Reducing Food Wastage through Sustainable Inventory Management Practices among Restaurants

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The purpose of this study is to investigate the elements that have an impact on the reduction of food waste in the hospitality industry in Saudi Arabia. These elements include the role of motivation, sustainable inventory management, and packaging functions. The study's overarching goal is to find ways to improve food waste reduction initiatives by gaining a better understanding of how these factors combine to influence waste management practices. A structured questionnaire was given to 253 Saudi responding hotel and restaurant employees and their inventory supervisors. This study uses scales developed in previous studies to measure the data. Stata-SEM was used in order to test the hypotheses and explore the variable correlations. The major mediator between waste reduction behaviour and motivation to minimize food waste was found to be sustainable inventory management. Other major moderators were packaging functions. These results tend to suggest that both internal motivating factors and external operational procedures are crucial in the managing of food wastes effectively. This paper has emphasized how motivation, inventory management, and packaging can help in reducing food waste. The paper intends to provide practical advice on waste management to the hotel industry, so that the industry could be made more sustainable and eco-friendly.

1. Introduction

Food waste, presents a problem whose effects have widely been felt across the globe in the corporate sector, human societies, and the natural environment. On an annual basis, the Food and Agriculture Organisation (FAO) approximates that 1.3 billion tonnes of food generated by humans is lost or squandered (Kaman et al., 2024). According to the Food and Agriculture Organisation of the United Nations (FAO), this waste exhausts water, land, and labour resources and contributes to the release of greenhouse gas emissions through the breakdown of food in landfills (Ting et al., 2024). By virtue of their prominent position in the food service industry, restaurants make a substantial contribution to food waste (Legendre et al., 2024). Restaurants squander a lot of food owing to over preparation, spoilage, and poor inventory control (Derqui & Filimonau, 2024). Several factors contribute to this inefficiency, given the severity of the issue, restaurant food waste reduction solutions must be explored immediately (Chia et al., 2024). Sustainable inventory management and packaging operations have become priorities. Sustainable inventory management has gained popularity as a method to reduce food waste (Jaiswal & Aagja, 2024). This helps restaurants match food supply and demand, reducing inventory and quality loss (Akkerman & Cruijssen, 2024). For this reason, inventory operations are optimized: demand is forecast, actual inventory is tracked in real-time, and supplier relationships are managed in a focused way (Tomaszewska et al., 2024). These approaches make food waste minimal, which is the main objective of the strategy. Other than inventory management, packaging processes protect the quality and shelf life of food. According to Sathatip (2024), proper packaging can protect

food against environmental conditions, direct storage of food, and control consumption, thus reducing wastage. These are the reasons that call for the change in behaviour for restaurants in order to reduce food waste (Lau et al., 2024). This study investigates how these reasons influence the sustainable inventory management, packaging, and reduction of food waste in restaurants' behaviours.

Meanwhile, a lot of empirical evidence is given about food waste reduction at restaurants which also highlighted the problem of waste management strategies and their respective treatment performance (Kohli et al., 2024). First, motivation has been demonstrated in many studies as an extremely significant factor affecting real improvement of food waste practices. Economou et al. (2024) established that economically driven restaurants were more likely to improve their inventory management and portion control, hence significantly reducing food waste. Moldovan et al. (2024) found that environmental concerns drive sustainable behaviours. Restaurants' food waste reduction strategies are affected by ethics, frequently related with CSR; going green is something that companies want to do to improve their brand and meet customer demand (Liu & Minamikawa, 2024). To cut down on food waste in restaurants, sustainable inventory control is a must. (Begho & Fadare, 2023) argued that accurate demand forecasting and real-time inventory management are needed to make sure that food supply and usage are in sync; this keeps food from going bad and overstocking happening. Food waste was cut by 30% in restaurants that used advanced inventory management systems (Schrank et al., 2023). These systems are better at estimating demand because they take into account things like seasonal changes, customer tastes, and one-of-a-kind events (Ribbers et al., 2023). This makes the best use of order numbers and cuts down on waste. By ensuring food freshness and usage before spoilage, sustainable inventory methods such as just-in-time (JIT) ordering and smart supplier partnerships can improve waste reduction (Aloysius et al., 2023). A study by Ananda et al. (2023) highlighted that restaurants may be able to better control how much food they serve by using re-sealable and portioning packing; this gets rid of the need to prepare for transport and waste. The numbers show that packaging keeps food fresh and high-quality, which cuts down on trash and spoilage. For less trash, it's also important that packaging explain to people how to store and use things (Rizzo et al., 2023).

Restaurant food waste reduction has been the subject of numerous research, but there are still gaps in our knowledge in a number of important areas (Tường

& Vũ, 2023). Motivation doesn't seem to have a clear effect on practical techniques like sustainable inventory management and packaging functions that help keep food from going to waste (Bulhões et al., 2023). Particularly when it comes to inventory management and packing (Zheng, Chen, & Ma, 2023), the role of motivation in waste reduction is ambiguous. In general, motivation to reduce waste is considered important, although the details surrounding it are somewhat vague (Chen, 2023). Most of these studies have looked into these variables in isolation and not necessarily with regard to how they interact with initiatives related to the reduction of food waste. What this implies is that deeper studies are needed regarding how initiatives aimed at waste reduction in restaurants are influenced by things like motivation, supply management, and packaging (Ratliff, 2023). Also, empirical studies do not take into consideration the moderating and mediating roles that packaging functions play in motivations versus practices that aim to reduce food waste (Ratliff, 2023). While packaging has been directly implicated in food waste, little is known about its potential indirect effects on people's motivation to undertake waste reduction activities (Hassoun et al., 2023). The effectiveness of motivated waste reduction attempts may be influenced by the quality and usefulness of packaging. The need for research on packing as a moderator or mediator of motivation and food waste reduction is highlighted by (Abdur-Rahim, 2023). The best packaging use for restaurant waste reduction may be discovered by these studies. The studies also don't have any long-term suggestions for how to start and maintain restaurant food waste reduction efforts (Matharu, Gupta, & Swarnakar, 2022). It's not fully known what the long-term benefits of smart packing, sustainable inventory management, and industry-wide growth are (Watanabe et al., 2022). Even though there is a lot of evidence that these strategies work right away. It has also not been fully looked into how changes to packaging will affect the environment or the economy.

