

# What Strategies do Restaurant Managers Employ to Mitigate Food Waste and what Challenges are Associated with Them?

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## ABSTRACT,

*This study addresses the gap in qualitative research on the implementation and effectiveness of food waste reduction strategies in restaurants, as well as restaurant managers' attitudes towards the integration of artificial intelligence (AI) for demand forecasting. Through in-depth interviews with restaurant managers, this research identifies key strategies such as accurate forecasting, dynamic ordering practices, strategic supplier selection, inventory management, menu design, and portion sizing. The findings highlight both the successes and challenges managers face in implementing these strategies. Additionally, the study reveals mixed reactions towards AI integration, with some managers recognising its potential to enhance demand forecasting and reduce waste, while others express concerns about cost and practicality. By providing a detailed analysis of real-world practices and attitudes, this research offers valuable insights for both practitioners and researchers, contributing to more effective food waste management in the hospitality industry and paving the way for future studies on AI adoption in this sector.*

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## Keywords

Food waste, Restaurants, Resource procurement, Menu design, Portion sizing, AI in the service industry

## 1. INTRODUCTION

The extraordinary extent of food waste in global food supply systems is gaining attention for its environmental, social, and economic consequences (Papargyropoulou, 2014). According to a report by the UN's Food and Agriculture Organization (FAO) titled *Global Food Losses and Food Waste* (FAO, 2011b), over 1.3 billion tons of food produced annually for human use are lost or squandered. This shows that there is a problem that the hospitality industry contributes to.

Pirani and Arafat (2016) suggest that over the next several years, there are expectations for the hospitality sector to develop at large rates in many regions of the world. The development of hospitality sector activities would result in an increase in waste created by the business. Therefore, improved waste management may result in considerable cost savings for businesses. Additional advantages of environmentally responsible disposal include a better company reputation and lower carbon emissions from less waste transportation (Ball and Abou Taleb, 2010). If existing waste management practices are not changed, the growing amount of waste created by the hospitality sector will result in a considerable rise in the industry's environmental impact.

There are already many quantitative studies that find the origins of food waste in restaurants, whether it be from the kitchen or from the customer, with some researchers giving suggestions on how to tackle the issue. A study in Finland found that 19% of edible food prepared in restaurants went to waste, with 30% coming from the kitchen and 50% from the leftovers on customers plates. The other 20% came from service waste, which was defined as the overproduction of food and buffet leftovers (Silvennoinen et al., 2015). There are also studies that highlight some of the effective strategies that could be employed to minimise waste, Sakaguchi et al., (2018) mention a few, such as; reviewing portion sizing, changing the menu, left-over utilisation, redesigning the supply chain, storage optimisation and staff training and education. Pirani and Arafat (2016) also emphasise the importance of accuracy in predicting the number of expected customers, playing a crucial role in managing food waste. Annor-Antwi & Al-Dherasi (2019) claim that through their research that AI when integrated with machine learning technology yields high accuracy forecasting which could in turn help in predicting the number of customers. However, Huang & Rust (2014) argue that AI imposes a threat to service jobs due to the human necessity for analytical skills becoming less important.

Although some studies have provided valuable insights as to the where waste comes from, being from the kitchen or the customers, as well as outlining some specific strategies that restaurants could use to minimise said waste, there is a lack of fine-grained studies and insights into how these strategies are implemented by restaurants and the challenges and successfulness associated with them. Very little is known about the actual experiences of practitioners implementing these strategies which this study aims to explore through evidence collected from the practitioners themselves. This is also highlighted by Silvennoinen et al. (2015) as they emphasise the need for more qualitative research as well as structured interviews with employees, customers, and management in order

to gather enough information on the best ways to prevent food waste in food services. In addition, there are no studies that outline restaurant managers' attitudes towards the integration of AI in the hospitality sector, which this study will address as well due to their potential of reducing food waste through accurate demand forecasting (Annor-Antwi & Al-Dherasi, 2019).

The main objective of this study is to identify and explore the challenges and the successfulness of the strategies employed to mitigate food waste through the use of in-depth qualitative research. As well as this, restaurants will be asked about their willingness to incorporate AI that could help with forecasting customer demand. With all of this in mind, the following research question will be explored:

*“What strategies do restaurant managers employ to mitigate food waste and what challenges are associated with them?”*

This study is academically relevant as it addresses a significant gap in existing literature on food waste management in restaurants. Whilst there are many quantitative studies that provide valuable insights into the extent and origins of food waste, as well as providing some strategies to help mitigate waste, there is much less qualitative research on the experiences, challenges and successes associated with these strategies. As well as this, there are no studies that portray restaurant managers' attitudes towards the implementation of AI in their sector. This is important to see whether future AI integration into traditional a-la-carte restaurants will be accepted by the managers.

The results of this study will directly benefit chefs and restaurant management from a practical aspect. This study can assist restaurants in putting in place more effective food waste management systems by identifying ideas and practices that work. This can therefore result in lower costs, more sustainability, and higher levels of customer satisfaction. The results of this study will also directly benefit AI developers by identifying the needs and concerns of restaurant managers when it comes to AI integration in the hospitality industry.

