Within the Waste Hierarchy

The results, illustrated in Table 3, present the research findings on practices for reducing food waste according to the food waste hierarchy, based on the analysis of managers' and HaFS's attributes. Two factors were utilized to examine the impact on practices for managing food waste based on the analysis of the sample group's independent variables: 1) attributes of managers, which include four factors: age, education level, HaFS work experience, and interest in learning about waste reduction; 2) attributes of HaFS, which include five factors: location, period of operation, number of employees, number of meals served, and general awards received. The dependent variable in this study is the practice of reducing food waste. Table 3 displays the research findings on practices for reducing food waste. The variable in the prevention aspect is in the range of 76.19 to 98.33 percent, moving in the same direction. Regarding the factors of recycling and reuse, the proportion of restaurants that are engaged in these practices varied by variable, ranging from 0 to 33.33 percent. Restaurants with more than 25 employees had the highest number of practices for reducing food waste in this category, accounting for 33.33 percent of the total. However, in the disposal aspect, the study found that none of the restaurants followed any procedures.

These research findings show that most restaurants actively practiced food waste prevention, while reuse and recycling were limited. The most critical factor driving food waste prevention practices in restaurants along the Andaman Coast, perhaps, is the unique local context of abundant and accessible resources. Specifically, food waste is due to poor ingredient purchasing and storage. Food preservation and storage include checking ingredient expiration dates, cleaning food storage areas, arranging food using the 'first-in, first-out' principle, and storing ingredients/food in suitable locations and at appropriate temperatures. The restaurants used the following procedures: trimming ingredients, adjusting menus to use similar ingredients, providing unserved excess cooked food to staff, offering takeout bags to customers, and generating income from food waste, such as shrimp heads. Finally, the average waste per day is about 20-30 kg for 37% of the sample restaurants (131 restaurants), followed by less than 10 kg of food waste in 33% of the samples (118 restaurants), and 10-20 kg for 84 restaurants, which is 23% of the sample group. The remaining restaurants had more than 30 kg of food waste daily. Nonetheless, no disposal practices at the restaurants were reported because the restaurants pay disposal fees to the LAOs. This finding aligns with that of Kattiyapornpong et al. [13], highlighting the critical role of food planning and the procurement of raw materials from local suppliers in reducing food waste. The abundant local supply from both the sea and the land, along with daily access to markets, allows managers to make daily purchases of fresh local ingredients. This daily purchasing eliminates the need to stock or store raw materials, reducing spoilage risk and reducing storage requirements.

Unlike hotel-owned restaurants, which comply with the food waste hierarchy model for food waste reduction as common practice [13], waste disposal practices in typical restaurants in Thailand are fundamentally shaped by the waste management system of local administrative organizations (LAOs), which are responsible for trash collection [51]. The restaurants do not manage waste on-site; their involvement is limited to budgeting for bins and paying disposal fees to the LAOs. Furthermore, the cost of publicly provided waste services is substantially lower than installing on-site disposal systems. Furthermore, over 90% of restaurants prioritize prevention, and thus, the volume of waste to be disposed of is minimal, supporting the prior studies by Ng and Sia [16] in ASEAN and China settings and by Srijuntrapun et al. [49] in Thai restaurants. Therefore, these findings reflect the contextual situation of Thai restaurants regarding the absence of the practices of reusing, recycling, and disposing of food waste.