The theoretical framework of planned behaviour (TPB) is used in this study. TPB outline that intentions, attitudes, subjective standards, and the sense of being able to control behaviour all affect action (Mallidis et al., 2022). TPB theory is on which this study is based. The study depicts that desiring to reduce food wastes is a reflection of positive attitudes towards reduction of wastes. With such attitudes, positive subjective norms and perceived control over inventory and packaging functions, the reduction of wastes can be of significance. TPB describes the reduction of restaurant food waste in light of internal and external factors, including sustainable inventory

management and packaging functions (Akkaş & Gaur, 2022). This study tries to discover the combined effect of such variables on waste reduction to better understand the processes. This paper discusses how companies are practicing food waste reduction, sustainable inventory management, packaging functions, and motivation. This paper hypothesizes that sustainable inventory management acts as a mediator in the relationship between waste reduction behaviour and motivation, and this relationship is weakened by packaging functions. This study investigates how these factors collectively contribute to the gaps in the existing literature. The study will, therefore, dwell on packaging, inventory control, and drive to understand impacts on waste reduction. This study provides empirical proof for the theoretical framework of this study and helps us understand how restaurants can practically exploit theory-motivated behaviours to reduce food waste.

2. Literature Review

Sustainable inventory management is becoming more and more popular as a solution to the problem of food waste (Kasza et al., 2022). Standard inventory processes' inherent inefficiencies have been under much study. Overstocking, deterioration, and food waste are resulting from these methods (Goh et al., 2022). Effective supply chain efficiency and lower food waste depend on sustainable inventory control making sure food is accessible at the right moment. Technology has demonstrated to increase inventory accuracy in data analytics and predictive modelling (Poonia et al., 2022). These contemporary technologies factor seasonal fluctuations, customer preferences, and shelf life to more precisely project demand. Matching usage to inventory helps businesses lower stock and spoilage (Fan, Ellison, & Wilson, 2022). This enables businesses to reach their objectives regarding sustainability. In inventory control, sustainability transcends economic to environmental and social issues (Poonia et al., 2022). Reverse logistics, joint supply chain management, and JIT inventory have proved to cut food waste. JIT inventory reduces lead times and matches demand for manufacturing. To increase their shelf life and lower waste, suppliers, manufacturers, and retailers cooperate to manage, store, and move food goods. Reversing logistics helps food be used again or redistributed, therefore lowering food waste (Kasza et al., 2022). By using these ideas, global food waste may be addressed and a more sustainable food system is produced, therefore enhancing inventory control (Mallidis et al., 2022).

People and organisations are motivated to reduce food waste by both internal and external causes (Matharu et al., 2022). This argument applies in restaurants in ethical, environmental, and financial aspects as well. The necessity to lower unsold food expenses typically drives economic incentives. Among these expenses are staff, disposal fees, and food per unit (Hassoun et al., 2023). All these inducements toward the reduction of food waste have been driven by the detrimental effects that the waste of food has on the environment: greenhouse gas emissions and the overall waste of valuable resources. The issue of food insecurity and, quite importantly, the morality of food going to waste while others are desperate for such food have also gained significant prominence in association with this problem (Hassoun et al., 2023). These food waste reduction incentives impact the rules, procedure and general management of a restaurant's food resource management. Motivation has influenced restaurant waste reduction, as empirical research has shown (Zheng et al., 2023). Restaurants are encouraged to save expenses by increasing inventory control and portion control, which results in waste reduction (Tường & Vũ, 2023). According to the research, environmental incentives do support local food procurement, composting, and recycling, hence lowering waste. The other important aspect of CSR initiatives linked to food waste reduction is ethical motivation. These initiatives better the surroundings (Ananda et al., 2023) on one side and improve the reputation and customer loyalty of the restaurant on the other. Results aggregated would therefore show that the motivation level on wasting less food in a restaurant significantly relates to its likelihood of adopting strategies that eventually lead to substantial waste reduction (Ribbers et al., 2023). Empirical research showed that the intention to reduce food waste significantly influences restaurants' current waste reduction behaviour. Empirical studies have also established the fact that motivation is critical in bringing about behaviour change (Begho & Fadare, 2023). Restaurants are most likely to reduce their waste for economic, environmental or ethical reasons when required to do so. According to the theory of planned behaviour, motivation influences intentions to perform a behaviour, and these latter influences directly lead to the performance of that behaviour (Moldovan et al., 2024). This theory supports this hypothesis. Thus, highly motivated people may be more proactive and efficient in decreasing restaurant food waste. Restaurants need motivation to overcome waste reduction challenges including the cost of new procedures or the resistance to change in existing practices, which ultimately reduces food waste (Kohli et al., 2024). This relationship is important because restaurants need motivation to overcome these challenges.

H1: Motivation to reduce food waste significantly impacts the restaurants food waste reduction behaviour.