## 2. LITERATURE REVIEW

### Sources of Food Waste

The origin of food waste in restaurants can be traced back to either the consumer or to the kitchen. A study investigating 127 restaurants in Tuscany, Italy, found that a mean percentage of 12.93% of food prepared in the kitchens was wasted due to spoilage or incorrect preparation (Principato et al., 2018). The same study revealed that a mean percentage of 15.83% of food was leftovers on clients plates. This shows that food waste originates from both the consumers and the kitchen itself. As well as this, another study done in Finland calculated that a total of 19% of edible food prepared in restaurants was wasted (Silvennoinen et al., 2015). This study also found that 30% of this waste came from the kitchen, which is described as spoiled products and incorrectly prepared food. 20% of restaurant food waste came from what they call service waste, which was defined as overproduction of food and buffet leftovers, and the other 50% of the food waste came from leftovers from customer's plates (Silvennoinen et al., 2015).

Sakaguchi et al., (2018) states that visual measurement is a common but inaccurate method in tracking the origins of food

waste. It involves estimating the volume of waste without precise tools, often leading to underreporting. Approximately 24% of restaurants use manual tools based on purchase and inventory sheets to quantify food waste. This method involves tracking food purchases and leftovers to estimate regular waste amounts. Additionally, weight accounting systems are used by about 7% of restaurants, this involves software systems that record the weight and types of food waste, as well as reasons for disposal. This method provides precise data but is less commonly adopted.

### **Strategies to reduce food waste**

There are many strategies discussed that could help in the reduction of food waste. Sakaguchi et al., (2018) mention a few, such as; reviewing portion sizing, changing the menu, left-over utilisation, redesigning the supply chain, storage optimisation and staff training and education. Hennchen (2019) indicates that the greatest potential for the improvement of food waste management lies in menu planning, more efficient production based on waste statistics and more accurate procurement of goods, aligning with many of the factors mentioned above. Pirani and Arafat (2016) also emphasise the importance of accuracy in predicting the number of expected customers plays a crucial role in managing food waste.

Elshaer (2022) discusses an analysis of a restaurant's operations using time-driven activity-based costing, where several key restaurant activities are mentioned, such as, purchasing, receiving, stocking, food preparation, cleaning, dining room set-up, taking orders, serving food and beverages, table handling and customer communication. Although demand forecasting is not mentioned in the above list of activities, Schmidt et al. (2022) state that small to medium sized restaurants have difficulty forecasting due to lack of data, time and funds to carry out data analysis. Additionally, Lasek et al. (2016) stress the importance of demand forecasting for a restaurant's revenue system for both independent and restaurant chains. The majority of the restaurant industry forecast sales by using judgmental techniques that consist of a manager's intuition and experience. However, restaurant sales forecasting can be influenced by a large number of factors such as: time, weather conditions, and economic conditions to name a few. This makes judgmental forecasting a complex task that is prone to errors (Lasek et al., 2016).

Muller (2012) makes the link between manufacturing and restaurants, stating that restaurants are "Uniquely positioned as both consumer service providers and tangible finished goods manufacturers." As well as this Muller (2012), emphasises the benefits of "lean manufacturing" and the ways in which restaurants can embrace it. Regarding manufacturing companies, Wacker & Lummus (2002) state that the importance of sales forecasting for resource allocation and labour scheduling cannot be overstated. This could be linked directly to purchasing in restaurants as they have 'wasting inventory' meaning that unlike traditional manufacturing companies their inventory has a shelf-life and cannot be stored long term, making forecasting even more important. The occurrence of food waste is directly linked to decisions regarding the planning of accurate food quantities (Hennchen, 2019). This study also indicates that the two major uncertainties when calculating adequate inventory are predicting how many people will show up to the restaurant on a given day and uncertainty about the size of portions in order to align with customer's demand.

According to Henchen (2019), the guiding principle for restaurants was to calculate larger portion sizes to ensure that

customers would leave the establishment satisfied, as hungry customers were viewed as the "worst case scenario." However, unfinished meals are the main reason behind food waste generation at the consumption stage (Pinto et al., 2018; Filimonau et al., 2020). To encourage more responsible consumption, portion control can be applied to create the ideal size of a meal (Principato et al., 2018). According to Ofei et al. (2015; Hennchen, 2019) two main obstacles in regard to reducing avoidable food waste were identified in large institutions: forecasting accurate customer numbers and facilitating flexible portions, suggesting that there is a chance at reducing the food waste on the customers plates by providing flexible portion sizes.

The design of the restaurant's menu can also be another factor that contributes to food waste. According to Goodwin (2023), restaurants can better estimate supply ordering and control food consumption by focusing on a limited selection of menu options. Chefs should focus on making each meal as sustainable as possible when fewer dishes are available, eliminating the need for large inventories that result in waste from unsold goods (Kantor et al., 1997; Charlebois, 2014). Aligning the menu with seasonal products can also help minimise waste because it is fresher and less prone to spoilage due to shorter transit distances (Solomon, 2022). Chan and Au (1998) also confirm that seasonal menu modifications may greatly minimise food waste in the restaurant business, they also point out that the cross-utilization strategy can be very beneficial (Charlebois, 2014).