Table 3. The practice of waste reduction within the waste hierarchy is separated by the restaurant's managerial and operational attributes.

variables	prevention				Reuse/recycle				disposal		overall			
	Non-practice		practice		Non-practice		practice		Non-practice		Non-practice		practice	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Attributes of Managers														
Age														
29-44 Year (Gen Y)	15	6.41	219	93.59	214	91.45	20	8.55	234	100	167	71.37	67	28.63
>45-60 Year (Gen X)	11	9.24	108	90.76	114	95.80	5	4.20	119	100	47	39.50	72	60.50
Education Level														
Below Bachelor degree	11	7.90	142	92.81	144	94.12	9	5.88	153	100	109	71.24	44	28.76
Bachelor's degree & above	15	7.50	185	92.50	184	92.00	16	8.00	299	100	105	52.50	95	47.50
HaFS Work Experience														
< 5 years	6	5.94	95	94.06	98	97.03	3	2.97	101	100	74	73.27	27	26.73
5-10 years	10	6.13	153	93.87	149	91.41	14	8.59	163	100	89	54.60	74	45.40
> 10 years	10	11.24	79	88.76	81	91.01	8	8.99	89	100	51	57.30	38	42.70
Interest in learning about waste reduction														
Not interested	11	6.11	169	93.89	169	93.89	11	6.11	180	100	121	67.22	59	32.78
Interested	15	8.67	158	91.33	159	91.91	14	8.09	173	100	93	53.76	80	46.24
Attributes of HaFS														
Location														
Island and land	2	4.65	41	95.35	33	76.74	10	23.26	43	100	17	39.53	26	60.47
land	24	8.00	276	92.00	285	95.00	15	5.00	300	100	188	62.67	112	37.33
island	0	0	10	100	10	100	0	0	10	100	9	90	1	10
Period of operation														
< 5 years	24	9.45	230	90.55	238	93.70	16	6.30	254	100	151	59.45	103	40.55
5-10 years	1	1.67	59	98.33	54	90.00	6	10.00	60	100	43	71.67	17	28.33
> 10 years	1	2.56	38	97.44	36	92.31	3	7.69	39	100	20	51.28	19	48.72

Table 3. The practice of waste reduction within the waste hierarchy is separated by the restaurant's managerial and operational attributes. (Continue)

variables	prevention				Reuse/recycle				disposal		overall			
	Non-practice		practice		Non-practice		practice		Non-practice		Non-practice		practice	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Attributes of HaFS														
Location														
Number of employees														
Large (> 25 persons)	10	23.81	32	76.19	28	66.67	14	33.33	254	100	24	57.14	18	42.86
Medium (10-25 persons)	16	5.56	272	94.44	281	97.57	7	2.43	60	100	179	62.15	109	37.85
Small (< 10 persons)	0	0	23	100	19	82.61	4	17.39	39	100	11	47.83	12	52.17
Number of meals served														
2 meals per day	24	7.23	308	92.77	312	93.98	20	6.02	332	100	208	62.65	124	37.35
3 meals per day	2	9.52	19	90.48	16	76.19	5	23.81	21	100	6	28.57	15	71.43
General Award Receive														
Non-receive an award	17	7.83	200	92.17	206	94.93	11	5.07	217	100	131	60.37	86	39.63
Receive an award	9	6.62	127	93.38	122	89.71	14	10.29	136	100	83	61.03	53	38.97

[3]1 refers to the age from Strauss and Howe [44].

4.2 Managerial and Operational Factors Influencing the HaFS's Practices of Food Waste Management using Simple Logistic Regression

Using simple logistic regression, the findings regarding factors influencing HaFS's food waste management practices fall into two categories: managers' attributes and restaurants' attributes. Details are shown in Table 4.

Table 4. The managerial and operational variables affecting restaurants' practices to reduce food waste using simple logistic regression.

