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BUFFET DINING AND FOOD WASTE IN HOTELS: A SYSTEMATIC REVIEW OF UNTOUCHED FOOD IN MALAYSIA

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Abstract:

Food waste poses a critical environmental, economic, and ethical challenge for the hospitality industry, with buffet dining identified as a major contributor due to untouched plates and unsold leftovers. Malaysia generates approximately 8.3 million metric tonnes of food waste annually, of which nearly 24% remains fit for human consumption, while 86,177 tonnes, equivalent to 10% of total wastage, are discarded during Ramadan alone. Despite this alarming scale, systematic inquiry into buffet food waste within Malaysian hotels remains limited. Anchored in the PRISMA 2020 reporting framework, this systematic literature review synthesised 65 peer-reviewed and grey literature sources to examine the patterns, drivers, and mitigation strategies of untouched buffet food. Content-analytic synthesis surfaced

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seven thematic pillars: organisation-wide awareness, prevention at source, technological implementation, awareness programmes, customer participation, charitable donations, and recycling. Among these, AI-powered tracking systems exemplified by Winnow, Lumitics, and Leanpath have demonstrated measurable reductions of up to 30% in documented hospitality pilots. Cultural factors, including Malaysia's gastrodiplomatic buffet culture and Ramadan hospitality norms, amplify waste volumes through over-preparation and the cultural imperative of abundant offering. Case evidence from Sofitel Kuala Lumpur Damansara and Westin KL illustrates that leadership-driven environmental commitment can translate into structural waste reductions. The review concludes that integrated interventions combining technological investment, fiscal incentives, and the integration of sustainable food-management criteria into Malaysia's hotel star-rating system are essential for evidence-based waste governance. Findings offer a benchmark framework for hospitality practitioners and policymakers, contributing to scholarship on sustainable tourism management.

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Keyword:

Buffet Food Waste, Hospitality Industry Malaysia, PRISMA Systematic Review, Sustainable Food Management

Introduction

The hospitality industry faces persistent environmental and economic challenges related to food waste, particularly concerning unsold or untouched food generated in hotel buffet lines. Food waste is a critical global concern, with approximately one-third of all edible food discarded, which intensifies environmental degradation and undermines food accessibility. Food wastage in Malaysia, on the other hand, is an alarming problem since the country produces 8.3 million metric tonnes of food per year, which is thrown away on an average yearly basis (National Security Council, 2024). This figure equates to 710 grams of food wasted per person daily, or 259.82 kilograms annually. It should be emphasised that 24 per cent of the food discarded is still usable for people, according to the National Security Council (2024). Most of the food that can be utilised goes into the landfills and takes up space (Shukla et al., 2024).

For the month of Ramadan, 86,177 tonnes (accounting for 10 per cent) of the overall food wastage were recorded (Noh, 2024). In particular, the observation is very important, since Malaysia, being a Muslim country, uses Ramadan as a time of moderation, contemplation, and worship, but not of over-consumption (Talat, 2024). According to Corrado and Sala (2018), food waste results from the inefficiencies of the global food system, as well as the destruction of the environment and depletion of natural resources. At the same time, the researchers stress

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the importance of preventing unnecessary food wastage in line with global goals; however, the reasons behind it must be identified first.

The buffet style of eating has been popular among those who prefer a variety of dishes due to the diversity of food cultures in the buffet. Apart from the variety, another strength of the buffet style is the visual appeal of the food. Serving through buffet styles makes it easy for the catering team to cater to different demographic groups at once. Jamaludin et al. (2021) state that proper presentation of the buffet will create a good impression among guests, fostering loyalty and increasing repeat patronage. Despite the many strengths of the buffet style, it comes with one big disadvantage, which is food waste and overconsumption (Yusof et al., 2018). This is because of the requirement to provide lots of food for many people in limited time periods, with artistic arrangements to make the food appealing.

Although the hospitality sector has implemented measures to mitigate food waste, including those related to buffet presentations, additional efforts are necessary (Kasim & Ismail, 2011). In Malaysia, as in many developing countries, governmental and societal pressure to promote food sustainability remains limited. The country's emphasis on tourism as a driver of economic development may conflict with the imperative to balance environmental preservation. If current development trends persist and food waste remains inadequately addressed by authorities and stakeholders, the hotel sector risks worsening environmental harm (Kasavan et al., 2019). Food waste in the industry contributes to increased greenhouse gas emissions as well as land and water pollution. Therefore, hoteliers must prioritise pollution minimisation, including effective food waste management, to ensure their long-term business viability.