Businesses usually have to modify their menus because of external reasons like seasonal changes, leading to the addition of new goods to their inventory (Wenzel, 1979; Charlebois, 2014). These seasonal menu items are frequently not included in computerised monitoring systems, which leads to incomplete tracking (Chan & Au, 1998; Charlebois, 2014). It's possible that the mistracking of inventory items is the cause of what at first looks to be food waste. To solve the issue of untracked inventory, restaurants can use activity-based costing techniques to track the ingredients needed for each dish. This detailed tracking helps to prevent issues with unaccounted inventory items, thereby reducing waste and improving overall inventory management (Vaughn et al., 2010; Charlebois, 2014)

### **Possibility of AI Integration**

While the opportunities of AI are prevalent within the restaurant industry, Huang & Rust (2014) argue that AI imposes a threat to service jobs, theorizing four types of intelligence linked to service tasks: mechanical, analytical, intuitive, and empathetic. Their theory concludes that as AI is continuously integrated into the service industry, human necessity for analytical skills will become less important (Huang & Rust, 2014). Annor-Antwi & Al-Dherasi (2019) claim that through their research that AI when integrated with machine learning technology yields high accuracy forecasting as opposed to other methods.

There are several articles that explore different methods of implementing AI in the supply chain of any business. The most prevalent and influential is ANNs, an information-processing technique that can be used to find patterns, knowledge or models from an extensive amount of data (Toorajipour et al., 2021; Aleksendrić & Carlone, 2015). Toorajipour et al. (2021) state that the second most prominent is FL/modelling, which has only recently gained traction due to the approach it takes in addressing qualitative information, in that it resembles the manner in which humans make decisions (Keramitsoglou et al. 2006).

With all of this in mind, there is a gap in understanding the experiences and challenges associated with implementing the strategies discussed above through the lens of the restaurant managers. This is backed up by Silvennoinen et al., (2015) who mentions that in order to obtain sufficient data for the best practices to avoid food waste in food services more studies based on qualitative methods and structured interviews for persons in management, workforce and customers will be required. On top of this, attitudes of restaurant managers to the integration of AI in their field is not mentioned, which this study will explore.

### 3. METHODOLOGY

#### 3.1 Research Design

This qualitative, inductive study aims to explore the experiences and challenges restaurant managers face regarding their strategies towards resource procurement, menu design and portion sizing in order to reduce food waste. Inductive reasoning will allow for the generation of new theories or models based on the data collected. The research design will employ semi-structured interviews with restaurant managers. Purposeful sampling will be used to select participants who have experience and expertise in the purchasing of resources, menu design and decisions regarding the portion sizes for their respective restaurants.

#### 3.2 Data Collection

Semi-Structured Interviews:

A semi-structured interview guide has been chosen in order to provide a flexible yet structured approach to exploring the various aspects of the experiences and challenges encountered by managers when implementing food waste reduction strategies. This allows the interviewer to follow a guide of predefined questions yet also explore further and ask different questions to ensure the interviewee elaborates and gives the information that the interviewer is looking for.

The interview questions were designed to cover four main areas that are known through the literature to have an impact on food waste, these areas include: Resource procurement, menu design, portion sizing and staff training. As well as this, an area named “challenges and solutions” was incorporated in order to gain insights into the biggest challenges that the restaurants face in regards to food waste and the measures they take to overcome said challenges. The idea of implementing an AI system that could help with forecasting consumer demand for certain products and “busy days” was also presented to understand the managers’ attitudes towards the integration of such systems in the future. The interview guide can be found in the appendix section of this paper.

Interviews will be conducted in-person and the time of the event will be selected at the preference of the interviewee. Each interview is expected to last 15-30 minutes, and will be recorded and transcribed with the consent of the participants involved.

#### 3.3 Participant Selection

Purposeful sampling will be used to ensure that participants are selected that have knowledge and experience in the focused areas of study.

Inclusion criteria:

- Restaurant or kitchen managers that have knowledge and expertise on their strategies for resource procurement, menu design and portion sizing.
- Restaurant or kitchen managers from a-la-carte restaurants, with no specificity on the average prices or perceived “luxury” of each of the restaurants. Allowing a comparison to be made across the different levels of restaurants.

Some of the managers selected also own multiple restaurants. For example R2 owns two separate restaurants and R6 owns a total of 14 different restaurants.