Sustainable inventory management reduces food waste in the restaurant industry, according to empirical studies (Sathatip, 2024). Sustainable inventory techniques include accurate demand forecasting, real-time inventory management, and smart supplier collaborations reduce food waste in restaurants (Akkerman & Cruijssen, 2024). Chia et al. (2024) discovered that restaurants adopting advanced inventory management systems might save waste by 30%. These technologies help restaurants match supply and demand, preventing food spoilage. Sustainable inventory management strategies such as batch cooking and ingredient cross-utilization reduce overproduction and spoiling (Betz et al., 2015). These data show that inventory management affects food waste reduction in restaurants. This means, with regard to such empirical findings, the practice of sustainable inventory management may hugely influence restaurants in reducing food waste (Legendre et al., 2024). Inventory management is considered the very core of restaurant operations and directly relates to food ordering, storage, and consumption. Sustainable inventory management should be able to provide food supply commensurate with its consumption trends to reduce overstocking and waste (Legendre et al., 2024). Supply chain management theories propose that efficient and sustainable inventory techniques can reduce waste by increasing supply predictions and ordering-to-delivery times (Ting et al., 2024). Therefore, restaurants with sustainable inventory management strategies will be less likely to generate food waste because they have kept surplus inventory to a minimum and resource utilization to its maximum. This is a significant hypothesis regarding implications for practice and policy (Derqui & Filimonau, 2024). If sustainable inventory management is proved to significantly affect food waste reduction behaviour, restaurants should be encouraged to use it as a waste minimisation approach. Industry standards and best practices for sustainable inventory management and policy initiatives to encourage restaurants to adopt them may result (Jaiswal & Aagja, 2024). This hypothesis supports sustainability goals since better inventory management decreases food waste and the restaurant industry's environmental impact (Tomaszewska et al., 2024). Thus, evaluating this hypothesis may reveal how sustainable inventory management might reduce restaurant food waste.

H2: Sustainable inventory management significantly impacts the restaurants food waste reduction behaviour.

A basis for understanding the mediating role of sustainable inventory management has been laid by empirical research on the complex linkages between motivation, sustainable practices, and food waste reduction in the restaurant business (Lau et al., 2024). Studies have revealed that although drive to lower food waste drives waste reduction activities, practical actions like sustainable inventory management usually make these activities successful (Economou et al., 2024). In light of Liu & Minamikawa (2024), restaurants that are either environmentally or financially motivated are likely to adapt sustainable inventory systems, hence waste reduction. Adopting demand forecasting and just-in--time ordering are some of the key sustainable inventory management strategies adapted by restaurants with a high motive in reducing food waste, Schrank et al. (2023) add. These results imply that sustainable inventory management may have a mediating effect on the motivation process that leads to food waste reduction (Aloysius et al., 2023). The empirical findings tend to show that motivation and conduct of restaurant food waste reduction have been immensely influenced by sustainable inventory management. On the other hand, motivation alone may not be sufficient in reducing food waste (Rizzo et al., 2023). Instead, inspired restaurants use some tactics in making sustainably accountable inventory to realize this objective. Organisational behaviour theories emphasise connecting internal incentives with external practices to attain goals (Bulhões et al., 2023). Thus, restaurant business interventions could target motivation and sustainable inventory management. The complex relationship between motivation, practices, and outcomes suggests that effective waste reduction requires a holistic approach that integrates psychological and operational factors (Chen, 2023), which has broader implications for sustainability research. It follows that, in testing this hypothesis, one might discover how restaurants would be in a better position to reduce food waste by incentivized behaviour and sustainable inventory methods.

H3: Sustainable inventory management significantly mediates the relationship of motivation to reduce food waste and the restaurants food waste reduction behaviour.

The impact of packaging in reducing food waste has been extensively studied in empirical research, with a focus on how different packaging functions affect food quality, shelf life, and spoilage (Ko & Hong, 2023). Good packaging reduces food waste by shielding food from

outside factors, enhances portion control, and offers storage and usage information (Abdur-Rahim, 2023). Watanabe et al. (2022) showed that perishable food shelf life might be extended by packaging that controls environment and increases barrier protection, hence lowering waste. Resealable and portioning packaging helps restaurants control food servings, therefore lowering over-preparation and spoilage (Akkaş & Gaur, 2022). These studies indicate that, in restaurants where food preservation and portion control are key and critical, packaging functions play an important role in supporting efforts at food waste reduction. These research results would therefore insinuate that probably, the relationship between restaurant food waste reduction motivations and conduct is significantly moderated by food waste packaging functions (Goh et al., 2022). Optimize packaging functions to enhance food waste reduction and strengthen the relationship between motivation and food waste reduction. In this hypothesis, such a focus could give prominence to packaging concerning restaurant food waste reduction (Goh et al., 2022). Therefore, if packaging functions significantly

affect the motivation-behaviour relationship, restaurants are bound to take serious packaging decisions in line with their strategy toward waste reduction. That might motivate the restaurant manager, supplier, and packaging designer to collaborate in developing sustainable packaging designs that enhance food-waste reduction (Kaman et al., 2024). This hypothesis proposes that restaurant food waste reduction efforts should focus on both improving motivation and aligning physical tools and resources, such as packaging, with these goals. This may lead to more complete food waste reduction initiatives that include behavioural and technology solutions (Legendre et al., 2024). Testing this hypothesis may reveal how packaging functions can enhance motivating drivers' effects on restaurant food waste reduction.

H4:Packaging functions for food waste significantly moderates the relationship of motivation to reduce food waste and the restaurants food waste reduction behaviour.
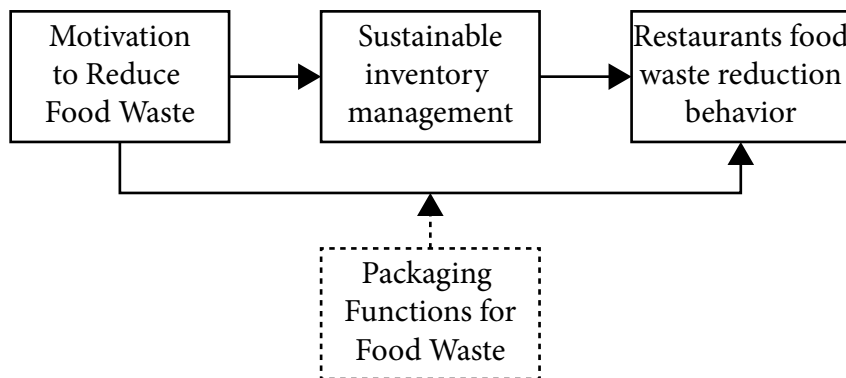

Figure 1: Theoretical Model.