The literature shows that both buffet eating and food waste avoidance techniques can be effectively combined. According to Chang (2021), buffet meals may help reduce food wastage through changes in serving techniques and consumer behaviour, encouraging diners to eat everything. Serving methods and consumer awareness could prevent overconsumption. For example, strategies such as limiting portion sizes, utilising smaller plates, or involving diners in food preparation have been shown to reduce waste. This study employs content analysis to examine food waste management trends in the hotel industry and to identify challenges faced by Malaysian hotel kitchens and food services. As noted in recent studies conducted by Kattiyapornpong et al. (2023), the food waste hierarchy plays a significant role in Thai hotels of any size. From a corporate social responsibility perspective, it aims to minimise both waste and costs while preserving the environment. Globally, academics and professionals alike are paying more attention to food waste due to its numerous economic, financial, social, and ethical aspects. Rising consumer expectations, high management costs, and excessive food production exacerbate these challenges.

In this connection, food wastage has become an international problem, with severe implications for both the environment and the economy, requiring the attention of the travel and hospitality sectors. Bridging the gap in academic literature regarding food wastage in hotels, the study offers recommendations of both conceptual and managerial nature. By focusing on the causes, existing management techniques, and potential remedies, this study examines leftover food waste in Malaysian hotel buffets. Specifically, the research aims to identify the primary causes of buffet food waste and to investigate the proactive and reactive tactics employed by hotels, including recycling procedures, organisation-wide awareness campaigns, technological interventions, consumer engagement initiatives, and charitable donations.

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The study further examines the efficacy of technological intervention, especially AI tracking, in mitigating food wastage. The study also examines the role of consumer behaviour and culture on food wastage. By offering these kinds of policy, operational, and cultural recommendations, this research tries to find ways of maintaining an equilibrium among the environment, operations, and customer satisfaction. With these goals in mind, some of the questions that need to be asked include the following: What are the main reasons for food being wasted and not used in hotel buffets? What prevention and corrective actions do hotels take, and how effective are they? What role does culture play in buffet food waste? How much can technology help in addressing food waste in the buffet? Finally, how can the hospitality industry improve buffet food waste management through integrated operational, cultural, and policy measures?

Literature Review

Definition of Food Waste

Food wastage occurs when edible food is thrown away at the retail level or consumer level (Chan, 2025). Throwing away food fits into the definition of waste in Article 3.1 of Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 concerning waste and repealing certain directives. While throwing away food meets the criteria to be considered waste, it does not mean that the act of intending to discard food is food wastage. Factors like producing food, storing food, processing food, and distributing food all play a part in food loss. The United Nations Economic Commission for Europe (2020) defines food loss as a decrease in either the amount or quality of food due to decisions made and actions taken by suppliers throughout the entire food supply chain.

Food Waste in the Hospitality Industry

Studies by Pirani and Arafat (2016) argue that the global expansion of the hospitality sector is likely to increase food waste. The authors note that while significant research has focused on food losses in the global supply chain, less attention has been paid to global food demand, underscoring the need for further inquiry. Furthermore, their research emphasised that effective waste reduction in the industry requires significant changes in food production and consumption patterns. Filimonau and Coteau (2018) concur, noting that reducing food waste in hospitality is a global challenge requiring collective stakeholder commitment. Academic research concerning how to manage food waste in hospitality (especially with an industry focus) is limited despite its importance. The lack of knowledge about the damaging effects of this type of food waste among policymakers, practitioners, academics, and consumers limits their ability to develop appropriate actions to reduce the problem.

Popularity of Buffet Offerings in Malaysia

Buffet meals help hotels increase their efficiency since they allow hotel staff to provide larger quantities of food to the guests and a larger variety of food (Samsuddin et al., 2022). Moreover, buffet meals can improve customer satisfaction levels and offer upselling options, as buffets cost more than meals served à la carte (Kimes & Ho, 2019). This decision is not made in the absence of a guest preference for buffets over à la carte meals. Abdul Fatah et al. (2019) found that during iftar, guests prioritise menu attributes such as variety, taste, and quality over factors such as location, entertainment, prayer facilities, and parking. However, choosing a buffet

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during iftar is not an event unique to Malaysian Muslims. During these mealtimes, non-Muslims can also socialise with their Muslim acquaintances and experience the culinary delights available through buffets (Annuar & Azuar, 2024). In addition, buffet services are not limited to Ramadan but are available all year-round.

Another reason for the use of buffet meals is the growing globalisation of Malaysian national cuisine (Nahar et al., 2018). Since Malaysian national cuisines were unknown before, the country decided to apply gastrodiplomacy to spread information about its culture and attract tourists from abroad (Som et al., 2019; Nahar et al., 2018). Thus, Malaysia applied programs like 'Malaysia Kitchen for the World.' It implies that buffet meals serve as a suitable medium to serve various dishes of Malaysian national cuisines at once, where participants will have an opportunity to try different ethnic dishes.

