Food Waste and Environmental Sustainability of the Hotel Industry in Taiwan

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Abstract: There is an alarming surge in food wastage stemming from culinary practices and intricate cuisines despite technological advancements. The reduction in food wastage is a pivotal sustainable development goal, yet statistics indicate high levels of wastage. Scholars have investigated food waste extensively with a focus on the hospitality sector, which accounts for nearly 12% of total waste. Factors contributing to food waste have been examined, yet findings tend to be isolated and lack a holistic approach. Existing research leans heavily toward developed countries despite the issue being more pronounced in developing economies. Investigations into hotel-related food wastage in Taiwan remain scarce. Effective waste management can curtail expenditures and enhance brand reputation and underscore a commitment to environmental sustainability for hoteliers and culinary managers. This study offers actionable insights to guide sustainable development. The current research employs qualitative interviews and structured questionnaires with culinary experts and hotel management to decode intricacies of food wastage across procurement, inventory, and preparation in Taiwanese hotels. Utilizing the Analytic Network Process methodology, the research provides insights to guide hoteliers in achieving sustainable development goals.

Keywords: food waste; hotel; buffet; sustainability

1. Introduction

In recent years, the convenience of food acquisition has been augmented due to technological advancements in culinary practices and the emergence of intricate cuisines. Concurrently, while individuals are more efficiently satiating their culinary desires, there has been an alarming surge in wastage. This waste extends beyond the tangible kitchen residue and includes other imperceptible forms. The European Union, in its 2030 agenda, declared the reduction in food wastage as a pivotal sustainable development objective. This initiative beckons the collective efforts of governments, institutional bodies, and the general populace. Aligning with proactive endeavors, the Pacific Asia Travel Association (PATA) [1] in Asia has initiated regional campaigns to curtail food waste, aiming to heighten the collective consciousness surrounding food wastage and the overarching goals of environmental sustainability within the tourism sector.

Statistics sourced from the Environmental Protection Administration (EPA) of the Executive Yuan [2] indicate that approximately five million tons of food wastage occur annually in Taiwan. The International Hotel Environmental Initiative [3] reveals that a typical hotel guest contributes 0.8–1.2 kg of waste daily. Disturbingly, over one-third of this waste is food-based, with a staggering 75% being edible, as corroborated by Williams et al. [4]. Research by Booking.com delineates that an overwhelming 75% of global travelers exhibit a proclivity for eco-friendly hospitality brands [5]. This underlines the necessity for hoteliers and culinary managers to address food wastage judiciously. Effective waste management can not only curtail expenditures but also enhance brand reputation and underscore a commitment to environmental sustainability—corporate social responsibility (CSR) in essence.
In recent years, scholars from various countries have extensively investigated the topic of food wastage. The food waste in the hospitality sector has swiftly emerged as a focal point, accounting for nearly 12% of the total waste [6]. Setting aside the disruptions caused by the COVID-19 pandemic, the increasing opportunities and convenience of dining out have accentuated this issue in both developed and developing nations [7]. Although the media have consistently addressed this subject, academic research remains notably sparse [8,9]. Multiple antecedents and consequences underlie food wastage. The extant literature has delved into various factors contributing to food waste, such as the handling of kitchen leftovers, consumer attitudes, and more. However, these research findings tend to be isolated, often constrained by regional or cultural nuances, lacking a holistic approach [10]. Moreover, despite the issue being more pronounced in developing economies, the existing research predominantly leans toward developed countries. In the Taiwanese context, buffet offerings in premium hotels have always been a coveted culinary experience. However, beneath the facade of these diverse and economical offerings lurks the latent issue of waste, which is attributable to both culinary establishments and the patrons. Yet, scholarly investigations into hotel-related food wastage in Taiwan remain scant. From an environmental standpoint, kitchen waste is laden with substantial quantities of oil and salt. Incinerating this waste alongside conventional rubbish results in the emission of the highly deleterious “dioxin”, leading to severe atmospheric contamination. The ramifications of this are either comparable to or surpass those of conventional waste incineration. Thus, the current research employs a blend of qualitative interviews and structured questionnaires, engaging with culinary maestros and the management personnel of premier hotels, aiming to decode the intricacies of food wastage across procurement, inventory management, and culinary preparations. Utilizing the Analytic Network Process (ANP) methodology, the research offers actionable insights, which can guide hoteliers in their pursuit of sustainable development goals (SDGs).