3. Methodology

In the hospitality industry, the study especially looked at hotels and restaurants in the Kingdom of Saudi Arabia. This survey sampled 253 employees and inventory supervisors from numerous regional hotels and restaurants. Respondents were involved in operational decision-making and waste management. These included hotel, restaurant, and inventory employees and supervisors. Individual tasks and responsibilities determined participant selection. To ensure that the knowledge gained would be useful in farm food waste management and mitigation, this precaution was taken. Data was collected using a structured survey. The tool measured the

aim to decrease food waste, sustainable inventory management, packaging functions, and restaurant attitudes towards food waste reduction. For the different linguistic backgrounds of the participants, the survey was offered in English and Arabic and delivered electronically. The questionnaire included scaled parts from earlier research to ensure reliability and validity. This study adjusted the scale initially meant to evaluate consumer food waste reduction behaviour to fit managers in the hotel sector, therefore ensuring that the gathered data fairly reflects the intended audience while keeping the fundamental ideas of the original questionnaire. These scales were chosen for their previously successful research and ability to measure the constructs of interest.

Table 1: Questionnaire Information.

S. No	Variables of Research	No of Items	References
1	Motivation to reduce food waste	07	(Krisjanti & Quita, 2020)
2	Sustainable inventory management	09	(Gatari, Shale, & Osoro, 2022)
3	Packaging functions for food waste	10	(Wikström et al., 2019)
4	Restaurants food waste reduction behaviour	05	(Ma et al., 2023)

This study employed scales from previous research to assure accuracy and reliability. This study covered sustainable inventory management, packaging purposes, motivation to lower food waste, and restaurant food waste reduction behaviour. A thorough choice of books guaranteed that every scale fit the hotel industry situation in Saudi Arabia. Initially, the items on these scales were checked for relevance and appropriateness for the objectives of the study to make sure they faithfully reflected the main components of each construct. Stata-SEM, or structural equation modelling, was used for data analysis underlined by acronym For the analysis of complicated interactions, Stata-SEM is a potent statistical instrument. The validity and dependability of the measurement model's assumptions and stata-sEM was applied to test them Path coefficients, factor loadings, and fit indices helped one ascertain the degree and importance of construct linkages. This study exposed how practices of hotel and restaurant food waste reduction are influenced by motivation, inventory control strategies, and packaging functions.

4. Results

Table 2 displays the reliability and validity assessment for the significant factors in this study: the motivation to reduce food waste, sustainable inventory management, packaging functions, and the behaviour of restaurants towards food waste reduction. Construct internal consistency, dependability, and convergent validity using Cronbach's Alpha, Composite Reliability (CR), and Average Variance Extracted (AVE). First, there is good internal consistency shown by all variables' Cronbach's Alpha values over 0.70. Strong dependability in gauging this construct is shown by the Cronbach's Alpha of 0.817 for incentive to cut food waste. Sustainable inventory management and restaurants' food waste reduction practices exhibit internal consistency with Cronbach's Alpha ratings of 0.728 and 0.843. Strong internal consistency and a Cronbach's Alpha of 0.831 characterise the food waste packaging functions. These results reveal how faithfully the components of each variable reflect their construct.

Table 2: Variables Reliability and Validity.

Variable	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
Motivation to reduce food waste	0.817	0.922	0.512
Sustainable inventory management	0.728	0.931	0.514
Packaging functions for food waste	0.831	0.848	0.542
Restaurants food waste reduction behaviour	0.843	0.951	0.527

The Composite Reliability (CR) values of all variables exceed 0.70, so suggesting good construct dependability. With Restaurants' food waste reduction behaviour having the highest CR at 0.51, showing exceptional dependability, the CR values of the constructions range from 0.848 to 0.951. With composite dependability (CR ratings of 0.922 and 0.931), sustainable inventory management and food waste reduction motivation were quite outstanding. Although somewhat less, the CR value of 0.848 for food waste packaging processes is nevertheless consistent. These results show that across items constructions are measured correctly and consistently. Finally, all variables' Average Variance Extracted (AVE) values exceed 0.50, indicating convergent validity. The construct explains more than half of the variance in the items, demonstrating that

they match the theoretical notions. The constructs' AVE values vary from 0.512 to 0.542, with Packaging functions for food waste having the highest AVE at 0.542 and Restaurants' food waste reduction behaviour at 0.527. Motivation to reduce food waste and Sustainable inventory management had AVE values of 0.512 and 0.514, respectively, over the threshold, showing that the constructs capture the anticipated variance.