Buffet as a Source of Food Waste

While buffets are popular in Malaysia, they are linked to high levels of food waste, with daily estimates reaching 17,000 tonnes. Mohd Sa'adi et al. (2024) found no correlation between hotel operators' attitudes toward food waste and their actual behaviours that contribute to waste. Instead, the researchers discovered that the volume of food prepared and subsequently wasted is shaped by operators' priorities, with waste prevention not a primary concern. The study identified that wastage occurs in two primary areas: the Back of the House (BOH) and the Front of the House (FOH). Mitigation could be effectively carried out in the former through appropriate preparation methods. It is to be noted that almost half of total wastage is avoidable (Papargyropoulou et al., 2016). A large part of the discarded food comes from the preparation phase and accounts for around 23% of the total value of the purchased food. Sha'ari et al. (2023) further validate that the slow-moving food inventory is responsible for increased spoilage and waste in restaurant kitchens.

When it comes to the FOH, there is a greater difficulty in controlling the guests' behaviour. Hotel operations tend to contribute to food waste since they place a lot of importance on preparing enough food to offer an extensive buffet to the guests (Halloran et al., 2014; Kuo & Shih, 2016). In addition, food safety standards can be too strict, thus preventing remaining food from being reused. Kuo and Shih (2016) also reported that while buffets help reduce staffing costs and encourage higher guest spending, they also increase food costs because large quantities of food are prepared and ultimately wasted. When you serve a variety of food, plentifully, at one price, people will tend to eat as much as they can, or more. They may think they are getting a good deal, or they may want to sample the variety, even if they are full.

Managing Buffet Food Waste

Hassandarvish (2019) states that Malaysian hotel operators regard food wastage as an industry-wide issue, not limited to Ramadan. As food wastage is now recognised as a financial loss, various measures have been implemented to reduce it. Given that consumer behaviour is a primary contributor to the problem, more buffet services are adopting interactive, made-to-order preparation methods. Some hotels are also collaborating with the Food Aid Foundation to donate food to underprivileged communities. Papargyropoulou et al. (2016) maintain that curbing food wastage requires a dual-approach strategy: one part addressing industry practices in the hospitality and food service sectors, and the other focusing on consumer food habits. Industry solutions include investing in infrastructure, particularly in the BOH, such as power-

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saving cold storage, efficient transportation, and technologies that reduce waste. Even discarded food can be utilised to reduce waste through segregation and, where applicable, composting. Regarding consumers, the Malaysian government and NGOs have also attempted to raise awareness about the problems of sustainable consumption (National Security Council, 2024; Consumers' Association of Penang, 2019). Among these measures were raising awareness among consumers regarding the negative consequences of food waste and promoting sustainable consumption (Nordin et al., 2024; Papargyropoulou et al., 2019).

Methodology

Systematic Literature Review Design

The research followed a Systematic Literature Review methodology based on the PRISMA 2020 reporting framework to provide methodological clarity, replication, and a comprehensive review of the buffet food waste literature in the Malaysian hotel context (Haddaway et al., 2022). Content analysis was used alongside the SLR to identify and organise the themes within the literature reviewed. This is important for conducting a thorough analysis of existing themes in the literature, from reasons for food waste generation to possible mitigating measures, as well as identifying the theoretical perspectives and approaches employed in the literature (Dhir et al., 2020), as shown in Figure 1 below.

Information Sources and Search Strategy

A systematic research was conducted for academic databases and other sources of information between January 2010 and December 2025 based on Scopus (n = 20), ScienceDirect (n = 15), Web of Science (n = 5), Emerald Insight (n = 12), ResearchGate (n = 2,279), SAGE Publications (n = 5), and Malaysian digital newspapers and industry portals (n = 23). The research was first constrained to open access articles written in English, published between 2010 and 202,5 to achieve a good balance between currency and full-text retrievability in open access SLR (Dhir et al., 2020; Vizzoto et al., 2021). The basic Boolean search strategy used is TITLE-ABS-KEY ("buffet" AND "food waste" AND "hotel" AND "untouched" OR "unsold" OR "plate waste"). Furthermore, a manual search was conducted on Google Scholar, Malaysian government websites, industry partners, and case study databases to obtain grey literature related to hotel operations in Malaysia. All the sources obtained were imported into EndNote 20 to remove duplicate records (Samson, 2022).

