International Journal of Management and Business Intelligence (IJBMI)
Vol. 4 No. 4, 2026: 1013-1030

Analysis of Artificial Intelligence-Based Food Waste Management: A Case Study in a Luxury Hotel and Resort

Kadek Ari Widiantari[1*], Ni Made Sri Rukmiyati[2], Ni Ketut Mareni[3]
Politeknik Pariwisata Bali Kementerian Pariwisata Republik Indonesia
Corresponding Author: Kadek Ari Widiantari deari.widiantari@gmail.com

A R T I C L E I N F O

Keywords: Artificial Intelligence, Food Cost, Food Waste, Food Waste Management, Hospitality Industry

Received : 27, June
Revised : 28, July
Accepted: 30, August

A B S T R A C T

This study aims to analyze the implementation of Artificial Intelligence (AI)-based food waste management at a five-star luxury resort in Bali, Indonesia, and its implications for food cost. The study employs a descriptive method with a qualitative case-study approach through interviews, observations, and documentation involving the Executive Chef, the Hygiene & Steward Manager, and the Cost Controller. Data were analyzed using Karakas' (2021) food waste management framework, comprising Menu Planning, Purchasing & Storing, Food Preparation, Communication with Guest & Staff, and After Service. The findings show that all five aspects have been implemented with the support of AI technology, which functions as a real-time provider of data on the type, quantity, and value of food waste generated during kitchen operations. The implementation of AI-based food waste management has implications for food cost through the reduction of food-material cost waste at every stage of operations, contributing an estimated saving of 0.33% to 0.44% of food cost per month. However, food waste is recorded as part of the Cost of Goods Sold (COGS) without being itemized as a separate account, so its financial impact is not yet fully explicit in the hotel's financial statements.

DOI: https://doi.org/10.59890/ijmbi.v4i4.53
ISSN-E: 3025-5589
https://journalijmbi.my.id/index.php/ijmbi

INTRODUCTION

Food waste is a persistent problem in food-service sectors, including the hospitality industry, which is characterized by relatively high levels of food consumption and production (Martin-Rios et al., 2021). The United Nations Environment Programme (UNEP) reports that global food waste reaches approximately 931 million tonnes per year, with a substantial share generated by the food-service and hospitality sectors (Kurnia et al., 2020; UNEP, 2021). This high volume indicates that food waste is not merely an environmental issue but also reflects inefficiency in the use of economic resources, with a direct impact on operating costs (Clark et al., 2024).

Hotel operations are inherently complex, as establishments must maintain food availability under fluctuating guest demand (Kurnia et al., 2020). Kitchen activities span menu planning, procurement, production, and food service delivered to defined quality standards (Johannesson et al., 2025). Buffet and banquet formats, high variability in guest demand, fluctuating occupancy, and service standards that emphasize generous food availability all contribute to food surpluses at both the preparation and post-service stages (Susanti & Wiryanata, 2024), increasing the likelihood of food waste across hotel operations.

A recent quantification study of hotels and restaurants in Bali found that hotels generate an average of 2,137.20 kg of food waste per property per month, dominated by vegetables, meat, and fruit residues from food-preparation activities (Sadyasmara et al., 2025). As a luxury resort with high-volume restaurant and banquet activity, the hotel examined in this study shares similar operational characteristics, making food waste management an essential part of maintaining operational efficiency and controlling food cost.

High levels of food waste in the hospitality industry do not only create operational problems; they also affect the hotel's financial performance, particularly food cost (Karvounidi et al., 2024). Food cost is the expense incurred by a hotel for procuring the food materials used in production (Cejas, 2025). Every plate of food that is thrown away represents costs already incurred — for raw materials, labor, energy, production, and waste handling (Sigala et al., 2025). From an accounting perspective, food waste is therefore not simply an operational or environmental concern; it is a recorded cost of food materials that generates no corresponding revenue for the hotel, and high levels of food waste can translate directly into avoidable cost burdens (Kurnia et al., 2020). Managing food waste effectively is consequently important for supporting operational cost efficiency and profitability (Principato et al., 2023; Sadyasmara et al., 2025).