Table 3 shows the measuring model's CFA results. The coefficients, standard errors, z-values, and p-values prove each item's factor loadings. Statistically significant loadings ($p < 0.05$) indicate importance in measuring constructs for all items. MRFW2–MRFW7 show high factor loadings of 0.447–0.712 on the Motivation to Reduce Food Waste factor, indicating considerable

contributions to this construct. Items SIM2 to SIM9 have significant Sustainable Inventory Management loadings between 0.494 and 0.722, confirming their relevance. Packaging Functions for Food Waste and Restaurants' Food Waste Reduction Behaviour constructions have robust loadings of 0.147 to 0.685 and 0.426 to 0.730, respectively, confirming their ability to capture the targeted constructs. Overall, the CFA results verify the measuring paradigm and support concept and item reliability.
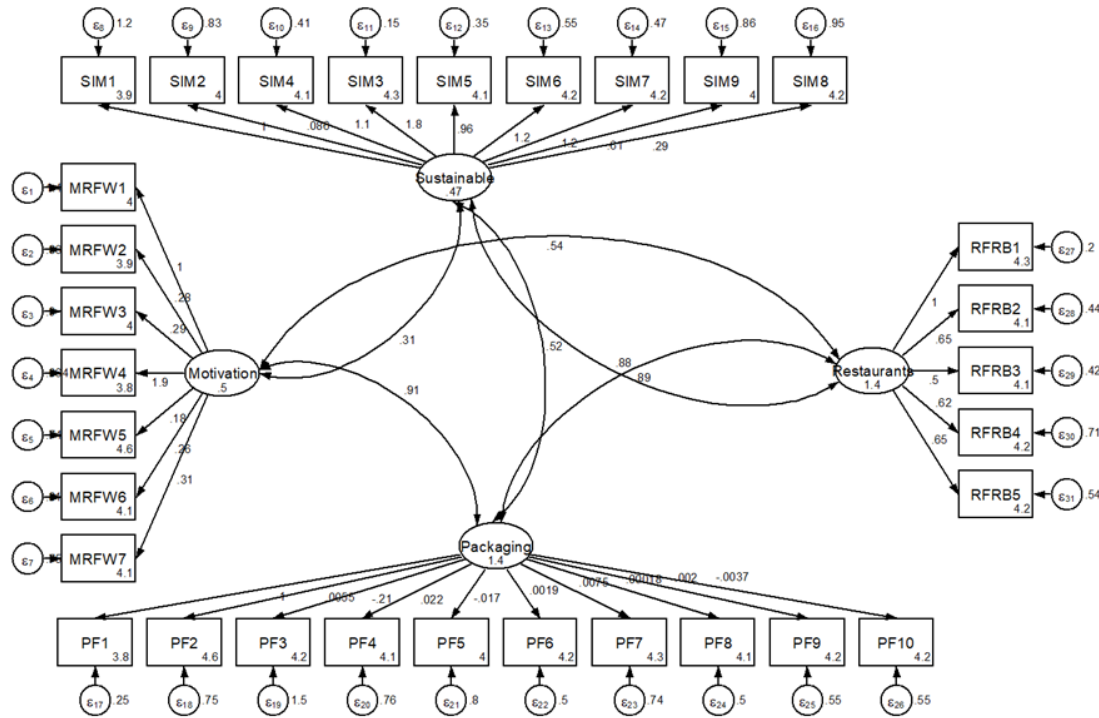

Figure 2: Estimated Model.

Table 3: Confirmatory Factor Analysis.

Measurement	OIM Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
MRFW1	1.000	(constrained)				
MRFW2	0.557	0.043	10.767	0.000	0.381	0.545
MRFW3	0.583	0.046	10.437	0.000	0.149	0.568
MRFW4	0.502	0.038	75.113	0.000	0.311	0.714
MRFW5	0.705	0.052	10.345	0.000	0.610	0.656
MRFW6	0.447	0.050	7.143	0.000	0.353	0.547
MRFW7	0.712	0.056	10.204	0.000	0.609	0.663
SIM1	1.000	(constrained)				
SIM2	0.521	0.054	7.687	0.000	0.420	0.629
SIM3	0.615	0.057	8.758	0.000	0.504	0.720
SIM4	0.569	0.049	8.938	0.000	0.474	0.660
SIM5	0.700	0.066	9.889	0.002	0.577	0.705
SIM6	0.494	0.058	8.241	0.004	0.412	0.673
SIM7	0.652	0.053	9.962	0.000	0.548	0.749
SIM8	0.584	0.068	6.916	0.000	0.450	0.711
SIM9	0.722	0.047	12.410	0.000	0.630	0.647
PF1	1.000	(constrained)				
PF2	0.625	0.051	9.553	0.000	0.526	0.718
PF3	0.685	0.048	10.978	0.000	0.590	0.619
PF4	0.558	0.048	8.992	0.000	0.465	0.646
PF5	0.666	0.052	9.870	0.000	0.564	0.762
PF6	0.147	0.082	8.901	0.000	0.252	0.833
PF7	0.664	0.038	71.339	0.000	0.113	0.347
PF8	0.661	0.036	76.706	0.000	0.104	0.379
PF9	0.579	0.072	9.190	0.000	0.138	0.555
PF10	0.674	0.062	9.784	0.000	0.215	0.706
RFRB1	1.000	(constrained)				
RFRB2	0.730	0.037	77.810	0.000	0.182	0.418
RFRB3	0.579	0.037	75.625	0.000	0.205	0.367
RFRB4	0.659	0.040	67.995	0.000	0.112	0.388
RFRB5	0.426	0.037	77.532	0.000	0.230	0.647

Table 4 shows measurement item fitness data for the study's primary variables. The values represent each indicator's construct-standardized loadings. For Motivation to Reduce Food Waste, markers MRFW2–MRFW5 had high loadings from 0.705 to 0.765, indicating their considerable contribution. In comparison, MRFW1 and MRFW6 have lower loadings of 0.655 and 0.649. Sustainable Inventory Management indicators have high loadings, with SIM1 leading at 0.926 and SIM2 at 0.871, indicating their importance.

SIM7's loading is 0.620. Packaging Functions for Food Waste indicators load strongly, especially PF1 at 0.837 and PF2 at 0.860, whereas PF6 and PF10 at 0.859 and 0.683 are variable. Restaurants' Food Waste Reduction Behaviour indicators show mixed findings, with RFRB1 at 0.698 being the highest and RFRB2 at 0.552 being the lowest, indicating different construct contributions. These fitness statistics demonstrate that measurement items accurately represent their variables.