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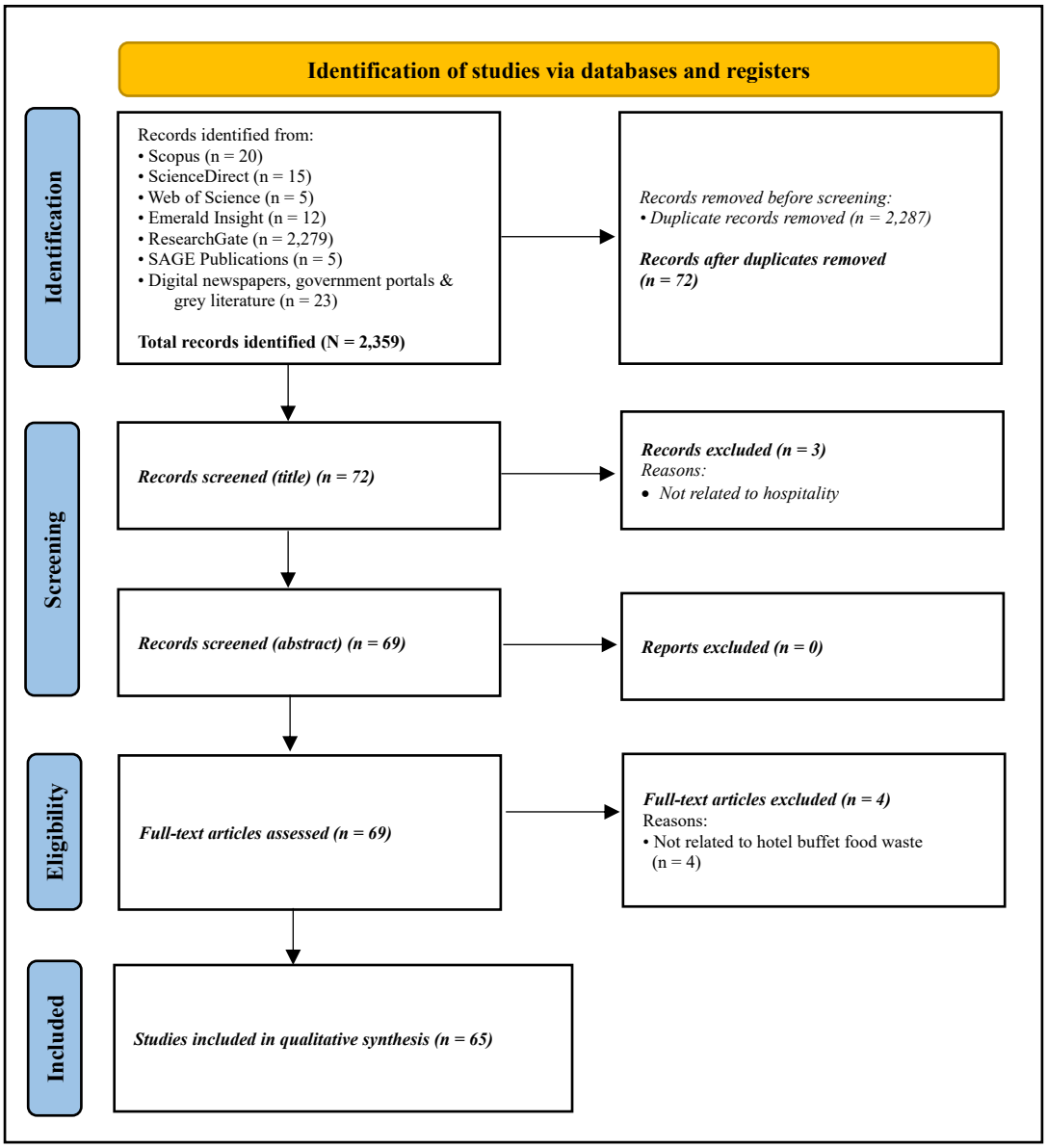

Figure 1: PRISMA 2020 Flow Diagram of the Systematic Literature Review Process
Source: Haddaway et al. (2022).

Study Selection and PRISMA Flow

All identified records (N = 2,359) were imported into EndNote 20 for reference management and duplicate removal. A total of 2,287 duplicate records were removed, leaving 72 records for screening. Three records were found unrelated to hospitality during title screening, resulting in 69 records that went through abstract screening. All 69 records successfully passed the abstract screening criteria and hence proceeded to full-text screening. Subsequently, four full-text articles were excluded because they did not address hotel buffet food waste, leaving 65 studies for inclusion in the final systematic review. This screening process is presented in the revised PRISMA 2020 flow diagram (Haddaway et al., 2022).

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Quality Appraisal

Each included study was assessed using an adapted version of the Mixed Methods Appraisal Tool (MMAT) Version 2018. The appraisal focused on five methodological domains:

- clarity of research questions and objectives,
- appropriateness of the study design,
- adequacy of data collection methods,
- coherence between data analysis and findings, and
- relevance of conclusions to the research objectives.

Two reviewers independently evaluated each article, and any disagreements were resolved through discussion until consensus was achieved. Rather than excluding studies based on methodological quality, the appraisal was used to assess the strength of the available evidence and to inform the interpretation of findings. This approach ensured methodological transparency while preserving the breadth of literature relevant to buffet food waste management in Malaysian hotels.