2. Literature Review

Food wastage has garnered international attention in recent years. Even before the onset of the COVID-19 pandemic in late 2019, Knezevic Kurnoga, and Anic [11] employed a typological approach to survey university students in Croatia. The attitudes toward food wastage among the participants were categorized into four groups, providing insights for marketers and policy makers to design campaigns targeting specific consumer segments to reduce food wastage. This study also addresses the relative dearth of food wastage research in Croatia among all EU nations. Principato Secondi, and Pratesi [12] focused on adolescents (students) and examined their knowledge, attitudes, and behaviors regarding food wastage. The findings indicated that the youths’ current level of understanding about the repercussions of food wastage is insufficient for effective mitigation. The study suggests that educators and governmental bodies should develop educational and communication campaigns tailored for young individuals with continuous monitoring of any shifts in their attitudes and behaviors. During the pandemic, some researchers conducted investigations on food wastage from a national or regional perspective. For example, Valenzuela-Fernández et al. [13] analyzed Latin American countries, exploring the impact of COVID-19 on environmental awareness, sustainable consumption, and consumer social responsibility. The study offers valuable insights for governments, brands, organizations, and societies in fostering actions that reduce the negative environmental impacts of consumption in the Latin American market. It fills the knowledge gap on the influence of the COVID-19 pandemic on environmental consciousness and sustainable consumption within the Latin American culture. Additionally, there are studies with a backdrop of homemakers and food wastage. Vasquez Neyra et al. [14], focusing on Peruvian households, emphasized the significant role of purchase planning, knowledge and utilization of label information, and skills in food storage and cooking in influencing dietary consumption and waste reduction. The study also accentuates the importance of environmentally friendly and responsible consumer behaviors, emphasizing awareness of the cost implications of
food wastage. Music et al. [15] found that during the COVID-19 pandemic, there was no significant reduction in food wastage among Canadian households. Instead, there were shifts in family dietary patterns, including panic buying, hoarding, an increase in home cooking, and changes in online food purchasing habits. The study concludes by advocating for the promotion of plant-based diets and support for local food production as strategies to harness the pandemic-induced changes for more sustainable food consumption.

The hotel industry, particularly large-scale hotels, frequently offers a variety of food services, such as breakfasts, banquets, and other dining events, to a vast number of guests. In their endeavor to provide customers with ample choices and consistent food availability, this often results in substantial food wastage. With the escalating global focus on environmental sustainability, the hotel sector, being one of the primary industries in food consumption, not only holds a responsibility to reduce wastage to enhance its environmental stewardship but should also recognize the economic benefits derived from curtailing food wastage. Hence, research on food wastage in this context is of utmost urgency. Recent studies on food wastage with a backdrop of hotels include that of Amicarelli et al. [16], who conducted surveys in two hotels in Italy and Romania. The findings underscored significant opportunities for the hotel industry to curtail food wastage, necessitating collaborative efforts between establishments and public authorities. Internally, hotels need reforms at administrative, culinary, and service levels, mandating transparent and efficient communication with suppliers to minimize wastage. Externally, hotels should consider formal agreements with food banks, fostering a network that incorporates corporations, retailers, and charitable entities to minimize wastage. Leverenz et al. [17] developed a food wastage tracking system targeting chain hotels in Germany, which was piloted in kitchens for 12 months. The research accentuates the potential of modest changes and improvements in routine kitchen processes to significantly reduce food wastage. Okumus [18], after conducting 32 interviews with hotel staff in Orlando, Florida, advocated for hotels to adopt measures to manage and curtail food wastage effectively. This approach not only enhances customer experience and reduces costs and operational stresses but also elevates stakeholder satisfaction while diminishing adverse environmental impacts. Filimonau and Delysia [8] embarked on an examination of the pertinent literature through the vantage point of hospitality managers. Their rigorous critique culminated in the proposition of a service framework adaptable across the diverse spectrum of the hospitality sector.

In Taiwan, due to the insularity of industries, limited research has managed to penetrate the managerial sectors to discuss food waste issues using them as a backdrop. Recent studies include an exploration of Taiwan’s current state and regulatory advancements in transforming food waste into value-added resources. Residential and commercial service establishments, such as restaurants, institutional dining, and hotels, as well as industrial locations like staff canteens, are identified as primary sources of food wastage. There is a strong advocacy for the private sector to invest more resources and technology to recycle food waste into valuable assets [19]. Analyzing consumer attitudes, societal norms, and behavioral intentions toward plate leftovers, the study underscores that an effective prevention of food wastage requires multifaceted participation. Heightening awareness of the consequences of food waste, leveraging positive societal norms to curb wastage, and imposing fines are identified as key methodologies for reducing food waste [20]. Wu and Teng [21] employed qualitative research methods, selecting two buffet restaurants operated by major chain restaurant corporations in Taiwan for a case study. Through in-depth individual interviews and focus group discussions with managers, chefs, and front-line staff, the study aimed to identify a corporate management approach to minimize food waste in this setting. Overall, research on food waste issues set against the backdrop of hotels remains a gap in Taiwan.

