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Challenges to Innovation Adoption in Food Waste Management: A Systematic Review of Local Foodservice SMEs in Bandar Baru Ampang

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ABSTRACT

Food waste presents significant environmental, economic, and social challenges in urban Malaysia. In Bandar Baru Ampang, the rapid growth of foodservice establishments, coupled with the slow uptake of innovative waste management practices and weak regulatory enforcement, worsens the issue. This study conducts a systematic literature review (SLR) using the PRISMA 2020 framework to examine the barriers and enablers of innovation adoption in local foodservice businesses. A total of 18 high-quality studies published between 2013 and 2024 were synthesized through thematic analysis. The findings reveal four dominant barriers: cultural norms, lack of infrastructure, operational inefficiencies, and limited awareness of sustainable practices. Enablers identified include supportive policy frameworks, NGO partnerships, digital technologies, and Islamic ethical principles that discourage waste (*bazir*). Social Practice Theory was applied to explore the interplay between behavioral and institutional dynamics. A conceptual framework is proposed to guide future empirical studies and support policy development. This work aligns with Sustainable Development Goal (SDG) 12.3, which targets a 50% reduction in food waste by 2030. The study highlights that cross-sector collaboration and culturally grounded strategies are essential for fostering a circular food system in Malaysia's urban foodservice industry.

1. Introduction

Globally, about one-third of food produced for human consumption, roughly 1.3 billion tonnes annually, is lost or wasted, making food waste a critical issue. In Malaysia, the problem is equally severe, with 16,687 tonnes of food waste generated daily, accounting for 60% of municipal solid waste [1]. Urban foodservice businesses of all sizes, from tiny independent eateries to massive hotel chains, make a substantial contribution to this waste stream; however, innovation adoption for waste reduction is still low [2]. In line with Sustainable Development Goal (SDG) 12.3, which aims to reduce per capita food waste at the retail and consumer levels by half by 2030, this review methodically

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synthesizes empirical data on the enablers and barriers of innovation adoption for food waste reduction in Malaysia's urban foodservice industry and similar LMIC contexts.

This study explores the growing problem of food waste in the local foodservice industry of Bandar Baru Ampang, where there is a need for sustainable, culturally-based solutions due to the city's rapid urbanization, inadequate infrastructure, and sluggish adoption of innovative waste management techniques. With the aim of reviewing existing literature, analyzing barriers using Social Practice Theory and Islamic ethical principles, and proposing a conceptual framework guided by research questions on the nature of these barriers, their interrelations, and potential solutions, the research problem focuses on identifying the operational, cultural, and institutional barriers to innovation adoption in food waste management. The paper's structure starts with an introduction on the topic, background, significance, problem, objectives, and questions, followed by a literature review, methodology, results and discussion, and conclusion with recommendations [2-5].

1.1 Contribution and Novelty of the Study

This paper contributes to the existing body of knowledge by providing one of the first systematic literature reviews (SLR) that focuses specifically on the barriers and enablers of innovation adoption in food waste management within Malaysia's urban foodservice SMEs, using Bandar Baru Ampang as a contextual case. While prior studies have examined food waste in households or large-scale hospitality settings, little attention has been paid to the operational realities of smaller, local foodservice businesses in rapidly urbanizing environments. The integration of Social Practice Theory with Islamic ethical principles on wastefulness (*bazir*) provides a unique theoretical lens that bridges cultural, behavioral, and institutional perspectives. In addition, the proposed conceptual framework offers practical insights for policymakers, SMEs, and NGOs by linking operational and cultural dimensions with global sustainability goals. By doing so, this study not only addresses a significant research gap in the Malaysian context but also contributes to international discourse on culturally grounded approaches to achieving SDG 12.3.

1.2 Literature Review

1.2.1 Food Waste in Foodservice: A Global and Malaysian Perspective

Food waste makes up almost one-third of the food produced for human consumption worldwide, or about 1.3 billion tonnes per year [6]. In Malaysia, 45–60% of municipal solid waste is made up of food waste, with urban areas producing the most of this type of waste [7]. Although the foodservice industry, which includes eateries, lodging facilities, coffee shops, and institutional caterers contributes considerably to this sum, food waste reduction techniques are still not widely used [2].