Eligibility Criteria

This review is based on the Malaysian hotel industry; however, international studies were included where they offered transferable evidence, theoretical perspectives, technological applications, or management practices related to buffet food waste. These comparator studies offered a barometer against more mature hospitality markets and assisted the interpretation of Malaysian findings whilst recognising contextual differences in culture, regulation, and operational practices.

Articles eligible for inclusion in this review had to fulfil the criteria below:

(i) research on buffet or all-inclusive meals in hotels or hospitality facilities;
(ii) research that focus on untouched leftover, or unsold food waste;
(iii) articles containing empirical data, theories, or case studies published in peer-reviewed journals, edited books, or institutional publications;
(iv) were published in English (or with available English translation) between January 2010 and December 2025; and
(v) had a Malaysian, Asian, or international comparator relevant to the Malaysian hotel buffet setting.

Studies were eliminated if:

(i) they delt with food waste in supply chains other than those related to service environments;
(ii) they constituted opinion editorials, blogs, or social media posts without primary evidence;
(iii) were not translated from non-English languages; or
(iv) did not have retrievable full text despite interlibrary loan requests.

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Data Extraction and Synthesis

A standardised data extraction sheet was used to capture:

(i) author(s), year, and country of study;
(ii) research design and methods;
(iii)buffet type;
(iv)proactive and reactive strategies employed; and
(v) key findings and reported waste reduction outcomes.

Extracted data were thematically synthesised using a seven-pillar framework (organisational-wide awareness, prevention at source, technological implementation, awareness programmes, customer participation, charitable donations, and recycling) adapted from Samsuddin et al. (2022) and Dhir et al. (2020).

Geographic Distribution Analysis

A geographic distribution analysis was performed as part of the PRISMA-compliant synthesis by classifying each of the 65 included documents by country of origin and study context. The analysis was conducted to demonstrate the geographic balance of the review and to highlight the Malaysian-anchored focus of the corpus, while situating it within international comparator literature drawn from East Asia, Europe, North America, and Southeast Asia (Dhir et al., 2020; Vizzoto et al., 2021). This comparative mapping highlights the prevalence of food waste studies in mature hospitality markets, providing a critical benchmark for evaluating the nascent research landscape within Malaysia's hotel sector (Filimonau & Coteau, 2018) as summarised in Table 1 below.

Table 1: Geographic Distribution of the 65 included Sources by Region and Country of Origin

Geographical Region	Number of Studies	Percentage (%)	Representative Authors
Malaysia	16	24.6%	Kasavan et al. (2019); Papargyropoulou et al. (2019); Samsuddin et al. (2022); Kasım and Ismail (2011); Sha'ari et al. (2023); Shukla et al. (2024)
Southeast Asia (excl. Malaysia)	4	6.2%	Kattiyapornpong et al. (2023); Kannangara et al. (2023); Okumuş et al. (2020)
East Asia (Taiwan/Korea)	4	6.2%	Chang (2021); Chang et al. (2022); Kuo and Shih (2016);
Europe	8	12.3%	Halloran et al. (2014); Kallbekken and Sælen (2013) Filimonau and Coteau (2018);

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			Albizzati et al. (2019); Osazee (2019); Odion (2019); Corrado and Sala (2018); Amicarelli et al. (2021); Pirani and Arafat (2016)
Middle East / South Asia	3	4.6%	Pirani and Arafat (2016); Chawla et al. (2022)
North America / Global Cross-Cultural	4	6.2%	Wansink and Sobal (2006); Chan (2025); Singh et al. (2024)
Mixed / General SLRs	4	6.2%	Dhir et al. (2020); Vizzoto et al. (2021); Samson (2022)
Malaysian-Context Grey Literature	22	33.8%	All Malaysian newspaper, NGO, and government sources
Total	65	100%	

Source: Author's Own Work

The inclusion of international literature should not be interpreted as shifting the focus away from Malaysia. Instead, these studies provide comparative evidence that supports the interpretation of Malaysian findings, particularly where local empirical studies remain limited. Technological innovations such as AI-based food waste monitoring, behavioural interventions, and operational management strategies have largely been evaluated internationally and therefore provide valuable evidence that can inform future implementation within Malaysian hotels.

Findings

The current paper is a critical analysis of the problems that emerge due to the presence of unsold food at Malaysian hotels' buffets and focuses on solving the problem of food waste. Although reducing food production is an effective way to reduce waste, implementing it in catering services is difficult. The findings highlight the importance of accurate demand forecasting and effective inventory management in minimising food loss across both operational contexts. A review of the literature identified two categories of strategies employed by hoteliers to address food waste: proactive and reactive. Proactive strategies aim to prevent and minimise waste through awareness throughout the organisation, source prevention, technological implementation, awareness programs, and customer participation. Conversely, reactive measures like recycling and donations to charity deal with waste reduction after the food has been produced. While these strategies differ, they are not mutually exclusive, and hotels may apply them in combination.