From a methodological standpoint, it is noteworthy that to the best of our knowledge, the Analytic Network Process (ANP) has yet to be deployed in the study of food wastage within the hotel industry.
3. Research Design

Traditional scholarly endeavors often confront restricted access to the intricate administrative machinery within hotel establishments, and the roots of food wastage extend beyond simplistic causal dynamics. In the labyrinthine decision-making hierarchy within hotels, managerial and culinary leadership emerge as cardinal stakeholders. This research seeks to excavate deeper insights into the gamut of food wastage in the hospitality sector, spotlighting the perspectives of managers and executive chefs. Such an in-depth exploration aspires to empower the industry to fathom food wastage nuances, enabling informed interventions for sustainable operations.

3.1. ANP (Analytic Network Process) Method

In 1971, Thomas L. Saaty introduced the Analytic Hierarchy Process (AHP) and subsequently expanded its scope to the Analytic Network Process (ANP) in 1996, as elucidated in Saaty [22]. Both AHP and ANP stand as esteemed methodologies within decision analysis that are designed for deconstructing intricate decision matrices. AHP simplifies complex decision scenarios into hierarchical configurations, deriving conclusions through relative importance assessments across distinct tiers. This is achieved via pairwise juxtapositions of criteria to gauge their comparative weight.

In contrast, ANP, an extension of AHP, accommodates the nuanced interdependencies, such as entwined network linkages, characterizing decision criteria. Unlike its precursor, ANP integrates both the relative importance and the interconnectedness of decision criteria. Within this framework, criteria and alternatives interlace to form a network, with nodes symbolizing criteria or alternatives, and edges denoting their interrelations. Through the development of a super matrix, the weights of individual nodes and scores of alternatives can be ascertained.

Owing to its comprehensive architecture, ANP emerges as an optimal tool for examining multifaceted decision issues, considering the intertwined dynamics among criteria, potential feedback conduits, and networked interdependencies. Concisely, while AHP is adept for hierarchically delineated issues, ANP excels in scenarios marked by intricate interrelations. In application, these methodologies illuminate the decision landscape, demystifying criterion significance and offering structured decision-making pathways. Moreover, they mitigate biases, amplifying the transparency and repeatability of the decision trajectory.

3.2. Research Setting

Although the ANP method boasts a mature lineage in diverse disciplines, its infusion into hospitality research, especially dovetailed with the food wastage paradigm, remains nascent. Contemporary publications have sporadically broached the confluence of hospitality and food wastage. For instance, Okumus and Sonmez’s [23] seminal work at Florida Orlando hotels leveraged semi-structured interviews, targeting wastage culminating from over-ordering and consumption. Filimonau and Delysia [8] proffered a nuanced critique of food wastage in the catering ecosystem, which was anchored in hotel managerial perspectives. Furthermore, Wang et al. [7] centered their lens on urban diner behaviors in China, gauging food wastage categories and magnitudes, juxtaposed against European and American studies predominantly addressing household dynamics.

Given that food wastage in hotel buffets is not confined to isolated criteria but rather manifests as a multi-layered, interconnected construct, this research harnesses the ANP methodology. The research roadmap and conceptual framework are delineated subsequently (refer to Figure 1).
The descriptions of various facets and indicators are as follows:

A. Procurement

Procurement quantity plays a crucial role in the operational efficiency of a business. Excessive procurement can lead to potential risks, especially when goods surpass the actual demand. Perishables with short shelf lives might deteriorate during storage, causing not only food wastage but also increased storage costs. On the other hand, insufficient procurement does not directly cause wastage but can negatively impact a restaurant. An inability to meet customer demands due to a shortage of ingredients can result in customer dissatisfaction and a subsequent decline in business performance.

The frequency of procurement significantly influences a restaurant’s operations. Frequent procurement typically implies restaurants order smaller quantities of ingredients, ensuring their freshness. However, this approach might lead to increased transportation and labor costs. Conversely, infrequent procurement can decrease these costs, but without proper storage and management, there is a higher risk of ingredient expiration and wastage.

Ingredients with high wastage rates are those susceptible to spoilage, damage, or deterioration, like certain fruits and vegetables that can easily bruise or discolor. Proper storage and handling are essential for such ingredients to minimize wastage. Without the appropriate facilities or expertise, a buffet restaurant may face significant food waste challenges.