1.2.2 Innovation adoption factors and obstacles

A number of factors influence the adoption of innovations in foodservice waste reduction. Lack of anaerobic digestion or composting facilities, standardized inventory management tools, and waste segregation systems are examples of operational obstacles[8]. High upfront technology investment costs and small and medium-sized businesses' perception of low return on investment are two examples of economic challenges [9]. Adoption is also hampered by behavioral and cultural barriers, such as a lack of staff awareness and resistance to change [10]. On the other hand, financial incentives, legal mandates, and the incorporation of waste reduction into brand reputation strategies are enablers [11].

1.2.3 Innovations in technology and management for the reduction of food waste

Technological solutions, such as automated portion control devices, digital waste-tracking systems, and mobile applications that connect surplus food to secondary markets or non-profit organizations, are highlighted in recent research [4]. Earlier research on sustainable food manufacturing also supports the role of automation in reducing material waste and improving operational sustainability. Taha [12] demonstrated that integrating automated monitoring and energy-efficient production systems across Malaysian and British manufacturers significantly improved sustainability performance. Redesigning menus and service formats to reduce overproduction, as well as staff training and incentive programs, are examples of managerial innovations [9].The Restaurant Food Waste Map (RFWM) method offers a structured adoption pathway by identifying intervention points throughout the stages of procurement, storage, preparation, and customer service [13].

1.2.4 Institutional, cultural, and policy factors

Malaysian policy frameworks, such as the Waste Segregation at Source Initiative and the National Agro-Food Policy 2.0, encourage waste minimization. However, enforcement remains uneven, particularly in smaller municipalities. Religious and cultural influences also shape waste practices, as Islamic teachings discourage waste and emphasize moderation [1]. It has been shown that in environments with a large Muslim population, incorporating these values into awareness campaigns can boost the adoption of waste reduction strategies.

1.2.5 Research gap

Although there are many insights into managerial and technological innovations for reducing food waste in the global literature, there is still a dearth of evidence specific to Malaysia, particularly from urban foodservice SMEs. There is a lack of knowledge regarding how operational, policy, and cultural factors interact to influence innovation adoption in the restaurant industry since most studies concentrate on waste in homes or stores. Using the PRISMA framework as a guide, this review synthesizes data from Malaysian and similar LMIC contexts to close that gap.

2. Methodology

2.1 Research Design

To ensure a transparent, organized, and repeatable process for synthesizing the available evidence, this study uses a systematic literature review (SLR) methodology, which is supported by the PRISMA 2020 guidelines [14]. The SLR approach is particularly effective for identifying research gaps and synthesizing findings across multiple studies while maintaining methodological rigor [9] PRISMA's structured flow, from identification to inclusion, was used in this study to reduce bias and guarantee that only the best, most pertinent studies were taken into account. This design enabled a targeted review of literature on innovation adoption for food waste reduction in the foodservice industry. The focus was on Malaysia and comparable low- and middle-income countries (LMICs) [2]. The study makes sure that the conclusions are supported by evidence that is both methodologically sound and contextually relevant by methodically screening the literature.

2.2 Search Strategy

The search strategy was created to find a wide range of studies that were pertinent to the goals of the study. Because of their broad coverage and interdisciplinary reach, three significant academic databases, which is Scopus, Web of Science, and Google Scholar that were chosen [15]. Boolean search strings were thoughtfully crafted to incorporate topic-related keywords such as "food waste," "food loss," "restaurant," "foodservice," "innovation," "technology," "adoption," and geographic identifiers like "Malaysia" and "Bandar Baru Ampang." Scopus's main search term was:

- ("food waste" OR "food loss")
- AND (restaurant* OR "foodservice")
- AND (innovation* OR technology* OR adopt* OR implement*)
- AND (Malaysia OR "urban" OR "Bandar Baru Ampang")
- AND (2013 until 2025).