Organisational-Wide Awareness

Why would a hotel business prioritise food waste prevention when doing so complicates an already complex operation? Any food business recognises that food waste represents a financial loss to shareholders. Unsold and unused food prepared for human consumption also carries significant environmental impacts (Albizzati et al., 2019), often incurring additional disposal

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costs. However, many food waste management practices are tied to the fundamental goal of economic sustainability, potentially creating a disconnect between economic drivers and social and environmental objectives (Huang et al., 2020). This disconnection can be mitigated by implementing an organisation-wide sustainable value framework.

Transforming an organisation to prioritise environmental sustainability and, by extension, food waste prevention is a critical component of change management (Kannangara et al., 2023). Kannangara et al. (2023) argue that any organisational change framework must account for leadership, the role of change champions, and staff involvement in driving successful sustainability strategies. Somera and Petrova (2024) further explained that a process framework is required to ensure environmental sustainability, and this process framework needs to be complemented by activities which relate to all stages of the framework. They also stressed the involvement of stakeholders, enabling users of technology and changing organisational culture. This transformation is exemplified by the program implemented at the Sofitel Kuala Lumpur. The hotel has introduced a monthly "Bin-Free Friday" to cut down on food waste in its buffet-style staff canteen. The committee extended the project to every Friday due to positive feedback from personnel, and incentives were implemented to ensure that food is consumed responsibly (Hotel Kitchen, 2024).

Westin Kuala Lumpur has similarly adopted sustainable efforts to reduce kitchen food waste. Collaborating with WWF-Malaysia, the hotel implemented measures to curb food waste, with the executive sous chef serving as the property's "food waste champion." The team introduced a new separation strategy to improve the segregation and traceability of food waste at the source (Hotel Kitchen, 2024). A thorough bin assessment conducted during a kitchen walkthrough, followed by the installation of new labels, signage, and colour-coding for waste streams, allowed the team to track food waste and generate reports on how food is prepared, presented, and served. These reports are submitted to management and shared with WWF-Malaysia (Hotel Kitchen, 2024).

Preventions at the Source

Previous studies by Dhir et al. (2020) have revealed that accurate demand forecasting is a fundamental principle in minimising food waste in commercial buffets. The analysis of historical data on customer visits and habits allows hotel owners to organise food production in accordance with demand and thus avoid overproduction, which is one of the main causes of food wastage. Nevertheless, its effective use requires an in-depth understanding of the factors affecting customer behaviour, including the day of the week, hour, holidays, and weather conditions (Amicarelli et al., 2021; Wansink & Sobal, 2006). Considering such factors may increase the accuracy of demand forecasting and prevent overproduction and underproduction. However, effective food waste reduction in commercial buffets is impossible without a proper inventory management system. Real-time monitoring of food consumption, along with dynamic production, allows adjusting food production according to real demands (Vizzoto et al., 2021). However, the main difficulty lies in accurate attendance estimation, since underestimation may cause dissatisfied customers and overestimation results in food waste (Chawla et al., 2022; Okumuş et al., 2020).

In the book titled “Playbook for Guiding toward Plant Rich Dishes in Food Services,” Attwood et al. (2020) suggest that food consumption choices may be driven by impressions of the dining environment rather than rational thinking. This observation corresponds with the theories

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offered by Rowley and Spence (2018) and Cobo et al. (2025) regarding multisensory eating experience. Rowley and Spence (2018) specifically noted that food surrounded by a large circle may be perceived as a smaller portion. In contrast, a marginally larger circle makes the portion appear greater. Based on these observations, hotel restaurants can "nudge" customers toward smaller portions using techniques such as lighting, colour, and shape (Kuikka, 2011; Rowley & Spence, 2018; Attwood et al., 2020). These cues often operate subconsciously and do not need to be overt to be effective. Some of these tactics involve changing the placement, size, and display of the food or drinks and using descriptive signage and menu items. Many hotels place brightly coloured signage in their buffet area strategically to encourage controlled portions or sustainable menu items (Doyle, 2024). This application of visual signs ensures that guests make an informed choice without compromising the buffet's visual appeal.

Other possible strategies incorporate the server's intervention into buffet service (Chang et al., 2022). It is often applied during breakfast service when chefs cook eggs according to orders and thus do not need self-service from guests. It could be applied to some other dishes as well, including noodle soups, pasta prepared according to individual orders, or carving stations. Yet, additional staff expenses could be a reason against it. Also, the increased number of servers could mean that the hotel consciously limits the intake of food, and thus, affects its value, abundance, and luxury. Though the hotel should not discourage consumption explicitly because it could lead to dissatisfied clients, this method could be used to enhance the value of expensive products. For instance, BIFE Charcoal Steakhouse makes use of servers to bring pieces of meat to guests' tables. Nevertheless, service quality needs to be kept on a high level to avoid guest dissatisfaction.