Ingredients with high food mileage travel longer distances from their source to the table. This long-haul transportation heightens the risks of ingredient loss and spoilage due to factors like climatic variations, temperature fluctuations, or improper packaging.
Moreover, a greater food mileage not only means potential wastage but also a larger carbon footprint, which goes against the principles of sustainable development.

B. Food Preparation

The sorting and cleaning process of ingredients is crucial in managing food waste. Excessive peeling or trimming, especially with certain fruits and vegetables that hold nutrients in their skin, can lead to significant wastage. Over-cleaning, on the other hand, not only consumes water excessively but may also cause over-hydration, impacting the ingredient’s texture and cooking results. Furthermore, neglecting to utilize all parts of an ingredient, like radish or celery leaves, results in wastage of perfectly edible portions that could be transformed into delicious dishes.

The cooking process and methods are pivotal in determining food wastage. Over-cooking not only diminishes the nutritional value and desired texture of the food but can render it inedible. Using inappropriate ingredient proportions can result in dishes with off-balance flavors, possibly leading to dishes being left uneaten or returned, causing waste. Bulk preparation, especially for same-day sales, can cause significant leftovers if the anticipated demand is not met. Furthermore, chefs lacking expertise might introduce errors like over-seasoning or improper cooking techniques, contributing to wastage. Lastly, when dishes are not consumed immediately, proper storage is vital to maintain their quality and taste.

C. Consumer Factors

Consumer habits greatly influence food wastage, especially in buffet-style restaurants. Often, the allure of multiple choices prompts consumers to serve themselves more than they can consume. This mismatch between desire and appetite leads to significant leftovers. Additionally, the buffet setting encourages a sampling mentality, where diners might take dishes merely out of curiosity, resulting in minimal consumption. Moreover, if the design of the establishment distances the buffet area from the dining space or makes accessing food cumbersome, patrons may over-serve themselves to minimize trips, further contributing to wastage.

The amount of food left on consumers’ plates is indicative of several factors influencing wastage. Over-selection, driven by the vast variety, often leads consumers to take more than they can consume. Moreover, as patrons explore new dishes, they may find that certain choices do not suit their taste preferences, resulting in leftovers. Additionally, in buffet settings, food may remain in warming equipment for long durations. When consumers receive food that is not at its optimal temperature, it further elevates the chances of it being left uneaten.

Consumer familiarity with ingredients plays a vital role in determining food waste. When diners lack information on the taste, properties, or preparation of certain ingredients, they may inadvertently select dishes they do not enjoy. Additionally, a misunderstanding of an ingredient’s nutritional importance or the complexity of its preparation can lead to its undervaluation and waste. Moreover, cultural and habitual differences can make certain ingredients appear foreign or unfamiliar to consumers, leading to uncertainty in how to consume them or a perceived mismatch in taste, further contributing to food wastage.

D. Menu Planning

Menu variety significantly impacts food wastage in dining establishments. With excessive choices, consumers face decision overload, often sampling too broadly and being unable to finish their selections. Moreover, maintaining the freshness of a wide variety of dishes becomes complex, with some surpassing their prime consumption window. Additionally, the sheer variety can result in certain dishes being favored and others overlooked, leading to unequal leftovers and wastage. Conversely, when choices are limited, consumers might revisit the same dish, leading to gradual appetite loss and subsequent leftovers. Furthermore, a restricted menu might not cater to the diverse tastes of all diners, causing some to abandon dishes after selecting them.
The quantity of ingredients used in each dish plays a crucial role in food wastage. When an excessive number of ingredients are incorporated, it introduces storage and management challenges, risking some ingredients expiring or deteriorating before use. Additionally, balancing a multitude of ingredients can cause inconsistent cooking, with some parts overcooked or undercooked, leading to consumer discard. On the other hand, using a limited number of ingredients can produce a monotonous taste and flavor profile, curbing consumer appetite and leaving more food untouched. Furthermore, a constrained ingredient palette can hinder dish adjustments, especially if an ingredient is lacking or of poor quality, negatively impacting the dish’s quality and increasing the likelihood of wastage.

E. Promotions

The frequency and clarity of promotions significantly impact food wastage and restaurant operations. With excessive promotions, buffet restaurants may face an inventory surge, leading to a heightened risk of ingredient spoilage. Such promotions can also drive consumers to over-serve themselves, resulting in more food waste. Additionally, to cut costs, some establishments may resort to lower-quality ingredients, affecting dish quality and further contributing to wastage. On the flip side, insufficient or ambiguous promotions can lead to unpredictable customer traffic, making it difficult for restaurants to forecast ingredient needs accurately. Moreover, while food wastage inherently raises costs, unclear promotions might not attract enough patrons to maintain profitability.