#### 3.4 Data Analysis

Thematic data analysis was used in order to analyse the qualitative data obtained from the interviews using the following steps:

Reading the transcripts of each interview thoroughly and highlighting phrases and certain passages that contribute to the research goal of identifying the successful strategies that restaurant managers use to mitigate food waste and the challenges associated with them. Open coding was used in order to identify these key concepts and ideas, and then themes were developed by organising these codes based on the similarities that they share into said themes. The themes were identified at the latent level, meaning data was looked at and underlying ideas, assumptions and conceptualisations could be made (Braun & Clarke, 2006). The latent level was chosen over the semantic level mostly due to the language barrier that was experienced at times, however, I truly believe that the codes signify what the interviewee really meant. A report was then prepared using the most important themes that show up, that provide insights into how restaurant or kitchen managers make decisions regarding the reduction of food waste. The thematic analysis was done manually with the use of a software called [taguette.org](http://taguette.org). The initial codes that went into the themes are displayed in Figure 1.

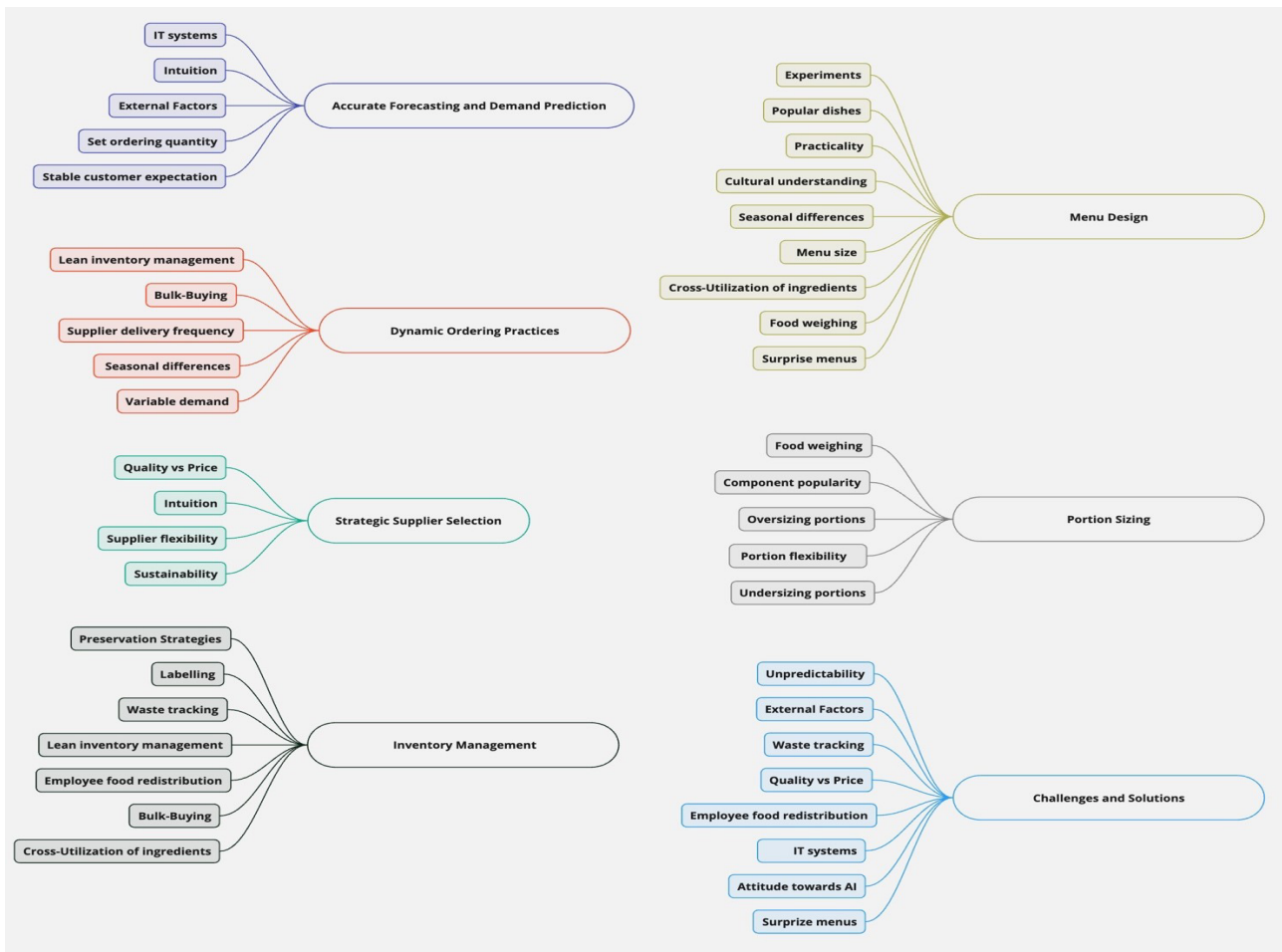


Figure 1. Data structure of sorting codes into themes

## 4. FINDINGS

The thematic analysis of the interviews with restaurant managers revealed several key strategies and practices that the managers employed to minimise food waste as well as the challenges associated with them. The analysis is organized around seven main themes: Accurate Forecasting and Demand Prediction, Dynamic Ordering Practices, Strategic Supplier Selection, Inventory Management, Menu Design and Portion Sizing.