Food waste management cannot be addressed only at the point where waste is generated; it needs to be embedded across every stage of hotel operations. Karakas (2021) proposes that food waste management in luxury hotels comprises five key aspects: Menu Planning, Purchasing & Storing, Food Preparation, Communication with Guest & Staff, and After Service. Applying these five aspects aims to reduce food-material waste from the menu-planning stage through inventory management, food preparation, and the eventual handling of food waste, so that food waste management supports both waste reduction and food-cost control through more efficient use of food materials.

Prior to adopting Artificial Intelligence (AI)-based tracking technology, the hotel examined in this study lacked detailed, informative data on food waste that could serve as a basis for evaluating its food waste management practices. Food waste generated from kitchen activities was collected directly by a third party for disposal, so the hotel only received information on the total volume of waste without knowing the specific type of food discarded, its weight, or the cost value of the resulting loss. This lack of data limited management's ability to conduct evaluations, so food-cost control could not be carried out optimally (Martin-Rios et al., 2021). This situation prompted the hotel to implement an AI-based food waste management system capable of providing digital, real-time, and accurate data, thereby improving management's awareness of the type, quantity, and value of food waste generated during operations, and providing a basis for managerial decision-making (Johannesson et al., 2025; Sigala et al., 2025). Baseline data recorded after the technology's implementation are presented in Table 1.

Table 1. Baseline Kitchen-Operation Food Waste Data after AI Implementation

Food Waste Type	**Waste Weight**	**Percentage (%)**	**Waste Value**
Fruit Trimmings	351 kg	23%	Rp 2,351,017
Plate Waste	1,138 kg	76%	Rp 0
Overproduction	8 kg	1%	Rp 108,917

Source: Kitchen-operation food waste data of the case-study hotel, 2026.

Table 1 shows that, following the adoption of AI technology, operational food waste data indicated that food-material losses occurred across several categories, each with a different quantity and value. The availability of such data represents a marked improvement in informational visibility compared with the previous condition, enabling management to identify the sources of waste at each operational stage more clearly, and indicating that food waste management requires a systematic approach at every operational stage so that the resulting information can be used optimally to support food-cost control.

Food waste management is one of the measures that can be taken to reduce a hotel's operating costs (Karakas, 2021). Each type of food waste requires a different handling method depending on its characteristics (Susanti & Wiryanata, 2024). According to Sadyasmara et al. (2025), food waste management is generally carried out through several methods, such as direct disposal, distribution to third-party collectors, or redistribution to employees for further use.

The development of AI-based technology has become one solution to the problem of limited food waste data (Karvounidi et al., 2024). AI technology helps hotels record food waste automatically and, on a data,-driven basis, so that information on the type, quantity, and economic value of food waste becomes more accurate and available in real time (Johannesson et al., 2025). Several studies show that AI-based technology implementation helps management identify wastage patterns, improve production-planning accuracy, and support more effective kitchen operating-cost control (Principato et al., 2023; Sigala et al., 2025). A case study of Conrad Shanghai found that AI-based food waste tracking generated more detailed waste data, helping management identify sources of waste more specifically so that menu planning and procurement could be adjusted more precisely, and contributing to a reduction in food waste volume (Karakas, 2021). Nevertheless, the success of AI implementation still depends on each hotel's operational conditions and the extent to which management makes use of the resulting data (Conrad, 2024; Winnow, 2013).

Research on food waste in the hospitality industry has largely focused on the classification of food waste and its handling methods, with most studies centered on the amount of food waste generated, the dominant types of waste, and management methods within hotel operations. Research examining food waste management as a means of minimizing food cost with the support of AI technology remains relatively limited, particularly in the context of luxury resorts in Bali. This study is therefore important for providing a more comprehensive picture of food waste management in support of hotel operational efficiency.