Anticipating patronage is crucial for managing food wastage and ensuring restaurant efficiency. Overestimating customer influx can lead to overstocking of ingredients and semifinished products. If the expected turnout does not materialize, not only does this result in wastage, but prolonged storage can also compromise ingredient freshness. Conversely, underestimating patronage poses its challenges. Buffet restaurants might find themselves ill-equipped to meet demands, leading to dish shortages. Such scenarios often necessitate emergency ingredient procurements, driving up costs and potentially affecting ingredient quality. Moreover, in a rush to cater to unexpected crowds, chefs may compromise on food preparation, affecting dish quality and thereby increasing the likelihood of food being left uneaten.

F. Unforeseen Factors

Consumer values play a pivotal role in determining food wastage, especially in buffet settings. A desire to maximize value can lead some patrons to over-serve themselves, which is a mindset often culminating in significant leftovers. Personal tastes or health beliefs can drive selective wastage, as patrons might favor certain food items, like meat, and discard others, such as vegetables. The perceived value of ingredients further complicates matters. Consumers might overindulge in what they view as "premium" items, like seafood or steak, even if they cannot consume their entire portion. Moreover, a general lack of awareness regarding the intricacies of food production and its environmental implications might result in many customers overlooking the importance of curbing food wastage.

Weather variables considerably influence food wastage in the hospitality industry. When eateries do not tailor their menus to the season or prevailing weather conditions, they risk over-preparing certain dishes, leading to waste. Unexpected weather events, like typhoons or snowstorms, can dramatically reduce customer visits, causing an excess of prepared ingredients to go unused. Additionally, the availability of ingredients fluctuates with the seasons. Restaurants that fail to adapt their menus or do not source from suitable suppliers may either waste ingredients or compromise on dish quality. Moreover, the challenge of preserving ingredients intensifies with extreme temperatures or high humidity. In the absence of appropriate refrigeration or drying methods, restaurants are at a heightened risk of food wastage.

The present investigation deploys the ANP methodology, pivoting on managerial perspectives, to discern the causalities underpinning food wastage and subsequently develop strategic interventions to curtail wastage in hotel buffets. Surveys were directed...
toward executive chefs and food and beverage managers within star-rated hotels across Taiwan with the selection criteria anchored to the database curated by the Tourism Bureau of the Ministry of Transportation, as referenced in the Tourism Bureau [24].

Given the intricacies associated with the ANP methodology, it necessitated the propagation of three distinct structured questionnaires. The formulation of these questionnaires, both in terms of dimensions and evaluative markers, drew from the insights offered by Okumus and Sonmez [23] and Amicarelli et al. [16]. Emphasizing the imperative of logical congruence, items within the ANP questionnaire underwent a consistency verification process. For an enriched perspective, inputs were sought from both academia (university-affiliated scholars from relevant domains) and industry (executive chefs and managers associated with star-rated hotels). The initial iteration, a preliminary questionnaire, solicited feedback from six domain experts, aiming for the refinement and enhancement of both reliability and validity. This initial feedback was instrumental in crafting a criterion-dependent questionnaire. Post-finalization, a cohort of 15 experts engaged with the questionnaire aided by comprehensive briefings from the researcher about the content, terminological clarifications, and essential considerations. The subsequent analysis leveraged the capabilities of the Super Decision (V3.2) for validation.

3.3. ANP Questionnaire Design and Completion

Grounded in the previously delineated network hierarchical framework, the questionnaire’s evaluative scale was bifurcated across nine stratified tiers: ranging from “extremely strong” to “extremely weak”. Numerical equivalents assigned to these tiers spanned 1, 3, 5, 7, and 9, offering respondents a gradient of considerations within this spectrum.

In scenarios where decision making gravitates toward a consensus from a cohort of experts, it is crucial to acknowledge and reconcile the inherent variability in their perceptions. Methods to amalgamate these expert insights bifurcate into two primary modalities: ‘pool first’ and ‘pool last’. Aligning with Saaty’s [25] recommendation, this investigation adopted the ‘pool first’ paradigm, synergized with a majority decision approach, to synthesize expert perspectives.