### 4.1 Accurate Forecasting and Demand Prediction

Most restaurant managers use a combination of IT systems and intuition to predict customer demand accurately, however some rely solely on their intuition. For instance, one manager R1 utilizes a common hospitality program that records each order made for each individual dish on specific days over the past years. This allows the team to spot patterns and trends. Other managers such as R7 and R6 rely solely on intuition, drawing on years of experience to in order to gauge future demand.

External factors such as weather and reservations also significantly influence these predictions in all managers across the board. As one manager R3 noted, “It depends on weather reservations and whether we have groups. Sometimes it's very difficult to get the right amount of preparation, so we keep a surplus of stock.” The weather seems to be one of the key aspects that all managers look at when forecasting, as one manager R1 stating that “We also look at the weather and if it is not good weather we order fewer resources as we expect less demand.” However, almost all participants mention the unpredictability in

the weather which is a challenge for them when it comes to forecasting demand. So, while both IT systems and intuition play important roles in accurate demand prediction, as well as the integration of external factors such as weather and reservations remains crucial for all managers to effectively forecast customer needs.

### 4.2 Dynamic Ordering Practices

From the interviews we have found that all restaurants differ in their ordering practices. Some managers like R2 and R3 stress that lean inventory management is key, not only to reduce the food waste that could come with over purchasing but also to ensure freshness for customer satisfaction. R2 states “I don't buy much everyday, I work with more fresh products. In that way I make sure I only have most products for a maximum of 1-2 days.” R2 had a relatively negative view of bulk-buying as they believe that it leads to more kitchen waste. In contrast, R5 had a different point of view as they receive supplies once a week and tend to order in larger quantities. Especially for items that are not as perishable, such as cashews and lentils which they order once a month in bulk quantities. It can be stated that restaurants use different ordering practices. Some prioritize lean inventory management to reduce waste and maintain freshness, while others use bulk-buying for durable items to optimize efficiency.

### 4.3 Strategic Supplier Selection

Selecting the right suppliers is crucial for balancing quality, price, and reliability. Managers consistently emphasise the

importance of sourcing high-quality ingredients while managing costs effectively. R2 remarked, "Quality is the most important. If you are a restaurant, you ask for a price but have to sell quality." Reliable suppliers who are responsive and professional are highly valued as highlighted by R3. The significance of having dependable suppliers who can deliver fresh products consistently is valued by many of the restaurants interviewed, as most of them receive stocks daily. This in turn helps with lean inventory management practices, as orders can be made dynamically in order to make up for shortages of stock.

Sustainability is another consideration made by some, although cost can be a barrier. R1 expressed a preference for local suppliers to support sustainability efforts but acknowledged the higher costs involved: "We would prefer to be sustainable but unfortunately we need to also survive, so we need to have contracts with certain suppliers to get better deals." On the other hand, R4 found success in dealing with more sustainable suppliers, as they claim that "almost all our meat now comes from Holland." It can be said that selecting the right suppliers is vital for balancing quality, cost, and reliability, with some managers also considering sustainability despite its higher costs. Some managers prefer to employ suppliers that are flexible and can deliver daily in order to guarantee maximum freshness, whereas others prefer to purchase in bulk for the week.

#### 4.4 Inventory Management

Managers use a variety of tactics to effectively manage inventory and reduce waste. In order to increase the shelf life of ingredients, preservation techniques like vacuum sealing, freezing, and fermenting are frequently employed. R1 explained, "We freeze a lot of things if we overproduce; we also use vacuum sealing to keep things fresher for longer." Tracking stock levels and cutting waste are made easier with proper labelling and daily inventory checks. R3 noted, "We also use date stickers and label everything. Forecast how busy it will be and make the minimum as fresh as possible."

Furthermore, R4 utilises apps such as TooGoodToGo to sell surplus food that might otherwise go to waste. R4 mentioned, "We use the TooGoodToGo app for example with pies that we aren't allowed to sell anymore but are still fine." This was only specific to R4, however, this could be a valuable method for anyone of these restaurants if they decided to employ it.

#### 4.5 Menu Design

By careful planning and frequent updates, menu design can significantly reduce waste. Managers minimise waste by offering a variety of dishes that appeal to different customer tastes while maintaining a balance. R1 highlighted this balance, emphasising the necessity of having both novel and traditional dishes on the menu to be able to cater to a wide range of customers. Due to seasonal preferences and the availability of fresh, local ingredients, seasonal adjustments are common. R3 mentioned, "Depending on the season, a stew is more for winter/autumn. We have worked here for a lot of years and we know the guests; we have a lot of dishes for several years on the menu as these are guest favorites but we give a twist sometimes."

Cross-utilisation of ingredients is also employed, as R5 reaffirms when asked if they use that strategy, "One tomato gravy is for many other dishes, and curries, it is so cost effective and is really the base of so many of the curries that we serve." To make sure that ingredients are used to their full potential, R4 explained how the same kind of chicken is used across multiple dishes. Also, R3 added that different parts of beef can be used for various dishes,

sometimes serving as a starter with one preparation and as a main course with another. Some managers believe that cross-utilization of ingredients effectively maximizes ingredient use and reduce waste.