Table 4: Measurement Items Fitness Statistics.

Variable	Indicator	Original Sample
Motivation to reduce food waste	MRFW1	0.655
	MRFW2	0.705
	MRFW3	0.726
	MRFW4	0.765
	MRFW5	0.724
	MRFW6	0.649
	MRFW7	0.717
Sustainable inventory management	SIM1	0.926
	SIM2	0.871
	SIM3	0.906
	SIM4	0.856
	SIM5	0.823
	SIM6	0.680
	SIM7	0.620
	SIM8	0.740
	SIM9	0.795
Packaging functions for food waste	PF1	0.837
	PF2	0.860
	PF3	0.778
	PF4	0.665
	PF5	0.657
	PF6	0.859
	PF7	0.884
	PF8	0.796
	PF9	0.843
	PF10	0.683
Restaurants food waste reduction behaviour	RFRB1	0.698
	RFRB2	0.552
	RFRB3	0.545
	RFRB4	0.676
	RFRB5	0.666

Table 5 shows model evaluation Chi-square fit statistics. Compared to a saturated model, the Likelihood Ratio Chi-square statistic is 7250.722, with a p-value of 0.000 showing a statistically significant difference. This shows that the model fits data better than a baseline model but not perfectly. The baseline versus saturated model Chi-square statistic is 3195.039 with a p-value of 0.000, indicating a significant difference. These fit statistics show that while the model fits well, it may need further refining to be ideal.

Table 5: Chi-Square Fit statistics.

Fit Statistic	Value	Description
Likelihood ratio	7250.722	model vs. saturated
p > chi2	0.000	
chi2_bs(2728)	3195.039	baseline vs. saturated
p > chi2	0.000	

Table 6 shows model goodness-of-fit R-square statistics. The Saturated Model's SRMR is 0.056 and the Estimated Model's is 0.069, indicating model fit. Variable R-square values show how much variance the model explains. Motivation to Reduce Food Waste has an R-square of 0.415, indicating that the model explains 41.5% of its variance. Sustainable Inventory Management explains 14.8% variation with a lower R-square of 0.148. Packaging Functions for Food Waste has the highest R-square value, 0.507, indicating that the model explains 50.7% of its variation. These data show how well the model accounts for construct variability.

Table 6: R-Square Statistics Model Goodness of Fit Statistics.

	Saturated Model	Estimated Model	R Square
SRMR	0.056	0.069	
Motivation to reduce food waste			0.415
Sustainable inventory management			0.148
Packaging functions for food waste			0.507

Path analysis results for study hypotheses are shown in Table 7. The coefficient for Hypothesis 1 (H1) is 0.286 with a standard error of 0.037, a z-value of 77.846, and a p-value of 0.000, demonstrating that incentive to decrease food waste positively affects restaurants' food waste reduction behaviour. Hypothesis 2 (H2) provides a coefficient of 0.606, a standard error of 0.058, a z-value of 11.389, and a p-value of 0.000, showing that sustainable inventory management affects waste reduction behaviour.
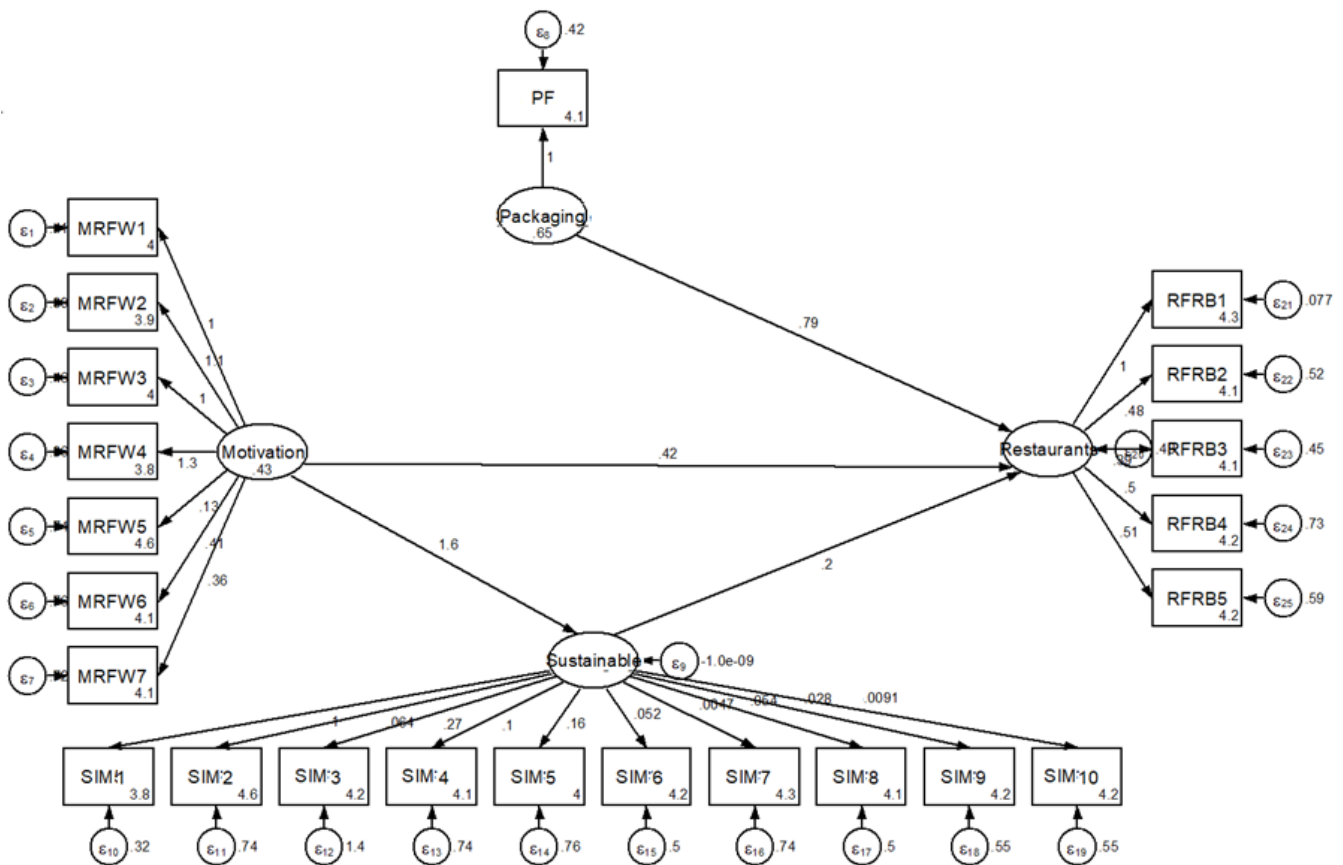