After completing the pairwise comparison matrix, it is necessary to meet the condition of consistency. In order to examine whether the decision-maker’s judgments are contradictory, the Consistency Index (CI) must be evaluated, where C.I. = (λ_{max} - n)/(n - 1). Additionally, the Random Index (RI) adjusts the C.I. values to account for different hierarchy levels, resulting in the calculation of the Consistency Ratio (CR). The significance and explanation of C.R. and C.I. values are shown in Table 1. After conducting the consistency test using the Consistency Ratio (CR) for the pairwise comparison matrices in this study, all C.I. values were ≤0.1, which complies with Saaty’s rule that if C.I. ≤ 0.1, it indicates the decision-maker’s judgments are consistent.

<table>
<thead>
<tr>
<th>Value</th>
<th>Formula</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consistency Index (CI)</td>
<td>CI = (\frac{\lambda_{max} - n}{n - 1})</td>
<td>&gt;0.1 (Inconsistency in judgments)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>=0 (Consistency in judgments)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≤0.1 (Satisfactory level of consistency in judgments)</td>
</tr>
<tr>
<td>Consistency Ratio (CR)</td>
<td>CR = (\frac{CI}{RI})</td>
<td>≤0.1 (Consistency reached an acceptable level)</td>
</tr>
</tbody>
</table>

4. Results and Discussion

After conducting a questionnaire survey with 15 hotel executive chefs and managers, data were analyzed using the geometric means method (GMM) suggested by Satty [22], and the ANP method was used for decision-making calculations. After performing a consistency test, all CI values for the research matrix were ≤0.1. The criteria and weight results were integrated using Super Decision software and are shown in Table 2.

Table 1. Evaluation of C.I. and C.R. value [25].
Table 2. Priorities of hotel food waste.

<table>
<thead>
<tr>
<th>Goal</th>
<th>Priority</th>
<th>Indicators</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>A_Purchasing</td>
<td>0.0571</td>
<td>a1.1 Procurement quantity</td>
<td>0.4377</td>
</tr>
<tr>
<td></td>
<td></td>
<td>a1.2 Procurement frequency</td>
<td>0.3516</td>
</tr>
<tr>
<td></td>
<td></td>
<td>a1.3 Procurement type—high perishable food</td>
<td>0.1274</td>
</tr>
<tr>
<td></td>
<td></td>
<td>a1.4 Procurement type—high food mileage food</td>
<td>0.0833</td>
</tr>
<tr>
<td>B_Food preparation</td>
<td>0.1086</td>
<td>b2.1 Food preparation and cleaning process</td>
<td>0.3273</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b2.2 Cooking process of ingredients (e.g., improper cooking or overcooking)</td>
<td>0.6727</td>
</tr>
<tr>
<td>C_Consumers</td>
<td>0.2571</td>
<td>c3.1 The amount of food taken by consumers</td>
<td>0.4949</td>
</tr>
<tr>
<td></td>
<td></td>
<td>c3.2 The amount of food left on consumers' plates</td>
<td>0.3399</td>
</tr>
<tr>
<td></td>
<td></td>
<td>c3.3 Knowledge of ingredients</td>
<td>0.0898</td>
</tr>
<tr>
<td></td>
<td></td>
<td>c3.4 Appearance of ingredients</td>
<td>0.0754</td>
</tr>
<tr>
<td>D_Menu planning</td>
<td>0.1543</td>
<td>d4.1 Items (e.g., too many or too few)</td>
<td>0.8622</td>
</tr>
<tr>
<td></td>
<td></td>
<td>d4.2 Ingredients (e.g., too complicated)</td>
<td>0.1378</td>
</tr>
<tr>
<td>E_Promotions</td>
<td>0.2286</td>
<td>e5.1 Promotion frequency</td>
<td>0.5210</td>
</tr>
<tr>
<td></td>
<td></td>
<td>e5.2 The predicted number of customers who will come</td>
<td>0.4790</td>
</tr>
<tr>
<td>F_Unforeseen factors</td>
<td>0.1943</td>
<td>f6.1 Consumers’ values</td>
<td>0.6142</td>
</tr>
<tr>
<td></td>
<td></td>
<td>f6.2 Weather factor</td>
<td>0.3858</td>
</tr>
</tbody>
</table>

From the managerial vantage within the hotel industry, the influential factors precipitating food wastage in buffets were hierarchically organized by their weightings. The “Consumers” category emerged as the predominant factor (0.2571), which was trailed by “Promotion” (0.2286), “Unforeseen factors” (0.1943), “Menu planning” (0.1543), “Food preparation” (0.1086), and culminating with “Purchasing” (0.0571). This aligns with the studies by Okumus [18], Filimonau et al. [26], and Demetriou [27] which suggest that since consumers have the autonomy to choose and take food based on their preferences in buffets, they often consume more, leading to wastage due to incomplete consumption.