Based on the preceding discussion, this study examines AI-based food waste management at a luxury resort in Bali, covering its implementation across the five aspects proposed by Karakas (2021) together with its implications for food cost, given that food waste management cannot be separated from its impact on hotel operating costs. Accordingly, this study aims to (1) analyze the implementation of AI-based food waste management across the five aspects, and (2) analyze the implications of food waste management for food cost. This study is expected to contribute both academically and practically to the hospitality industry, particularly in efforts to improve cost efficiency and operational sustainability.

LITERATURE REVIEW

Food Waste

The United Nations Environment Programme (UNEP, 2021) defines food waste as food fit for consumption that is not utilized and is ultimately discarded at the serving or consumption stage. The Food and Agriculture Organization similarly defines food waste as edible food that is discarded because of negligence during production, processing, or distribution (FAO, 2025). In the hospitality industry, food waste is commonly divided into two categories based on when it occurs: pre-consumer food waste, which occurs before food is served to guests, such as during storage, ingredient preparation, and kitchen production (including trimmings and overproduction), and post-consumer food waste, which occurs after food has been served and not fully consumed, commonly known as plate waste (Karakas, 2021; Susanti & Wiryanata, 2024).

Causes of Food Waste in Hotels

According to Wiryanata & Susanti (2025), the causes of food waste in hotels can be grouped into five factors. First, suboptimal inventory management, arising from ineffective stock control — including inconsistent application of the First In, First Out (FIFO) principle and inaccurate guest forecasting — that leads to spoilage or over-purchasing (Karakas, 2021; Susanti & Wiryanata, 2025). Second, guest behavior, where differences in preference and consumption habits, together with the perception that abundant food display is part of the hotel experience, encourage guests to take more food than they consume (Karakas, 2021; Wiryanata & Susanti, 2025). Third, inefficient culinary practices, particularly during cutting, peeling, and plating, compounded by aesthetic presentation standards that render some usable food unused (Sigala et al., 2025; Wiryanata & Susanti, 2025). Fourth, operational inefficiency and staff competency gaps in handling, storing, and monitoring the shelf life of ingredients (Wiryanata & Susanti, 2025). Fifth, plate waste linked to menu design and portion sizes that are poorly matched to guest needs or preferences, including dietary mismatches (Sigala et al., 2025; Wiryanata & Susanti, 2025).

Food Waste Management

Food waste management is a series of efforts undertaken to reduce and handle the food waste generated during hotel operations (Wiryanata & Susanti, 2025). It is not limited to handling waste that has already been generated, but also encompasses preventive actions at every operational stage aimed at minimizing food-material waste. Karakas (2021) explains that food waste management in the hospitality industry is implemented through five operational stages, each contributing to controlling the sources of food loss.

Menu Planning is the stage of designing a menu that matches operational needs, carried out through periodic menu evaluation, selecting menu items based on demand levels, and using ingredients appropriate to availability and seasonality (Karakas, 2021), including decisions on portion size and service format that affect both guest satisfaction and profitability (Wiryanata & Susanti, 2025).

Purchasing & Storing covers ingredient procurement — supplier selection, specification of ingredient requirements, and demand forecasting — together with storage practices that preserve quality and prevent spoilage, such as applying FIFO and FEFO (First Expired, First Out) principles, deep-freezing and cook-and-chill techniques, and stock labelling (Karakas, 2021). Sustainable procurement and effective inventory management further help minimize food waste from the earliest stage, before ingredients are processed in the kitchen (Wiryanata & Susanti, 2025).

Food Preparation is one of the main sources of food waste in hotel operations, arising from trimmings, production errors, and overproduction during ingredient cutting and cooking (Karakas, 2021; Wiryanata & Susanti, 2025).