R7 uses a tactic that they've called "the chefs menu" or surprise menu as shown in the codes. This is where they allow the customer to be surprised by the chefs giving the chefs free reign to design their dishes. This is especially useful in dealing with food waste as they tend to utilise products in this menu that are soon to expiry, but still come up with a delicious dish. R2 employs a similar strategy for their tapas menu, where customers can order the chef's selection which typically consists of "less popular but still delicious tapas items."

#### 4.6 Portion Sizing

Strategies for portion sizing are to minimise waste and maximise customer satisfaction. Controlling portion sizes with standardised measurements ensures consistency and lowers waste. R3 follows specific standards for different types of food, stating, "You use standards. 160-180 grams of meat and fish. 100-120 for vegetables. You take a general amount for a person to eat." Portion sizes can be changed in response to customer feedback to guarantee satisfaction and cut down on waste. R1 mentioned how initial complaints about small portions led to quick adjustments: "We got complaints at the beginning about dishes being too small so we immediately on the spot changed it and gave 1.5 times more than we originally intended for the dish."

Some restaurants have made a reputation by serving small plates such as R7, where they claim that this concept allows everyone to try many different dishes but leave behind minimal waste due to the portion being rather small. R2 have a tapas menu, where they can serve smaller versions of their main course dishes, offering portion flexibility. Implementing strategies for portion sizing, such as standardized measurements, flexible portions, and small plates, helps minimize food waste according to managers.

#### 4.7 Role of AI in Reducing Waste

The main challenge associated with minimizing waste is the unpredictability of customer demand, influenced by factors such as weather and local events. As R3 noted, "Sometimes it's very difficult to get the right amount of preparation, so we keep a surplus of stock." Managers use IT systems and historical data to make more informed predictions. R1 utilizes a hospitality program to track orders and spot trends. Additionally, maintaining a small surplus of non-perishable items helps meet unexpected demand without significant waste. The adoption of new technologies for waste management is often hindered by the associated costs and the effort required to integrate them into existing operations. As R1 stated, "We are also looking into other programs to manage food waste but it's a lot of money and a lot of work to get it started."

Moreover, attitudes towards AI systems among managers vary. The belief provided to the interviewee was that AI will be able to help predict customer demand more accurately through integration with the restaurants already existing IT systems helping them with ordering and preparing precise quantities and reducing overall food waste. While some are open to the idea, others are skeptical about its accuracy and cost-effectiveness as shown on Figure 2.

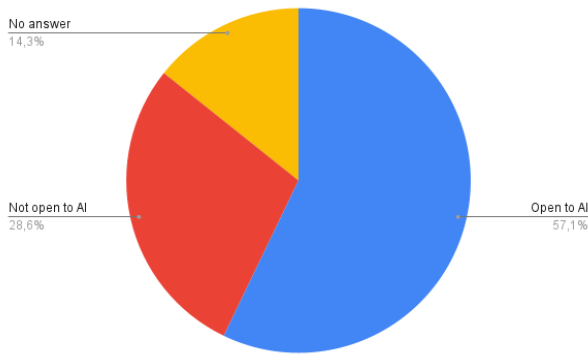


Figure 2. Pie chart showing the openness of 7 restaurants to implement AI system

R1, R2, R5, and R7 are willing to adopt AI software that can integrate past orders and weather forecasts to enhance predictions. This group represents 57.1% of the managers interviewed. The excitement is seen where R5 states, “It’s good, AI especially, it would be great. We can reduce the manpower and help with calculations. It has changed many sectors, but the restaurant sector is still pending.”

Conversely, R3 and R4, representing 14.3% of the restaurants, were opposed to adopting the innovative AI idea. When asked about the consideration of implementing AI systems R3 states, “In all the years we have everything on paper, we can see everything on paper. I know it’s the future, but I prefer the old school pen and paper and it’s working fine.” This shows mixed feelings towards AI’s implementation throughout the data collected. There is a restaurant (R6) that could not give an answer. The manager said that they might use it one day but probably do not wish to do that. They were on the fence between considering implementing it or sticking with traditional methods.

## 5. DISCUSSION

The findings of this study highlight several significant themes that provide insights into the strategies and decision-making processes employed by restaurant managers to minimize food waste. This section discusses these themes and compares them with existing literature and explores their implications through theoretical contributions and managerial implications.

### 5.1 Theoretical Contributions

By emphasising the relationship between intuitive decision-making and technology adoption in the context of restaurant management, this study adds to the body of current work. Demand forecasting using a combination of IT technologies and managerial intuition highlights how complicated and hybrid decision-making processes are in the hospitality sector. This is consistent with and builds upon the research of Schmidt et al. (2022), who stress the significance of precise demand forecasts for food waste management.