In terms of the indicators for each cluster, the top contributing factor to food waste from the “Consumers” category was “The amount of food taken by consumers” (0.4949); for “Promotion”, it was “Promotion frequency” (0.5210); for “Unexpected factors”, it was “Consumers’ values” (0.6142); for “Menu planning,” it was “Items (e.g., too many or too few)” (0.8622); for “Food preparation,” it was “Cooking process of ingredients (e.g., improper cooking or overcooking)” (0.6727); and for “Purchasing”, it was “Procurement quantity” (0.4377). Demetriou [27] also mentions in his research that certain buffets encourage customers to avail of buffet services by prepaying, serving as a promotional strategy. This economically incentivizes them to eat more, resulting in increased food wastage. The aspect of ‘food preparation’ resonates with the speculation made by Okumus [18].

In light of the aforementioned analytical insights, hotel managerial perspectives converge on the assertion that consumers, coupled with the cadence of promotional undertakings, are principal contributors to food wastage. This consensus extends to emphasize the salience of food preparation and menu strategizing as influential factors. Notwithstanding its marginal weighting, procurement practices warrant consideration for their potential impact on food wastage. Within the ambit of the less predictable “Unforeseen factors”, the weight of “Consumers’ values” noticeably surpasses that of the “Weather factor”. As articulated in the discourses of Principato et al. [12], Fernández et al. [13], Vasquez Neyra and Cequea [14], Huang and Tseng [20], Chen and Jai [28], and Filimonau et al. [29], consumers’ values directly influence their food selection and consumption behaviors in hotel buffets, subsequently becoming a primary reason for food wastage. Some consumers, driven by the pursuit of ‘value for money’, might be inclined to over-portion. The variety in buffets lures consumers into sampling an array of dishes, sometimes just for a taste. Certain cultural contexts view leftover food as a symbol of abundance, and some consumers, either uninformed about
the true value of food or influenced by societal pressures, opt for more. Consequently, it is imperative for hotels and buffet operators to delve deeper into consumers’ values and behavioral patterns to efficaciously mitigate food wastage.

5. Further Research
5.1. Discussion and Findings

Star-rated hotels in Taiwan have long been celebrated for their lavish buffet offerings at affordable prices, which is a proposition that resonates well with local consumers. Rooted in a “value for money” ethos, guests frequently partake in these bountiful spreads, often leading to overindulgence and subsequent food wastage. Consequently, these establishments grapple with substantial volumes of kitchen waste—whether arising from food preparation or patrons’ leftovers. Considering environmental sustainability and individual health, it is essential for both service providers and customers to exercise restraint, mitigating the adverse consequences of food wastage on ecosystems and personal well-being.

Although this is an exploratory study and the challenges of researching food wastage in Taiwan’s hotel industry (as highlighted in the literature review) are acknowledged, the empirical findings of this study underscore the imperative for hotels to adopt a multifaceted approach to combat food waste. Strategies may include raising consumer awareness regarding food wastage, optimizing menu planning and culinary techniques, and implementing stricter controls over procurement and promotional strategies. Moreover, hotels can leverage advanced technologies like intelligent supply chain management and waste segregation to reduce food waste. In summary, reducing food waste is a global issue requiring collective action, with the hotel industry bearing significant responsibility in this shared effort. Building on this perspective, Misiak et al. (2019) [30] suggest that instilling “moral judgment” in consumers regarding food wastage behaviors in daily life (e.g., guilt associated with wasting food) may be another viable avenue, albeit one requiring long-term implementation, with the execution method and effectiveness warranting further research.

From the perspective of customer expectations and brand image, modern consumers are increasingly prioritizing corporate social responsibility. Booking.com’s research [5] indicates that 70% of global travelers prefer environmentally-friendly hotel brands. This highlights the necessity for hoteliers and culinary managers to address food wastage cautiously. Hotels that can demonstrate their commitment to reducing food waste not only enhance their brand image but also attract environmentally conscious customers. Furthermore, as integral community members, hotels have a duty to support sustainable development. By curbing food waste and collaborating with local charitable organizations to donate unconsumed food to those in need, they underscore their social responsibility.

Returning to the core objective of this study, gaining in-depth insights into the specific causes and patterns of food wastage in Taiwan is of paramount importance for the hotel industry. These insights not only facilitate more effective resource management and service quality enhancement for hotels but also contribute to waste reduction and resource optimization. As illuminated by the research findings, the consensus among hotel managers’ centers on meeting consumer demands and promotional activities as the primary drivers of food wastage. In addition to contemplating how to balance (or trade-off) these two major contributing factors, the study’s results further underscore the significance of food preparation and menu planning in influencing wastage. Despite the relatively lower weighting of procurement indicators, they remain worthy of attention due to their potential impact on food wastage. All of these factors require further exploration to seek viable solutions for the issue of food wastage in Taiwan’s hotel industry.