Communication with Guest & Staff comprises two dimensions. Communication with guests involves understanding guest needs and preferences and offering alternatives that reduce food waste, such as doggy bags or food boxes for à la carte service (Karakas, 2021), while guest education through visual or digital media, eco-friendly buffet and menu design, incentive programs, and interactive activities can encourage guests to value portions more and choose more wisely (Wiryanata & Susanti, 2025). Communication with staff involves training, regular meetings, recognition, and resource support that build employee awareness, engagement, and responsibility toward food waste prevention, since the success of any waste-management system depends not only on its technological sophistication but also on active staff participation (Karakas, 2021; Wiryanata & Susanti, 2025).

After Service is the stage of managing food waste once it has been generated, covering safe reuse of edible surplus, handling of unsold or near-expiry products, and the separation of food waste to support more effective disposal (Karakas, 2021). Food waste collected at this stage is first sorted before being managed through environmentally-friendly methods such as reuse of still-edible surplus and recycling of food residues into products such as animal feed or compost (Wiryanata & Susanti, 2025).

Artificial Intelligence Technology in Food Waste Management

AI-based technology assists the automatic identification, processing, and analysis of data. In the hospitality industry, AI adoption in food waste management typically takes the form of digital monitoring systems that record the type and quantity of food waste in real time, providing more detailed data for evaluating food-material losses (Wiryanata & Susanti, 2025). A summary of prior studies on AI-based food waste management is presented in Table 2.

Table 2. Summary of Prior Studies on AI-Based Food Waste Management

Researcher(s) & Year	**Study Focus**	**Key Findings**
Martin-Rios et al. (2021)	Sustainability-oriented innovations in food waste management technology	Monitoring technology helps organizations identify sources of food loss more accurately, supporting waste reduction and more cost-effective operations.
Principato et al. (2023)	Digital tools in reducing food waste in industrial canteens	AI-based digital tools helped reduce preparation waste by about 30% and lowered waste as a percentage of sales from 2.9% to 0.6%.
Karvounidi et al. (2024)	Sustainable food waste management in the hospitality industry	Technology-supported waste reduction helps hotels save on food materials, energy, and operating costs, supporting food-cost efficiency.
Johannesson et al. (2025)	Leveraging AI for minimized food waste in the restaurant industry	AI supports demand forecasting, inventory management, and real-time waste tracking, reducing

		food-material waste and improving operational efficiency.
Sigala et al. (2025)	Reducing food waste in the HORECA sector using AI-based waste-tracking devices	AI-based tracking devices reduced food waste by 23–51% and cut the cost of wasted food by up to 39% through real-time monitoring.

Source: compiled from prior studies, 2026.

Most of the studies summarized in Table 2 indicate that AI-based technology in food waste management functions primarily as a real-time monitoring tool, helping identify the type, quantity, and source of food waste generated during food operations, while also supporting operational efficiency and reducing food-cost losses.

Food Cost

Food cost is a key component of food-and-beverage operating costs because it is directly tied to the use of food materials in production. Dittmer and Keefe (2009) explain that cost is the expenditure incurred by a food-service business for goods or services once they have been consumed or rendered; in food service, ingredients are considered to have become a cost once they are used and are no longer available for their original purpose — whether processed into a product, used inefficiently (wastefully), spoiled, or lost to theft.

The accumulated value of all food materials used within an operating period is known as the Cost of Goods Sold (COGS). Egan (2020) explains that COGS represents the monetary value of ingredients actually used to produce the menu items sold to guests, and this value may differ from total purchases because not all purchased ingredients are consumed within a single accounting period. COGS is calculated by adding beginning inventory to purchases and then subtracting ending inventory.

Food Waste from a Food Cost Perspective

Food waste is not solely an environmental concern; it also has direct implications for the use of food-material costs in food-service operations. As Dittmer and Keefe (2009) note, ingredients become a cost once they are used and no longer available for their intended purpose, including when used wastefully or when they spoil — meaning that discarded food still generates food cost even though it produces no revenue for the business.