Technological Implementation

Technology can help reduce food waste at every stage of the process, from purchasing to disposal (Amicarelli et al., 2021; Singh et al., 2024). Both research teams advocated for technologies such as smart kitchen appliances, real-time inventory systems, and waste conversion solutions, which minimise food waste, lower operating costs, and support sustainability initiatives. For example, Winnow Solutions' artificial visual and measurement system helps reduce waste (Winnow Limited, 2021). This system includes cameras installed above kitchen bins and weighing scales installed underneath them. Whenever food is discarded, the camera captures an image while the scale measures the weight. The system, equipped with an artificial intelligence chip, uses heuristic methods to determine the type and quantity of food being discarded. This data is then cross-referenced with a food cost database to generate a report for kitchen management review Winnow Limited, 2021). These reports allow management to readjust their food preparation strategies to minimise waste.

A similar system, the Lumitics Food Waste Prevention System, has been in use since April 2022 (Grand Hyatt Kuala Lumpur, 2023). This system automatically identifies waste by measuring, tracking, and recording it. This method provides valuable data for hotel kitchens, enabling them to reduce daily food waste, costs, and environmental impact. The system's tracker, Insight, has been proven to reduce food waste by 30% or more, increase cost savings by 8%, and reduce the carbon footprint.

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Conducting Awareness Programme

Phooi et al. (2022) highlighted the high level of food waste awareness among Malaysians. They discovered that over 70% of Malaysians consider wasting food a guilty act and a waste of money, natural resources, and farmers' efforts. They also stated that those who are aware of the problem often feel guilty, which reduces their wasteful practices. Most Malaysians also believe food waste leads to higher waste management costs, pest attraction, and water pollution. Although this awareness is encouraging, the researchers found that many Malaysians do not fully grasp the extent of food waste's impact on their daily lives.

The Malaysia Save Food Ramadan 2024 initiative, established by the Ministry of Domestic Trade and Cost of Living (KPDN) of Penang, involves collecting leftover food and beverages from vendors at Ramadan bazaars and distributing them to needy students in higher education institutions. The project, established in collaboration with GEMA Malaysia, aims to reduce food wastage and tackle the cost-of-living challenges facing the community. Given that there are 80 Ramadan bazaars found in five (5) districts in Penang, the project encourages an effective food surplus management system in the future. Also, KPDN has been carrying out inspections in Ops Pantau 2024 to ensure the availability of essential goods and manage cost-of-living challenges in markets, including bazaars, supermarkets, and online markets (Mohamad, 2024).

Inducing Customer Participation in Reducing Food Waste

Phooi et al. (2022) suggested that implementing a food waste charge or penalty system could effectively reduce food waste. In their study, 34.76% of respondents believed that penalising food waste could serve as a deterrent, as many associate it with financial loss. However, the researchers pointed out that such a system might work well for some businesses but not others, and that Malaysians might not continue the practice of reducing their food waste at home. Another concern is that business owners would shy away from penalising consumers. On this issue, Siniver et al. (2013) found that requiring guests to pay for their buffet meal in advance reduced food consumption. However, it must be noted that such an approach increases complexity for guests, as they may not wish to prepay, and requires sufficient manpower to process payments and prevent "eat-and-run" incidents.

Besides that, rather than penalising customers, it is better to utilise a reframing technique to appeal to their sense of morality. According to a study by Kallbekken and Sælen (2013), where 52 Finnish hotels produced between 34 and 38 kilograms of food waste daily, researchers tested an intervention that included preparing smaller plates for the buffet and placing a sign on each table with the text, "Welcome back! Again! And again! Visit our buffet many times. That is better than taking a lot once." Smaller plates discourage guests from taking large portions at once, while the signs encourage them to return for more as needed without feeling embarrassed. The research found that in the absence of other waste-preventing interventions, this strategy reduced food waste by almost 20%.

Another approach to reducing food waste is to involve guests in preparing their own food. For example, in hot-pot-style buffet services, guests are provided with a pot containing pre-selected soup and select ingredients to cook themselves. Because the pot is limited in size, guests naturally estimate how much of each ingredient they can add. Another popular variant is the barbecue buffet where guests cook their own ingredients; some establishments also offer a

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combination of both methods. Chang (2021) found that this method, when used with moral persuasion and a discount, successfully induces guests to produce less food waste.

Charitable Donations

The research findings from case studies of Malaysian hotels and literature around the world prove beyond reasonable doubt that food donation programs contribute significantly to the reduction of edible food waste while ensuring community food security. Grand Hyatt Kuala Lumpur (2023) has collaborated closely with non-profit organisations such as the Kechara Soup Kitchen Society by donating excess food from daily buffet spreads, certified safe by qualified chefs, for distribution to people experiencing homelessness, the urban poor, and the Orang Asli. The Kechara Soup Kitchen is a Malaysian non-profit organisation established in 2006 that offers food, healthcare, education, and other services to the homeless and urban poor. The organisation runs under the motto "Hunger Knows No Borders" and serves people of all backgrounds, regardless of race, religion, or nationality. The group runs numerous activities, such as a food bank, an empowerment program, and a street food delivery service. Malaysia's homeless and urban poor rely heavily on the Kechara Soup Kitchen, which provides critical services that help individuals get back on their feet and improve their quality of life.