5.2. Conclusions

In recent years, the global culinary landscape has borne witness to significant technological advancements and a proliferation of diverse cuisines, thereby affording consumers unparalleled convenience and an extensive array of choices in satiating their gastronomic desires. Nevertheless, this augmented convenience has been accompanied by a consequen-
tial increase in food wastage—a phenomenon of paramount concern. The imperative of addressing this issue has crystallized on the global stage, with eminent organizations such as the European Union and the Pacific Asia Travel Association (PATA) recognizing the exigency of curtailing food waste for the overarching purpose of environmental sustainability.

Within the specific context of Taiwan, disconcerting statistical data provided by the Environmental Protection Administration (EPA) unequivocally illustrate that a staggering five million tons of food go to waste annually within the nation’s borders. In this wanton extravagance, the hotel industry bears a significant share of responsibility. Of particular note is the contribution of buffet-style offerings to this culture of prodigality, warranting special attention. These culinary feasts, celebrated both within and outside the premises of Taiwan’s top-tier hotels, are highly esteemed experiences. Nevertheless, they conceal a problem of food waste attributable to both the culinary establishments themselves and the profligate tendencies of their patrons.

It is equally important to underscore the limited scholarly research directed toward the issue of hotel-related food waste within the Taiwanese context. This represents an academic gap that requires remediation. This study’s empirical revelations cast a luminous spotlight upon the multifaceted tapestry of food wastage pervading the echelons of the hotel industry in Taiwan. In its comprehensive assessment, the study discerns a hierarchy of contributory factors, with the agency of consumers emerging as the preeminent catalyst. This primary impetus, in turn, is buttressed by ancillary determinants encompassing promotional strategies, unforeseen variables, menu planning, culinary preparation, and procurement practices. It is incumbent to expound that the actions and proclivities of consumers serve as the fulcrum upon which food wastage precariously balances, as buffet-goers habitually manifest behaviors characterized by over-portioning, gastronomic exploration across an extensive menu gamut, and an occasional misperception of leftover comestibles as emblematic of opulence.

In summation, this research underscores the compelling urgency attendant upon addressing the pervasive specter of food waste within Taiwan’s hotel industry. By means of a judicious comprehension of the principal causal agents and the salient role played by consumers, industry stakeholders can efficaciously institute waste mitigation strategies. These stratagems, while engendering fiscal economies, concurrently serve as instruments to elevate brand cachet and articulate a commitment to the overarching tenets of environmental sustainability—a quintessence encapsulated within the rubric of corporate social responsibility (CSR). To navigate this exigent terrain successfully, hoteliers must embark on a comprehensive exploration of consumers’ axiological orientations and comportment, thus enabling the edification and cultivation of more conscientious gastronomic choices. Furthermore, proactive collaboration with governmental entities, environmental advocacy organizations, and supply chain affiliates stands as a sine qua non, ensuring the formulation of a holistic and synergistic approach to the amelioration of food wastage within the hotel industry. In adhering to these precepts, the hotel sector can harmoniously align itself with the global imperatives of sustainability and contribute substantively to a future imbued with environmental responsibility and conscientious stewardship.

5.3. Limitations and Future Research Suggestions

As indicated in the literature review, in Taiwan, it is rare for academic researchers to have access to or conduct in-depth interviews with the managerial echelon of hotels, including managers and executive chefs. Fortuitously, the author of this study was able to undertake this exploratory research. However, due to the ramifications of the COVID-19 pandemic, time constraints, and considering the willingness of hotels to participate, this research could not encompass all of the star-rated hotels in Taiwan. During the study period, Taiwan was still enforcing pandemic control measures, making it challenging to differentiate between peak and off-peak seasons, leading respondents to base their answers on past experiences. However, once these pandemic control measures are lifted and dining
numbers outside of hotels increase, we anticipate more accurate responses. Nonetheless, this research contributes to filling a gap in this domain.

For future research that aims to explore hotel food waste more comprehensively, it is recommended to extend the research to other food and beverage departments, such as whether there are differences in food waste factors or amounts between Chinese and Western restaurants. With the assistance of the hotels themselves, the survey participants can be expanded to include kitchen staff or explore the issue of food waste in the hotel industry from the perspective of consumers.

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