Food waste management is implemented through several operational stages — menu planning, purchasing & storing, food preparation, communication with guest & staff, and after service (Karakas, 2021) — each playing a role in preventing food-material waste so that ingredients can be used more efficiently. According to Tracey (2009), food-cost control is exercised from ordering, receiving, and storage through to production and service; at every stage there is potential for over-ordering, spoilage, overproduction, or inconsistent portion sizes that can simultaneously increase food waste and inflate food cost. Barnard (2009) similarly identifies waste, spoilage, portion-size inconsistency, and production errors as conditions that need to be controlled in restaurant operations because of their direct link to food-material usage.

Conceptual Framework

Building on the theoretical foundations above, this study uses Karakas' (2021) five-aspect food waste management framework — Menu Planning, Purchasing & Storing, Food Preparation, Communication with Guest & Staff, and After Service — to examine how AI-based food waste management is implemented at the case-study hotel. AI technology is positioned as the provider of data on the type, quantity, and value of food waste generated at each of these five stages. The results of this analysis then form the basis for examining the implications of food waste management for food cost, so that the study consists of two interrelated components: an analysis of AI-based food waste management implementation, and an analysis of its implications for food cost.

METHODOLOGY

Research Object, Location, and Period

The object of this study is AI-based food waste management implemented at a five-star luxury resort in the Ungasan area of southern Bali, part of an international upscale hospitality group. The parties involved as key informants were the hotel's Cost Controller, Hygiene & Steward Manager, and Executive Chef. The study was conducted from October 2025 to March 2026, during which the researcher collected data through direct observation and interviews with the parties concerned to obtain an in-depth understanding of AI-based food waste management at the case-study hotel.

Data Types and Sources

This study uses both qualitative and quantitative data. Qualitative data consist of interview results with the Cost Controller, the Hygiene & Steward Manager, and the Executive Chef, together with observation results on the implementation of AI-based food waste management and supporting documentation, used to analyze how the management practices were implemented. Quantitative data consist of food cost, food waste saving, waste value, and waste weight obtained from the AI technology dashboard, used to support the analysis of the implications of food waste management for food cost.

Primary data were obtained through interviews and observations with the informants directly involved in implementing AI-based food waste management. Secondary data were obtained from documents related to its implementation, including food waste monitoring reports generated by the AI technology, food cost data, and other supporting documentation, used to complement, strengthen, and verify the primary data so as to produce more comprehensive information.

Data Collection Techniques

Data were collected through three techniques. Interviews were conducted semi-structurally using an interview guide developed based on the food waste management concept and linked to its implications for food cost. Observation was conducted directly at the hotel to observe the implementation of AI-based food waste management, focused on the execution of the five management aspects and the use of AI technology in supporting food waste management and its implications for food cost. Documentation was used as supporting data to complement the interview and observation results, comprising food waste reports, food cost data, and documentation of AI technology implementation.

Data Analysis Technique

Data were analyzed using the interactive qualitative analysis model of Miles and Huberman (1984), as cited in Sugiyono (2023), which consists of four interrelated stages carried out continuously until data reach saturation: data collection, data reduction, data display, and conclusion drawing/verification. Data collection was carried out through interviews, observations, and documentation focused on the implementation of AI-based food waste management and its relationship to food cost. Data reduction involved selecting and summarizing the interview, observation, and documentation results relevant to the research focus, and grouping them according to Karakas' (2021) five aspects and their implications for food cost. Data display was carried out in the form of descriptive narrative, tables, and figures adapted to the food waste management concept. Conclusion drawing/verification involved interpreting the analyzed data to answer the research questions, with conclusions verified against the interview, observation, and documentation results to produce accountable findings.