We limited publications to 2013–2025 to ensure currency and relevance. Starting in 2013, the review is situated right after the development of FAO's seminal definitions and quantification work, offering a consistent starting point for comparisons across studies [6] While closing at 2024 captures the most recent pre-2025 evidence without partial-year bias, the window also fully spans the Sustainable Development Goal 12.3 implementation decade (2015–2030), during which time policies, measurement protocols, and empirical work on foodservice food-waste prevention accelerated. We also looked through grey literature, such as policy reports from the Solid Waste and Public Cleansing Management Corporation, to lessen publication bias and gather practice-based insights [7]. Also, FAO statistical datasets and documents from NGOs engaged in food redistribution programs [4] Operational, local, and time-sensitive viewpoints that are frequently underrepresented in peer-reviewed journals were provided by these supplementary sources. The reference list retains the original spellings of cited titles, while the body of this review uses the closed compound foodservice for consistency.

2.3 Criteria for Inclusion and Exclusion

To guarantee that the review included only the most pertinent and contextually appropriate studies, precise inclusion and exclusion criteria were set before the screening procedure [14]. According to the inclusion criteria, research had to:

i. use empirical methodologies (qualitative, quantitative, or mixed methods) or systematic/bibliometric reviews,
ii. investigate the adoption of innovations, whether technological, managerial, or policy-driven, so that it aimed at reducing food waste,
iii. concentrate specifically on the restaurant or foodservice industry, excluding broader supply chain or household waste contexts unless directly linked to foodservice operations,
iv. be published between 2013 and 2024 to guarantee that the results are current, and
v. be located in Malaysia or similar urban LMIC environments [2]

On the other hand, studies that did not fit the research scope were filtered out using the exclusion criteria. Among them were:

i. investigations conducted at the household, retail, or farm level;
ii. studies that only addressed technical valorisation without considering adoption in operational settings;
iii. editorials or opinion pieces that lacked a methodological framework;

iv. publications that were released outside of the allotted time frame; and
v. duplicate records that were obtained from several databases [16]

The inclusion and exclusion criteria applied in this review are summarized in Table 1, which details the focus areas of selected studies and the reasons for their inclusion or exclusion.

Table 1
Criteria for inclusion and exclusion

Citation	Focus Area	Meet Inclusion Criteria?	Reason for Inclusion/ Exclusion
[4]	Food wastage reduction app, NGO food redistribution	Yes	Empirical, Malaysia, NGO redistribution innovation
[9]	Sustainable waste management in hospitality	Yes	Global hospitality waste innovations, relevant to adoption
[1]	Islamic perspectives on food waste in Malaysia	Yes	Cultural/religious influence on waste behaviour
[10]	Interviews on adoption gaps in Klang Valley	Yes	Qualitative insights on adoption barriers
[17]	Adoption constraints in Dutch restaurants	Yes	Innovation constraints & adoption
[18]	Household waste behaviour study in the Netherlands	No	Household-only focus, no foodservice link
[19]	Global post-harvest food loss overview	No	Post-harvest losses, no operational adoption
[20]	Food loss and waste in logistics service providers perspective	No	Logistics-focused only, not food waste innovation

2.4 Screening Process

The PRISMA 2020 framework, which offers a structured four-stage pathway, which is identification, deduplication, screening, and eligibility assessment, was adhered to during the screening process [14]. Ninety (90) records in all were gathered from the database and searches of the grey literature during the identification stage. Four (4) identical records that were discovered to be listed in several databases were eliminated during the deduplication stage, leaving eighty-six (86) distinct studies for review. In order to rapidly ascertain whether studies might fit the inclusion criteria, the screening stage involved a review of abstracts and titles. Fifty (50) records were excluded during this phase, mainly because they did not focus on innovation adoption, addressed contexts outside the foodservice industry (e.g., household or retail waste), or did not fall within the designated publication timeframe [6]. The remaining 36 studies advanced to the eligibility phase, where full-text evaluations were carried out to gauge the studies' methodological soundness, depth of findings, and applicability to the goals of the study [9]. Eighteen (18) studies were eliminated at this stage due to factors like inadequate methodological detail, a lack of discussion of factors related to adoption, or a primary focus on theoretical modeling without applied foodservice outcomes. This resulted in a final collection of eighteen (18) excellent, contextually relevant studies that served as the foundation for the qualitative synthesis. The systematic filtering provided by PRISMA reduced bias, promoted transparency, and increased the validity of the body of evidence underlying this review. The results of the PRISMA screening process are presented in Table 2, showing how records were identified, screened, and filtered to arrive at the final set of 18 studies. The PRISMA 2020 flow diagram (Figure