Figure 3: Structural Model for Path Analysis

The coefficient of Hypothesis 3 (H3) is 0.712, the standard error is 0.065, the z-value is 8.733, and the p-value is 0.000, indicating that sustainable inventory management strongly mediates the association between motivation and food waste reduction behaviour. Finally, Hypothesis 4 (H4) shows that packaging functions modify the association between motivation and food waste reduction behaviour with a coefficient of 0.517, standard error of 0.148, z-value of 11.430, and p-value of 0.000. Each hypothesis has significant effects, indicating strong correlations between variables.

Table 7: Path Analysis.

Hypothesis	OIM Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
H1	0.286	0.037	77.846	0.000	0.314	0.458
H2	0.606	0.058	11.389	0.000	0.569	0.727
H3	0.712	0.065	8.733	0.000	0.591	0.682
H4	0.517	0.148	11.430	0.000	0.292	0.895

5. Discussion

Reducing food waste is a major obstacle for a sustainable future especially in the restaurant industry, where ethical, environmental, and financial aspects call for creative answers. This is particularly relevant in the framework of the restaurant business. The influence of motivation, sustainable inventory management, and packaging functions on food waste reduction is examined within the context of this conversation. This study aims to analyse these issues by means of several hypotheses related in order to expose the mechanisms influencing waste reduction and provide solutions both pragmatic and long-lasting. The results show that restaurants must be aware of the interactions of internal incentives and external operational procedures in order to be able to lower food waste and support sustainability goals.

The results of this study show that restaurants' commitment to sustainable inventory management and inherent aim to lower food waste influence their food waste reduction strategies, therefore supporting both the first and second hypotheses. The first hypothesis shows how internal factors affect waste management techniques by claiming that the incentive to reduce food waste has a substantial influence on the behaviour of restaurants towards food waste reduction. Research indicates that food waste is more likely to be minimised in restaurants with strong motives that is, whether such motives are ethical, environmental, or financial. Highly motivated restaurants are more proactive in waste reduction techniques include optimising portion sizes, improving food storage, and matching menu planning with client demand, according past studies (Chia et al., 2024). This result supports the conclusions of the lately released studies. This study shows that motivation initiates and sustains waste reduction initiatives, resulting in more consistent and large food waste reductions. It is clear that motivation drives meaningful waste reduction transformation, hence restaurant management teams must have a strong motivational base. The second hypothesis, that sustainable inventory management strongly affects restaurants' food waste reduction behaviour, emphasises the importance of operational

methods in reducing food waste. Results show that restaurants that use sustainable inventory management methods including precise demand forecasting, real-time inventory tracking, and smart supplier collaborations reduce food waste more effectively. This supports supply chain management literature that says optimising inventory systems reduces overstocking, spoilage, and waste (Akkerman & Cruijssen, 2024). According to the studies, sustainable inventory management increases supply-demand alignment and restaurant efficiency, which lowers waste. Ordering, storing, and using food based on consumption patterns helps restaurants lower waste and extra inventory. These results show the usefulness of sustainable inventory management as a tool in the food waste reduction strategy, implying that restaurants implementing these strategies will see significant waste management benefits.

The relevance of operational methods in converting motivation into results is highlighted by the third hypothesis, which claims that sustainable inventory management considerably moderates the association between motivation to decrease food waste and restaurants' food waste reduction behaviour. The greatest way to realise these motivational urges is through sustainable inventory management, however motivation is required to begin waste reduction activities. Using sustainable inventory management techniques helps restaurants with strong ethical, environmental, or financial goals to lower food waste better reach their waste reduction targets. Food is ordered, stored, and consumed according to consumption demands thanks to accurate demand forecasting, real-time inventory tracking, and smart supplier relationships, therefore lowering overstocking, rotting, and waste. The mediation study underlines the need of encouraging restaurants and providing them with the tools to apply these incentives into waste reduction strategies. The literature stresses the need of connecting internal motivations with outside practices to reach organisational objectives (Sathatip, 2024). The adoption of the fourth hypothesis, which asserts that packaging functions for food waste considerably influence the relationship between motivation to reduce food waste and restaurants' food waste reduction behaviour, throws light on

the complicated waste reduction dynamics of the restaurant sector. It seems crucial to inspire waste reduction practices by means of package quality and usability. Restaurants that apply their waste reduction targets are better at using packaging to preserve food quality, extend shelf life, and control portion size. This moderating effect demonstrates that packaging is a tangible resource that can support or undermine efforts at motivated waste reduction. The study implies that by affecting internal incentives, packaging functions promote food waste reduction. This result supports earlier studies on the function of packing in food preservation and waste reduction (Kohli et al., 2024), but it also indicates how packaging could improve the effects on motivating factors on behaviour.