RESULTS AND DISCUSSION

Overview of the Research Object

This study was conducted at a five-star luxury resort located in the Ungasan area of southern Bali; a destination known for a high volume of tourist visits. The hotel provides accommodation, restaurant, bar, and banquet facilities oriented toward luxury hospitality service. The restaurant that is the focus of this study is the hotel's all-day-dining outlet, which operates for breakfast, lunch, and dinner service, so that the food waste and food cost data analyzed in this study cover the hotel's overall operating period. In its operations, the hotel makes use of AI-based technology to support the provision of food waste data generated during operations, functioning through digital tablets used for real-time monitoring. The data generated by the AI system cover the type of food waste, the amount of waste, and the cost value lost during operations, and this information is subsequently used by hotel management as the basis for AI-based food waste management, including evaluation of raw-material management, control of food-production volume, and control of food cost.

AI-Based Food Waste Management across the Five Aspects

This study analyzes the implementation of AI-based food waste management using Karakas' (2021) framework, comprising Menu Planning, Purchasing & Storing, Food Preparation, Communication with Guest & Staff, and After Service, based on interviews, observation, and documentation involving the Executive Chef, the Hygiene & Steward Manager, and the Cost Controller.

Menu Planning

Menu planning at the case-study hotel is supported by AI-generated data used to identify the food items that generate the most food waste, providing a basis for menu evaluation. During the observed period, the AI system grouped food waste by area, food group, and specific items generating the largest volume of waste, with the trimmings category recorded as the largest contributor and fruit trimmings the single largest item, followed by vegetable, compost, and meat trimmings. The Hygiene & Steward Manager explained that this information is used as feedback for kitchen operations so that management can understand which food items generate the most waste and adjust menu planning for subsequent periods.

The Cost Controller further explained that menu planning is also supported by monitoring the overproduction category, used to evaluate whether the quantity of food produced matches actual guest consumption. Over the two months observed, overproduction fell from Rp 108,917 (8 kg) in February to Rp 21,997 (1.7 kg) in March, attributed to guest-count forecasting prior to production and staged production of certain menu items — particularly for breakfast buffet service — according to actual guest demand as service progressed. Food that remained unserved was kept at appropriate temperature and quality using hotboxes so that it could still be used in a subsequent service if it continued to meet quality and food-safety standards.

The Executive Chef additionally highlighted the use of plate-waste data, which recorded a total of 836 kg during the observed month, averaging 289 grams per cover, with the highest value on Sundays (381 grams per cover) and the lowest on Fridays (201 grams per cover). This information is used to evaluate the appropriateness of portion sizes and the level of guest acceptance of the menu offered; in response, the kitchen adjusted portion sizes and serving equipment for several menu items so that the amount of food guests take is better matched to their needs without reducing service quality.

Purchasing & Storing

The Cost Controller explained that ingredient requirements are determined based on forecasted guest numbers so that prepared quantities match operational needs, helping the hotel maintain material availability while avoiding excessive use. During the observed period, out-of-stock incidents were recorded at zero, indicating that ingredient availability was consistently maintained. AI-generated data on the value and category of ingredients most frequently lost as waste — dominated by fruit, vegetable, and meat trimmings

— are used as a basis for evaluating both procurement and the use of food materials during subsequent operating periods.

Food Preparation

The Hygiene & Steward Manager, Cost Controller, and Executive Chef were interviewed regarding the sources of food waste generated during ingredient preparation. Trimmings from peeling, cutting, and cleaning fruit and vegetables prior to production were identified as the most frequent source of waste, and the AI-generated data confirmed the trimmings category as the largest contributor of food waste by both value and transaction frequency during the observed month, as summarized in Table 3.

Table 3. Trimmings Data from Food Preparation and Its Implications for Food Cost

Trimmings Category	Weight (Feb.)	Value (Feb.)	Weight (Mar.)	Value (Mar.)
Fruit Trimmings	351 kg	Rp 2,351,017	242 kg	Rp 1,624,603
Vegetable Trimmings	50 kg	Rp 751,905	23 kg	Rp 340,200
Meat Trimmings	14 kg	Rp 181,404	11 kg	Rp 148,385
Total	415 kg	Rp 3,284,326	276 kg	Rp 2,113,188

Source: processed from AI-based food waste reports of the case-study hotel, 2026.