1) summarizes the screening stages, showing how 90 initial records were reduced to 18 studies included in the final synthesis.

Table 2
Prisma stage of article selection

PRISMA Stage	Description	Records (n)	Excluded (n)	Reason for Exclusion
Identification	Records identified through database searching and grey literature (Scopus, Web of Science, Google Scholar, NGO and government reports)	90	-	-
Deduplication	Duplicates removed after cross-checking titles, abstracts, and DOIs	4	-	-
Screening	Titles and abstracts reviewed for relevance to inclusion criteria	86	50	Household-only focus; retail-only studies; technical valoriation without adoption context; outside publication timeframe
Eligibility	Full-text articles assessed for methodological quality and relevance	36	18	Insufficient methodological detail; lack of innovation adoption focus; theoretical only without applied context
Included	Studies included in qualitative synthesis	18	-	-

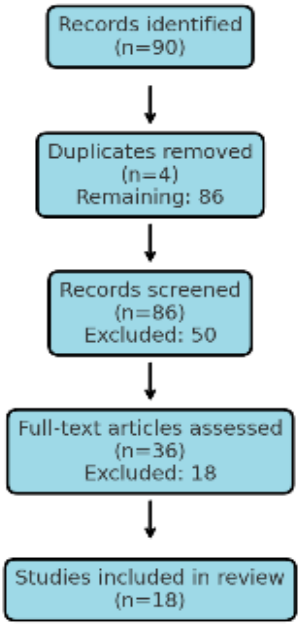

Fig. 1. PRISMA 2020 flow diagram for study selection process

3. Results

3.1 Characteristics of Included Studies

Eighteen studies that satisfied all PRISMA-defined inclusion criteria were included in the final synthesis. Eleven (11) of these came from Malaysia, offering first-hand knowledge of the local foodservice industry's operational realities, legal frameworks, and cultural contexts. In addition to a few high-income settings that provided transferable lessons on innovation adoption in hospitality and foodservice operations, the remaining seven studies were drawn from similar LMIC contexts in Southeast Asia, Africa, and Latin America. The featured research' methodological philosophies varied, as 8 of them used qualitative techniques including theme analysis and semi-structured interviews ([2], [10], five (5) employed mixed-methods or case study designs to integrate operational data with stakeholder views [9,11], while five (5) employed quantitative surveys to gauge adoption rates and influencing variables [1]. By enabling both depth of contextual understanding and breadth of coverage, this methodological diversity enhanced the synthesis.

3.2 Identified Barriers

Four primary types of obstacles to the adoption of innovations in the reduction of food waste were found in the literature:

- Among the most commonly mentioned operational obstacles were the lack of standardized waste segregation systems, insufficient oil trap infrastructure, and the absence of composting facilities, especially in Malaysian SMEs [2]
- Economic barriers were also important; research showed that technological solutions, like digital waste-tracking tools, were expensive up front and that small restaurant owners believed their investments would not pay off [9]
- Human-centered behavioral barriers include inadequate employee training, a lack of managerial commitment to waste reduction, and ingrained operational practices that put expediency and convenience ahead of sustainable practices [10]
- Institutional and policy barriers pertaining to uneven waste management regulation enforcement, especially in smaller municipalities with less funding for innovation and regulatory oversight [7]

These obstacles frequently compound one another. For instance, inadequate infrastructure can increase perceptions of cost burden, and lax enforcement of policies can worsen low managerial commitment.