Variable	b	se. of b	Wald	z	p-value	OR.	95% CI of OR.	
							Lower	Upper
Attributes of Managers								
Age[1]								
29-44 Year (Gen Y)	-	-	-	-	-	1	-	-
>45-60 ปี (Gen X)	1.3398	0.2368	32.011	5.658	0.0001***	3.82	2.41	6.11
Constant	-0.9133	0.1446	-	-6.315	0.0001***	0.40	0.30	0.53
Education								
Below Bachelor degree	-	-	-	-	-	1	-	-
Bachelor degree & above	0.8071	0.2279	12.538	3.541	0.0003***	2.24	1.44	3.52
Constant	-0.9072	0.1786	-	-5.079	0.0001***	0.40	0.28	0.57
Interested in waste reduction								
Not interested	-	-	-	-	-	1	-	-
interested	0.5677	0.2202	6.649	2.579	0.0099 **	1.76	1.15	2.72
Constant	-0.7183	0.1588	-	-4.523	0.0001***	0.49	0.36	0.66
HaFS work experience								
< 5 years	-	-	-	-	-	1	-	-
5-10 years	0.8237	0.2744	9.0109	3.002	0.0026**	2.28	1.34	3.95
> 10 years	0.7140	0.3106	5.2844	2.299	0.0215*	2.04	1.12	3.78
Constant	-1.0082	0.2248	-	-4.484	0.0001***	0.36	0.23	0.56

Table 4. The managerial and operational variables affecting restaurants' practices to reduce food waste using simple logistic regression. (Continue)

Variable	b	se. of b	Wald	z	p-value	OR.	95% CI of. OR	
							Lower	Upper
Location								
Island and land	-	-	-	-	-	1	-	-
Land	-0.9428	0.3340	7.9679	-2.823	0.0048	0.39	0.20	0.74
Island	-2.6221	1.0992	5.6904	-2.385	0.0171	0.07	0.01	0.44
Constant	0.4249	0.3119	-	1.362	0.1731	1.53	0.84	2.87
Period of operation								
< 5 years	-	-	-	-	-	1	-	-
5-10 years	-0.5454	0.3137	3.0227	-1.739	0.0821	0.58	0.31	1.06
> 10 years	0.3313	0.3449	0.9227	0.960	0.3369	1.39	0.70	2.75
Constant	-0.3826	0.1278	-	-2.994	0.0027**	0.68	0.53	0.87
Number of employees								
Large (> 25 persons)	-	-	-	-	-	1	-	-
Medium (10-25 persons)	-0.2084	0.3346	0.3879	-0.623	0.5340	0.81	0.42	1.58
small (< 10 persons)	0.3747	0.5210	0.5172	0.719	0.4720	1.45	0.52	4.09
Constant	-0.2877	0.3118	-	-0.923	0.3560	0.75	0.40	1.37
Number of meals served								
2 meals per day		-	-	-	-	1	-	-
3 meals per day		0.4962	8.347	2.889	0.0039 **	4.19	1.66	12.02
Constant	-0.5173	0.1135	-	-4.559	0.0001***	0.60	0.48	0.74
Receive General Award								
Non-Receive an award	-	-	-	-	-	1	-	-
Receive an award	-0.0277	0.2240	0.0153	-0.124	0.9010	0.97	0.63	1.51
Constant	-0.4209	0.1388	-	-3.032	0.0024**	0.66	0.50	0.86

[4]*p < .05; **p < .01; ***p < .001

4.2.1 Attributes of Managers

There were four independent variables: age, education level, HaFS work experience, and an interest in learning about food waste reduction (Table 4). The results showed that all variables influenced the dependent variable, practices for reducing food waste, as hypothesized. Specifically, the variable of restaurant managers' educational level influenced food waste reduction practices. The group with a bachelor's degree or higher reduced food waste by 2.24 times more than the group with a lower education level, a statistically significant difference (p-value < .05; 95% CI of OR = 1.44-3.52). Specifically, the findings indicated that managers' education level substantially impacted food waste reduction initiatives. The results align with the studies by Bunditsakulchai and Liu [11] and Zhu and Liu [26], which indicate that higher levels of education lead to better food waste separation. In addition, managers' age also influences their practice of food waste reduction. The study found that the group aged 45-60 years (GenX) practiced reducing food waste 3.82 times more than the group under 45 years (GenY), which was statistically significant (p-value < .05; 95% CI of OR = 2.41-6.11) (Table 4). This finding aligns with the literature (e.g., 31, 33-34), which consistently indicates that older people generate less food loss. Bunditsakulchai and Liu [11] emphasized that this older generation values a traditional social norm regarding food, developed through family, educational, and societal institutions, thereby establishing the behavioral basis for reducing food waste among older adults. Therefore, older-generation managers are more likely to achieve reductions in food waste than younger managers.