Recycling

Food upcycling is a relatively new approach to reducing leftover food within the supply chain. It involves creating value-added products by repurposing materials that would otherwise be discarded, thereby lowering environmental impact. The term "value-added" refers to moving up the food recovery hierarchy or enhancing food quality, such as improving its nutritional value. For instance, upcycled beer can be produced using unsold pastries from bakeries, and soybean pulp, a byproduct of soymilk production, can be used to create upcycled flour. This method can also be applied in the kitchen, where chefs can use vegetable scraps to make stocks for vegetarian menus. Another approach is to sell excess food to guests at a reduced price (Odion, 2019; Huang et al., 2020). Osazee (2019) argues that guests may be willing to buy leftover food from the buffet if the prices are reasonable and the food is properly packaged and easy to procure. However, the researcher also admitted that implementing such reselling would face challenges, including the need for additional workforce and equipment to repackage the food, additional storage space, and compliance with health and safety requirements.

Huang et al. (2020) stated that food waste mitigation strategies should be planned to minimise startup and operating costs while maximising benefits. Osazee (2019), while researching a buffet restaurant at a university campus, found that these challenges are manageable; for example, while specialised packaging requires an initial investment, kitchen staff can perform the task during off-peak periods. To ensure the success of such reselling efforts, effective marketing is essential (Samson, 2022). For example, the Danish startup Too Good To Go connects food businesses with customers through an application that serves as a marketplace for selling leftover food. Businesses benefit by reducing waste and increasing revenue, while guests benefit from lower prices. Since its launch in 2016, the company has expanded to 18 countries across Europe and America, with a community of 95 million registered users and 160,000 active partner business owners (Too Good To Go, 2024).

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Conclusion

Effective management of food waste has emerged as an essential challenge in the Malaysian hotel industry mainly because of the widespread problem of overconsumption in buffet dining venues. The latest research findings have shown that the existing incentives for reducing waste are not enough to ensure sustainable development in the tourism industry. Otherwise, failure to address this problem will result in further environmental destruction, and thus there is an urgent need for solutions. The findings of content analysis of unsold buffet food indicate several recommendations to increase operational efficiency, in particular, adoption of AI technologies such as Winnow and Lumitics for quantifying unsold food.

This study focused solely on open-source, peer-reviewed literature that relates to buffet services in hotels. Further studies can be conducted by widening the geographical area covered or even by looking at non-English material. In terms of methodology, future research may use quantitative research methods, such as surveys and statistical tools. In particular, examining the relationship between food production and wastage will enable the hotel to shift from experience-based preparation to data-informed production (Clark et al., 2025; Papargyropoulou et al., 2016). Moreover, the use of artificial intelligence in optimising supply chain procurement and forecasting can be a good approach for reducing economic losses (Çolak, 2023; Papargyropoulou et al., 2019). Besides advancements in technology, further research should focus on the potential impact that senior culinary staff can have due to their ingrained behaviour and approach towards cooking (Filimonau et al., 2020a). Researching the impact of organisational culture on the adoption of eco-friendly technologies can be useful for filling in the existing knowledge gap related to sustainable management of foodservice operations (Legendre et al., 2023). In addition, studying the impact of national culture on the behaviour of tourists can provide important insights into how the diversity of tourism patterns in developing countries can impact the effectiveness of mitigation measures (Filimonau et al., 2019).

Technological advances allow the use of Internet of Things (IoT) devices in restaurants to move away from reliance on subjective measures of plate waste and collect objective metrics of the problem in real time (Khan et al., 2024). In addition, coupling data-driven interventions with behavioural nudges, such as gamified social messages, would allow manipulation of guests' consumption habits through culturally sensitive reduction (Appel et al., 2025). Finally, creating a cross-sectoral alliance between hotel managers, chefs, and waste management experts is crucial to developing scalable approaches that go beyond the boundaries of single establishments (Martin-Rios et al., 2018). Cross-sectoral collaboration enables the shift from individual initiatives towards industry-wide standards that consider the life-cycle impact of digital automation (Milton, 2024). The suggestion to implement traceability systems based on blockchain technology stems from the recent literature on hospitality technology and its benefits for transparency and food provenance (Buhalis et al., 2024). In addition, blockchain-based traceability would help boost customer trust in their food choices by providing information about the origin and ethically sourced ingredients used in buffets (Buhalis et al., 2024).

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