3.3 Identified Enablers

On the other hand, the literature showed that there are a number of things that could speed up the adoption of new ideas to cut down on food waste:

- When combined with awareness campaigns and technical support, government-led programs like Malaysia's Waste Segregation at Source program and the National Agro-Food Policy 2.0 were found to encourage adoption [7]
- NGO partnerships were very helpful in getting extra food to people who needed it, and groups like Kechara Soup Kitchen made it easy for foodservice businesses to send edible waste to those in need [4]

- Digital innovations like inventory management systems and waste-tracking apps made it easier for operators to track reductions over time, optimize procurement, and identify menu items with high waste [4,9]
- In Malaysia, cultural and religious framing had a particularly strong impact. Islamic principles, which emphasise moderation and forbid waste, gave foodservice operators a strong moral justification for implementing waste reduction measures [1]

Crucially, a number of studies [11] pointed out that a combination of these enablers was usually necessary for successful adoption. For instance, digital tools worked better when they were introduced in conjunction with government incentives and supported by messaging that resonated with the culture. To consolidate the findings, Table 3 provides a summary of the 18 studies included in the review, highlighting their contexts, methodologies, barriers, and enablers.

Table 3
Systematic literature review summary

Citation	Context/Country	Methodology	Identified Barriers	Identified Enablers
[2]	Malaysia	Mixed methods (interviews, surveys)	Operational gaps; lack of composting facilities	SME engagement; local awareness campaigns
[9]	Global/Europe	Case study, secondary data	High technology costs; low ROI	Managerial best practices
[21]	Malaysia	Qualitative interviews	Weak regulatory enforcement	Policy frameworks
[4]	Malaysia	Secondary data, NGO case	Operational capacity constraints	NGO partnerships; redistribution
[1]	Malaysia	Qualitative interviews	Behavioural inertia; cultural habits	Islamic ethical framing
[7]	Malaysia	Government report/data	Limited enforcement capacity	National waste policy
[6]	Global	Global statistical review	Global infrastructure & supply chain loss	Global awareness
[11]	Europe	Qualitative interviews	Operational challenges in innovation	Chef-led waste reduction actions
[10]	Malaysia	Qualitative interviews	Managerial reluctance	Stakeholder collaboration
[13]	Malaysia	Case study mapping	Lack of standardised monitoring	Operational mapping tools
[16]	UK	Surveys & interviews	Limited adoption motivation	Government policy alignment
[8]	Europe	Surveys & interviews	Perceived low ROI	Best practice sharing
[22]	Spain	Case study, multi-stakeholder	Stakeholder misalignment	Cross-sector collaboration
[23]	USA	Consumer behaviour surveys	Consumer over-ordering	Menu redesign
[17]	Netherlands	Qualitative case study	Operational inefficiencies	Process optimisation
[24]	USA	Operational measurement	Measurement inconsistencies	Waste tracking
[25]	Malaysia	Surveys	Low awareness	Awareness campaigns
[26]	Switzerland	Managerial interviews	Institutional inertia	Training & managerial buy-in

3.4 Discussion

The foodservice industry in Malaysia faces issues that are typical of many LMICs, including the existence of laws like the Waste Segregation at Source Initiative that are not consistently applied, particularly to SMEs [2,7]. Adoption is discouraged by operational gaps, such as limited composting

facilities and inadequate waste segregation infrastructure, as well as the high cost of technologies like waste-tracking systems [4,9]. Managerial reluctance to invest is further reinforced by lax enforcement.

Research from developed economies demonstrates that combining financial incentives with stringent regulation can hasten adoption [11,16]. By integrating waste reduction into Islamic ethical principles, which place an emphasis on moderation and discourage extravagance, such measures could be strengthened in Malaysia [1]. Overcoming systemic and behavioral barriers can be achieved strategically by combining cultural motivators with incentives and policy enforcement. Similar supply-chain innovations have been explored in Malaysia's defense logistics sector. Taha [27] examined the sustainable military fresh-ration supply chain and found that contract management and storage conditions were the main determinants of ration quality, while camp farming acted as a moderating factor that strengthened overall supply resilience. Their findings suggest that localized production and integrated resource management can enhance operational sustainability, an approach that can be adapted by urban foodservice SMEs seeking to reduce food waste through locally grounded innovation.