As for the variable of interest in learning about food waste reduction, Table 4 showed that the interested group had a statistically significant effect on reducing food waste, with an effect size 1.76 times greater (p-value < .05; 95% CI of OR = 1.15-2.72) than those who were not interested. Recent studies conducted by Fatemi et al. [28] and Uzoma et al. [30] also found that self-directed learning and personal growth significantly impact food waste reduction in both domestic and restaurant settings. Willingness to learn [45] and implement sustainable practices (e.g., food preparation and preservation, reusing and repurposing during cooking, designing menus to minimize preparation time, offering appropriate portion sizes, and reducing plate waste) fosters responsible food behaviors [13, 45]. This suggests that managers who are interested in and willing to learn about food waste reduction can be more effective at implementing practices to reduce food waste than those who are less interested or unwilling to learn. When restaurant managers show a strong interest in and dedication to reducing food waste, they are more likely to cultivate an organizational culture that promotes responsible consumption. Importantly, work experience in the restaurant industry significantly influences practices for reducing food waste, according to the research findings. The group with 5-10 years of restaurant work experience and the group with more than 10 years of restaurant work experience influenced practices for reducing food waste 2.28 times and 2.04 times that of the group with less than 5 years of restaurant work experience, respectively, with statistical significance (p-value < 0.05; 95% CI of OR = 1.34-3.95 and 1.12-3.78) (Table 4). This finding corresponds with Lévesque et al. [38], who observed that experienced managers effectively encourage teams, manage inventory, and formulate menus for sustainable food. Research conducted by Hayeebueraheng and Phanthuwongpakdee [36] and Zhao et al. [27] reports similar patterns. In summary, the managerial role is held by either the direct owner or a designated representative with the authority to set the strategic direction for the establishment. Therefore, prioritizing the selection of restaurant managers (i.e., education level, age, interest in learning about waste reduction, and work experience) is a crucial consideration for restaurant owners, as the manager determines the operation, particularly food waste reduction practices.

4.2.2. Attributes of the HaFS

Regarding restaurant attributes, there are five independent variables: period of operation, location, number of employees, number of meals served, and general awards received. The study results presented in Table 4 indicated that only the number of meals served has a significant impact on food waste reduction, as hypothesized. Specifically, selling three meals per day increased food waste reduction practices by 4.19 times

compared with restaurants serving two meals per day, a statistically significant difference (p-value < 0.05; 95% CI of OR = 1.66-12.02). The remaining variables did not influence waste reduction practices (Table 4). This finding aligns with the previous studies (e.g., 39, 40-41), which suggests that restaurants offering a variety of meals are more likely to implement systematic planning strategies to reduce food waste. The lack of significance for location suggests that waste reduction for greater sustainability has become common in the tourism and hospitality industry [14], regardless of where the restaurant is located. The insignificance of the operation period is consistent with the descriptive findings that over 90% of all restaurants excel at prevention (efficiency). This finding also suggests a 'ceiling effect' where the prevention leaves minimal waste available for reuse or recycling. Unexpectedly, contrary to previous studies such as Zhao et al. [27], the size of restaurants did not significantly influence food waste practices in this research finding. Although several award programs incorporate waste reduction in their evaluation criteria [42], achieving award-winning status did not correspond with the implementation of food waste reduction practices. The absence of significant relationships in this study may reflect contextual differences, such as variations in restaurant size or resource availability along Thailand's Andaman coast.