Acceptance of all four hypotheses demonstrates the complexity of restaurant food waste reduction, which includes motivation, sustainable inventory management, and packaging functions. This study emphasises the requirement of internal drives and external resources in waste reduction targets and implies that a complete approach is required to manage this major problem. The findings emphasise the need of motivated leadership and operational and physical instruments in turning motivation into results. This research provides a roadmap for merging motivation with practical solutions to develop a more efficient, responsible, and ecologically conscious food service sector as restaurants struggle with sustainability.

5.1. Implications

This study sheds light on how motivation, operations, and external factors effect restaurant food waste reduction. The study found that food waste reduction motivation greatly influences waste reduction behaviours, supporting the link between inner and extrinsic motivation and organisational performance. This confirms motivation theory, which holds that appropriate mechanisms can turn internal urges to pursue goals into physical actions. The study also reveals that sustainable inventory management mediates motivation and behaviour, extending the supply chain management and waste reduction theoretical framework and suggesting that practical approaches are critical. This mediation effect stresses the need to combine motivational and operational management theories to generate effective waste reduction strategies. The research also reveals how packaging functions control internal incentive forces, providing food waste management theory a new dimension. The resource-based approach asserts that organisational capacities

and resources affect strategic initiatives. These findings show the complexity of food waste reduction, enhancing theoretical perspectives on motivation and waste management and providing a more complete framework for understanding and addressing this important issue.

This study has substantial implications for food waste reduction for restaurant operators, legislators, and sustainability advocates. The study demonstrates that waste reduction requires restaurant personnel and management motivation. Training, incentives, and leadership commitment should motivate staff intrinsically and extrinsically to reduce food waste. The research stresses the need for sustainable inventory management strategies like exact demand projections, efficient stock management, and waste-tracking devices to mediate the relationship between motivation and waste reduction outcomes. This is why restaurants need strong operational strategies that match reward with action. New packaging solutions may help since packaging functions moderate waste reduction, according to the study. Restaurants should use packaging that preserves, controls servings, and reduces spoiling. These practical tips may help restaurants improve waste management to reduce food waste, expenses, and environmental impact. This research helps practitioners optimise waste reduction through motivation, operational improvements, and resource investments.

5.2. Limitations and Future Research Directions

This research provides useful insights into food waste reduction processes, although it has limits. Cross-sectional data, which covers activities and attitudes at one moment, is a major shortcoming. This methodological constraint prevents causality inference or observation of how motivating factors, inventory management methods, or packaging functions affect waste reduction behaviours over time. The study's concentration on regional restaurants may further limit its generalisability. The results may not apply to different situations or regions due to local restrictions, cultural attitudes towards waste, and economic conditions affecting restaurant waste reduction measures. The measuring of factors is robust, although self-reported data may include biases or mistakes in reporting food waste reasons and practices. To overcome these limitations, longitudinal research should record changes over time and establish causality. Expanding the research to encompass other geographical regions and food service establishments would improve generalisability and help explain global and contextual waste reduction techniques. Mixed-methods approaches, such as qualitative interviews

and quantitative surveys, may reveal how motivation, inventory management, and packaging functions affect waste reduction behaviours. Future research should examine how technical advances in inventory management and packaging and legislative changes affect waste reduction methods. Future studies can expand on this data to improve food waste management tactics and make the food service business more sustainable.

6. Conclusion

In conclusion, this study highlights the crucial role of motivation, sustainable inventory management, and packaging functions in influencing restaurant food waste reduction. The study validates that motivation strongly impacts waste reduction efforts and identifies sustainable inventory management as a crucial mediator, improving our understanding of waste reduction mechanisms. The data demonstrate that a motivated workforce and good inventory management can significantly enhance waste reduction. The study shows how packaging functions might moderate motivational and operational methods' effects. These insights provide a complete framework for restaurants to link internal motivational factors with practical and external resources to reduce food waste. These findings have broad implications for restaurant operators and policymakers looking to improve sustainability. The study admits limitations such cross-sectional data and apparent lack of generalisability. These findings should inform future research by include longitudinal investigations, increasing geographic and contextual scopes, and investigating technological advances. Future research can improve food waste reduction tactics and make the food service business more sustainable by tackling these issues. This research advances waste management and lays the groundwork for restaurant food waste reduction.

6.1. Acknowledgment

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Appendix 1

Motivation to reduce food waste

1. Saving money
2. Setting example for others
3. Managing household efficiently
4. Thinking about hungry people
5. Guilt about waste in general
6. Making a difference through my actions
7. Concern on the issues of energy and water

Sustainable inventory management

1. The entity has an effective inventory management system that helps achieve accurate demand forecasting.
2. The entity has effective inventory control techniques and mechanisms in place.
3. The entity has automated inventory control procedures to ensure appropriate stock levels are kept.
4. The entity has a working inventory records management unit that ensures accurate inventory records.
5. The entity has an up-to-date asset register which ensures proper inventory records management.
6. The entity regularly carries out stock/asset inspection and audits to keep track of inventory.
7. The entity ensures that the right stock levels are kept.
8. The entity has a policy on appropriate stock levels.
9. The entity considers lead time to ensure the safety stock kept is sufficient.

Packaging functions for food waste

1. Easier to empty.
2. Easier to open.
3. Less amount of food.
4. Easier to reclose.
5. Better information of ingredients.
6. Better information about when the food can be consumed safely.
7. Easier to handle.
8. Better protection of food quality - in unopened packaging.
9. Better protection of food quality- in opened packaging.
10. Easier to dose correct quantity.

Restaurants food waste reduction behaviour

1. I reduce food waste in our operations by closely monitoring procurement practices.
2. I minimize food waste by optimizing meal planning and preparation processes.
3. I encourage the reuse of leftover food within our operations rather than purchasing new inventory.
4. I implement recycling of leftover food as a cost-saving measure.
5. I prioritize recycling leftover food to contribute to environmental sustainability.