Additionally, the study supports and expands upon the principles of lean inventory management adapted to the restaurant industry, as discussed by Muller (2012). R2 suggests that this is one of the key methods that help in combatting food waste. This is only possible with flexible suppliers that can deliver supplies on demand, as opposed to the weekly supply deliveries employed by R5. By illustrating the diverse ordering practices and preservation methods used by managers, this research shows how theoretical concepts are practically applied to minimise waste.

Some previous literature denotes that portion sizing did not have a significant impact on the minimisation of food waste (Charlebois et al., 2015). However, the findings of this research contradict this, as many of the managers consulted attributed the minimisation of food waste to their portion sizing. For example, R7 uses small portions of 70-100 grams per dish, which they claim significantly reduces the impact of food waste due to customers tending to finish the whole dish. Another aspect is portion flexibility; R2 states that the separation of the tapas and main menu allow customers to have a smaller version of a main dish that they would have wanted, which would lead to them finishing the whole plate.

Charlebois et al., (2015) mention that menu design issues, such as the popularity inequality of dishes and the inability to cross-utilise ingredients leads to waste. R2 and R7 utilise clever ways to overcome these challenges through surprise menus, where they can push out less popular dishes to customers that order said menus. This method is further evidenced to help mitigate food waste through a study conducted by Pirani and Arafat (2016).

A few managers are aware of how AI might enhance inventory control and demand forecasts. R5 was excited about AI’s potential and mentioned that they could be able to manage resources more effectively with the use of sophisticated prediction tools. This is consistent with research by Annor-Antwi & Al-Dherasi (2019), who show that when AI and machine learning technology are combined, predicting accuracy is higher than with conventional techniques. Food waste can be considerably decreased by using AI’s capacity to analyse massive volumes of data and spot trends, which can greatly assist in producing more accurate forecasts.

Despite the potential benefits, there is some skepticism among some managers. R3, for instance, is cautious about the cost and practicality of implementing AI systems. The concerns are backed up by Huang & Rust (2014) that discuss the complexities and potential downsides of integrating AI into service industries. They argue that while AI can enhance mechanical and analytical tasks, it may reduce the need for human analytical skills, which could be seen as a threat to certain jobs within the industry. This adds to the literature regarding the attitudes of managers towards the implementation of AI in their practice.

### 5.2 Managerial Implications

The strategies identified in this study provide managers with a practical roadmap on successful strategies to reduce their food waste and what those strategies entail through examples from real world restaurants. This is different from existing literature that sets out to quantify food waste and discuss strategies from a theoretical perspective as opposed to a practical one.

**5.2.1 Leveraging Technology for Demand Forecasting:** Managers can benefit from using advanced IT systems to track sales trends and predict future demand more accurately. Systems such as “Lightspeed” and “YourBI” are used by R1 and R4 respectively in order to record the amount of specific dishes sold in a given time period. This can help reduce the reliance on intuition and mitigate the risk of over-preparation, as solely relying on judgmental forecasting is a complex task and prone to errors (Lasek et al., 2016).

#### 5.2.2 Adopting Lean Inventory Practices:

Implementing lean inventory management by purchasing fresh products in small quantities can help maintain ingredient freshness and minimize waste. As R2 noted, “I don’t buy much

every day, I work with more fresh products. In that way, I make sure I only have most products for a maximum of 1-2 days.” Supporting the claim that lean inventory management is a staple for businesses that have perishable inventory (Muller, 2012). In order for this to be effective, it seems that the restaurants must undertake dynamic ordering practices and have flexible consistent suppliers that can provide produce daily.

### 5.2.3 Strategic Supplier Selection:

Balancing quality, price, and reliability in supplier selection is crucial. On top of this, flexible suppliers that have the option of daily deliveries is crucial for strategies such as lean inventory management, which is undertaken by some restaurants in the study such as R2 and R3. Opting for local suppliers can support sustainability efforts and reduce the environmental impact of transportation.

### 5.2.4 Employing Preservation Methods:

Using techniques such as freezing, vacuum sealing, and fermenting can extend the shelf life of ingredients, allowing managers to use them over a longer period and reduce waste. However, some managers such as R6 prefer to only use fresh ingredients thus would not adopt such preservation strategies, suggesting that the quality that practitioners want to provide will influence their willingness to engage in preservation methods.

### 5.2.5 Optimising Menu Design:

Balancing innovative and familiar dishes, making seasonal adjustments, and utilizing ingredients across multiple dishes can help minimize waste while catering to diverse customer preferences. The balancing of innovative and familiar dishes is crucial because some consumers prefer standard dishes instead of trying experimental ones, as highlighted by R1. The cross utilisation of ingredients was seen as crucial as well, with R4 emphasising the benefit to food waste by having 3 dishes use the same type of prepared chicken. Seasonal adjustments was also mentioned by the restaurants with many changing their menu seasonally. This is backed up by evidence from Goodwin (2023), that ingredients that are in season tend to have a longer shelf life, which would minimise the wastage of said ingredients.