4.3. Managerial and Operational Factors Influencing the HaFS's Practices of Food Waste Management using Multiple Logistic Regression

The findings from the multiple logistic regression analysis presented in Table 5 confirm that attributes of managers, including education level, age, restaurant work experience, and interest in learning about effective waste reduction, still influence food waste reduction.

Table 5. The managerial and operational variables affecting restaurants' practices to reduce food waste using multiple logistic regression

Variable	b	se. of b	Wald	z	p-value	OR.	95% CI. of OR.	
							Lower	Upper
Constant	-2.2596	0.3374	-	-6.697	0.0001***	0.10	0.05	0.20
Age	1.6080	0.2714	35.1054	5.925	0.0001***	4.99	2.96	8.60
Education level	0.7319	0.2498	8.5864	2.930	0.0033**	2.08	1.28	3.41
Interested in learning about waste reduction	0.5742	0.2449	5.4968	2.344	0.0191*	1.78	1.10	2.88
HaFS work Experience (5-10 Years)	0.8174	0.3098	6.9595	2.638	0.0083 **	2.26	1.25	4.21
HaFS workExperience (> 10 Years)	0.0752	0.3528	0.0454	0.213	0.8312	1.08	0.53	2.15
Number of meals served	1.7596	0.5329	10.8995	3.301	0.0009 ***	5.81	2.14	17.78
Model Chi square = 72.78 (df = 6), p = .0001 Nagelkerke R Square = 0.252								

*p < .05; **p < .01; ***p < .001

Details are shown in Table 5, indicating that the group with a bachelor's degree or higher can reduce food waste by 2.08 times compared with the group with a lower education level, which is statistically significant (95% CI of OR = 1.28-3.41). This finding evidently shows that educated managers have the cognitive capacity to understand complex sustainability frameworks [48, 49], such as the food waste hierarchy, and thus, enable them to practice waste reduction. In terms of age, the group aged 45 or older (Gen X) reduced food waste by 4.99 times compared with the group aged 45 or younger (Gen Y), a statistically significant difference (95% CI for OR = 2.96-8.60). This research finding aligns with the literature, especially in Asian settings such as Thailand and China, where younger generations may intend to reduce waste, while older managers often hold practical conservation values that prioritize waste prevention [10, 13, 49]. For the group interested in reducing food waste, the amount of food waste can be reduced by 1.78 times compared to the group that was not interested (95% CI of OR = 1.10-2.88). This research suggests that managers with a self-interest in learning are essential for proactive waste practices in restaurants, supporting Ng and Sia's [16] research. As for

restaurant work experience, the 5-10 years of restaurant work experience still had a statistically significant influence on food waste reduction practices by 2.26 times that of the group that had less than 5 years of restaurant work experience (95% CI of OR = 1.25-4.21), suggesting that managers with years of experience have better demand forecasting [39]. Regarding the attributes of HaFS, the restaurant that served three meals per day still had a significant influence on reducing food waste by 5.81 times compared with restaurants that served two meals per day (95% CI of OR = 2.14-17.78). This finding suggests that full-service operations may implement more structured food inventory and preparation to control costs, whereas limited-service operations may view waste as unavoidable [6]. Based on the appropriateness examination of the model, the multiple logistic regression model was appropriate (Model Chi-square = 72.78, df = 6, $p < .0001$) and able to explain the influence on reducing food waste by 25.2 percent (Nagelkerke R-square = 0.252).