The proposed conceptual framework (Figure 2) illustrates the interaction of barriers, enablers, and cultural, ethical dimensions that influence innovation adoption in food waste management. Barriers such as operational gaps, high investment costs, weak enforcement, and low awareness often hinder adoption, while enablers, including supportive policies, NGO partnerships, digital tools, and training, can drive change. These factors intersect with cultural and ethical framing, particularly the Islamic principle of *bazir* (wastefulness) and insights from Social Practice Theory, which together provide a moral and behavioral foundation for adoption. The integration of these elements supports innovation adoption in Malaysia's foodservice sector, contributing towards achieving SDG 12.3, which targets a 50% reduction in food waste by 2030.

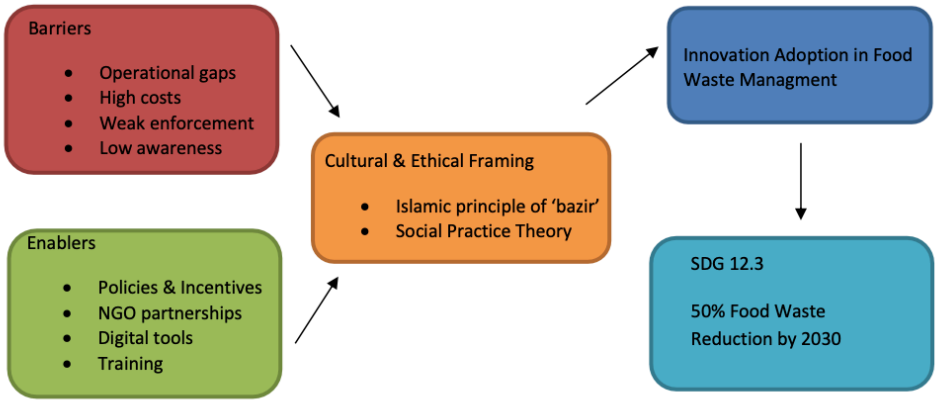

Fig. 2. Conceptual framework for innovation adoption in food waste management

4. Conclusions

From a starting pool of ninety (90) records, this systematic literature review identified eighteen (18) high-relevance studies using the PRISMA 2020 framework as a guide. The review provided a clear picture of the systemic, operational, and behavioral factors influencing adoption by synthesizing evidence on the obstacles and facilitators of innovation adoption for food waste reduction in Malaysia's urban foodservice sector. According to the analysis, barriers like poor infrastructure, high

investment costs, lax regulatory enforcement, and low managerial commitment are frequently interconnected and reinforce one another, which reduces the effectiveness of isolated interventions.

In contrast, the presence of favorable government policies, financial incentives, partnerships with non-governmental organizations, the implementation of digital waste-tracking tools, and culturally relevant awareness campaigns, especially those based on Islamic principles, were linked to successful adoption. The findings suggest that achieving SDG 12.3 requires a coordinated, multi-stakeholder approach that links operational realities with supportive policy frameworks. The review recommends that policymakers give priority to integrated measures that combine technical assistance for SMEs, financial incentives, and regulatory enforcement. Industry stakeholders can better align operational efficiency with sustainability goals by utilizing technology in conjunction with culturally relevant messaging. In order to provide solid evidence for scaling best practices across the country, future research should concentrate on empirical evaluations of integrated policy–technology–culture interventions in the Malaysian context.

Overall, this review not only highlights the systemic, operational, and cultural challenges in Malaysia's foodservice industry but also introduces a novel integration of Islamic ethics and Social Practice Theory into the discourse on innovation adoption. By providing a culturally grounded conceptual framework, the study offers both theoretical advancement and actionable guidance for policymakers and practitioners seeking to accelerate progress towards SDG 12.3.

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