### 5.2.6 Adjusting Portion Sizes

Standardized portion measurements and flexibility in portion sizes can help control food waste. Offering small plates and sharing options can further reduce leftovers as stated by R6, that’s restaurant concept is primarily built around small portions made for sharing. Strategies like offering smaller versions of main dishes in a “tapas” menu was also a successful strategy implemented by R2. As well as this, reducing the sizes of dessert dishes was proven to be a successful strategy by R3, as since they are smaller now consumers would order more of them knowing that they can finish their plates.

## 6. CONCLUSION

In this study many strategies mentioned in previous literature to reduce food waste were explored but this time through the lens of the restaurant manager. This allowed the exploration of real-world examples of these strategies and the challenges that restaurants face when implementing them. This section aims to answer the primary research question “What are the strategies that restaurant managers employ to mitigate food waste and what challenges are associated with them?”

When it comes to accurate forecasting and demand prediction, some restaurants opt for the use of IT systems that record past

sales data to help with forecasting the demand of certain dishes in specific periods. Others however, rely solely on intuition based forecasting. A challenge with forecasting that almost all the restaurants shared was the unpredictability of external factors, such as the weather.

Dynamic ordering practices is another strategy that was found to help mitigate food waste. Although this strategy is not discussed in previous literature, many managers from the study state that this is essential in order to maintain a lean inventory and ensure freshness of the product. Whilst some managers use bulk-ordering for the week, others prefer ordering small quantities daily to keep stock fresh. A challenge associated with this however is finding the right supplier that is flexible and consistent enough to be able to deliver daily, which leads to the following point.

Strategic supplier selection is crucial for balancing quality, price, and reliability. Managers highlighted the importance of working with flexible suppliers who can provide daily deliveries, which supports the lean inventory practices as mentioned above. Additionally, some managers prefer local suppliers to enhance sustainability, however, this poses a challenge for some due to the higher costs involved with going for sustainable suppliers.

Effective inventory management techniques, such as vacuum sealing, freezing, and proper labelling, were commonly used to extend the shelf life of ingredients. Some restaurants also employ apps like TooGoodToGo to sell surplus food that might otherwise go to waste. However, even though these preservation techniques are efficient at extending the shelf-life of ingredients, some restaurants would prefer to ensure that the ingredients are as fresh as possible and will rather not use such strategies, relying even more on having reliable and flexible suppliers as mentioned above.

Menu design also plays a significant role in reducing food waste according to the managers. The implementation of seasonal adjustments and cross-utilisation of ingredients across multiple dishes helps to minimise waste. A challenge identified with menu design is ensuring that a balanced menu is offered, with both the restaurants innovative and traditional dishes. This ensures that the restaurant caters to diverse customer preferences and helps to reduce the likelihood of waste from less popular items.

Portion sizing strategies include standardized measurements and flexible portions to ensure customer satisfaction and minimize waste. Offering small plates and sharing options were particularly effective in reducing leftovers. The challenge with portion sizing is ensuring that the customer leaves happy and is satisfied with the amount of food they get for the price they pay. Oversizing portions may make the customer feel that they get value for their money, however, in turn could lead to excess waste being left on the plates of customers.

The potential integration of AI in demand forecasting received mixed reactions. While some managers are enthusiastic about the precision and efficiency AI can bring, others are skeptical due to concerns about cost, practicality and especially the unpredictability of the weather, as even the forecast can be wrong at times.

## 6.1 Future Research

Exploring AI Adoption in Restaurants: Further research is needed to understand the barriers to adopting AI systems in the restaurant industry. Studies could focus on developing cost-effective, user-friendly AI solutions that can enhance demand forecasting and inventory management.



Developing Training Programs: Research could also focus on designing and evaluating training programs that enhance staff awareness and adherence to waste reduction practices. Effective training can play a crucial role in creating a culture of sustainability and minimising food waste within restaurants. It was shown that many of the restaurants interviewed relied on the kitchen's common sense, rather than providing specific training towards dealing with food waste.

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## 9. APPENDIX

*Interview Guide Used for the Collection of Data*

### Resource Procurement

- How do you forecast the amount of food to order for your restaurant?
- What tools or methods do you use to predict customer demand?
- How often do you review and adjust your ordering practices?
- How do you choose your suppliers, and what criteria do you consider most important in this selection process?

- What inventory management practices do you use to minimise food waste?

### Menu Design

- How do you decide what dishes to include on your menu?
- What factors influence your menu design in terms of minimising food waste?
- Do you change or update your menu to reduce waste? How often?
- Do you use any strategies like cross-utilisation of ingredients across different dishes to minimise waste?

### Portion Sizes

- How do you determine the portion sizes for the dishes on your menu?
- How do you gather and incorporate customer feedback regarding portion sizes?
- Do you offer flexible portion sizes or allow customers to choose their portion sizes? If so, how has this affected food waste?

### Staff training

- What training do you provide to your staff regarding food waste management?
- Are there any policies that have been implemented to reduce food waste?

### Challenges and Solutions

- What are the biggest challenges you face in minimising food waste, and how do you address them?
- Does the restaurant have any IT systems in place that could help with managing food waste?
- Can you share any successful strategies or practices you have implemented to reduce food waste?