5. Conclusion and Limitations

This study investigated the management characteristics and attributes that influence food waste management in restaurants along the Andaman coast of Thailand. This study employed the waste hierarchy theoretical framework to provide a systematic analysis of how restaurants manage food waste. The results indicated that the manager's attributes, including age, education level, interest in learning about waste reduction, and work experience, have a statistically significant influence on reducing food waste in restaurants located on the Andaman coast of southern Thailand. At the same time, the number of meals served is the only HaFS attribute that shows statistical significance, responding to the call for food waste management in the food service sector [2]. This study contributes to theoretical implications by addressing factors that influence food waste reduction practices within the waste hierarchy framework in hospitality and tourism research highlighting various practices for managing sustainable food waste, along with factors affecting them in restaurants, aiming to facilitate the achievement of the SDG goal (12.3) [1]. The findings of this research also have practical implications, highlighting the important factors that restaurant managers can influence in reducing food waste. The findings of this research suggest that managers' characteristics, rather than physical or operational attributes, play a more critical role in shaping food waste reduction in Thailand's Andaman coastal context. The research findings emphasize that effective reduction of food waste necessitates prioritizing particular attributes of restaurant managers. The managers with educational qualifications (bachelor's degree or higher), age group (Generation X or ≥45 years), at least 5 years of experience in the restaurant industry, and interest in learning are preferable. These characteristics were identified as significantly impacting the effective adoption of food waste reduction initiatives. Effectively reducing food waste lowers operational expenses and promotes responsible food consumption towards sustainability. While restaurants currently rely on local government for food waste management, it is recommended that products such as compost, bio-fertilizer, or paving blocks be produced from collected waste and then returned to the restaurants. This approach will establish a circular feedback loop, enhancing the efficiency and incentivizing sustained food waste reduction by the establishments [38, 46].

For policy recommendations, the results suggested measures across three areas: preventive practices, enhanced reuse and recycling, and measures for entrepreneurs. Restaurants could implement measures such as posting warning signs and increasing disposal fees based on the weight of leftovers, as they currently lack customer participation in promoting waste reduction. For the second aspect, guidelines for reuse or recycling, including food donation and the utilization of food waste, are recommended. Moreover, the restaurant can use innovation and technology to monitor food waste donation and efficient waste disposal in real time. This approach could also lead to the creation of recycled food waste products, such as bio-fertilizers and paving blocks, which would be returned to restaurants to encourage their participation in the BCG economic model [38]. Economic measures are another aspect that could be strengthened; subsidies and tax breaks could be appropriate incentives to encourage the reduction and reuse of food waste [41]. Finally, measures to promote entrepreneurship are recommended [52]. The selection of a suitable manager should be prioritized. A manager should possess qualities of curiosity and a desire to learn and seek new knowledge. They should be open to sustainable development directions, including food preparation and preservation, recycling, menu design to

reduce preparation and cooking time, appropriate portion sizes as options, and reducing waste from customer plates. Sustainable consumption habits occur when employees are confident [53].

Finally, although this study highlights the theoretical contributions and practical implications of applying the waste hierarchy framework to manage food waste in restaurants, it also notes some limitations. This research focuses on food waste practices within the waste hierarchy framework in restaurants, specifically on managerial and restaurant characteristics. The research does not examine the attitudes of the restaurant staff—managers, kitchen staff, and waiters/waitresses—the raw material suppliers, or restaurant customers toward preventing and reducing food waste, which are considered limitations of this research. This research adopts a quantitative methodology, limiting the exploration of the underlying influences on managerial decision-making and practical operations. Future research should incorporate qualitative studies, including in-depth interviews with restaurant managers demonstrating different levels of food waste reduction. Future studies should also examine how restaurants reduce food waste from the perspectives of staff, raw material suppliers, and restaurant customers. It could also include an investigation into the design of a training and awareness-raising program that focuses on capacity building and on fostering positive attitudes towards food waste management. Economic incentives and consumer pressures that may influence the adoption of food-waste-reduction practices in restaurants are other areas worth researching. It is also recommended to investigate how restaurants reduce food waste in various geographical regions for comparative analysis. The sample size is another limitation, as it includes only restaurants along the Andaman coast. The determination of weight is another aspect lacking in this research paper and should be investigated in further research. Finally, conducting research across different settings, including tourism, hospitality, and food service activities in developing countries, could enhance understanding and address existing gaps in the field of study.

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