The Executive Chef explained that the high value of fruit trimmings is linked to the cutting standards applied in fruit processing: not all parts of a given fruit can be used in food presentation, and the unused portion is recorded as trimmings, a factor that is already accounted for in menu costing — as, for example, with watermelon, whose unused portion is factored into menu cost planning from the outset. This information helps the Executive Chef and Cost Controller monitor the value of waste generated during preparation and identify which ingredient categories contribute most to food cost at this stage.

Communication with Guest & Staff

Communication with guests is carried out through guest-satisfaction checks by service staff after food is served, providing feedback used as a basis for menu improvement. Communication with staff is implemented through training on the AI system's operating procedures — covering how to weigh and categorize food waste (overproduction, plate waste, and trimmings) — delivered at the start of implementation and reinforced with ongoing coaching. The Cost Controller noted that some employees showed early resistance, viewing the system as additional work, and that maintaining consistent use required continuous training and support. Data generated by the AI dashboard are discussed during operational briefings, helping staff understand the sources of food waste and providing feedback to relevant departments; nevertheless, raising staff awareness continues to be identified as an ongoing challenge. The Executive Chef emphasized that effective food waste management depends not only on technology, but also on staff work habits and discipline, requiring continuous education and a supportive workplace culture.

After Service

Food waste is separated by category before being weighed and recorded through the AI system, allowing handling methods to be tailored to the characteristics of each waste type. Organic waste such as fruit trimmings is sent to a third party for composting or conversion into animal feed, while non-reusable waste is managed according to standard disposal procedures. Not all surplus food is discarded outright: food that still meets quality standards is redirected for internal use, as summarized in Table 4.

Table 4. Reuse of Surplus Food at the After-Service Stage

Category	Weight (Feb.)	Value (Feb.)	Weight (Mar.)	Value (Mar.)
Staff Food & Sampling	94 kg	Rp 4,390,012	26 kg	Rp 2,895,737
Rework	0 kg	Rp 0	0.1 kg	Rp 3,049

Source: processed from AI-based food waste reports of the case-study hotel, 2026.

The Cost Controller explained that items such as salads and dry breakfast items may be resold at the à la carte lounge or used in a subsequent service if they still meet quality standards, while pastry overproduction is redirected to the staff canteen rather than becoming food waste directly, and organic waste such as fruit trimmings is routed to a third party for composting or animal feed. The Executive Chef added that reuse decisions must weigh food-safety considerations, since food that has been exposed to the external environment or is at risk of contamination cannot be reused because of health risk; on this basis, the Executive Chef estimated that around 50% of surplus food — mainly certain overproduction items and unexposed pastry products — can still be repurposed, while food that no longer meets quality and safety standards is discarded according to standard procedure.

Implications of AI-Based Food Waste Management for Food Cost

Food waste management at the case-study hotel not only generates information on the type and quantity of food waste during operations, but also generates information related to food cost, because every item of food waste originates from ingredients that were purchased and used in hotel operations. Table 5 presents the food cost, food waste saving, and the corresponding percentages recorded over the six-month observation period.

Table 5. Food Cost and AI-Based Food Waste Saving, October 2025 – March 2026

Indicator	Oct. 2025	Nov. 2025	Dec. 2025	Jan. 2026	Feb. 2026	Mar. 2026
Food Cost (Rp)	1,093,213,704.78	676,836,093.88	833,842,537.89	986,172,713.39	945,053,326.09	784,165,546.71
Food Waste Saving (Rp)	11,087,825.00	9,046,320.00	11,130,243.00	11,924,269.00	12,304,662.00	8,663,662.00

% Affected to Food Cost	0.33%	0.44%	0.44%	0.39%	0.43%	0.39%
Standard Food Cost (%)	33.4%	33.4%	33.4%	33.4%	33.4%	33.4%
Actual Food Cost (%)	32.93%	32.92%	32.99%	32.16%	32.89%	35.26%

Source: Cost Controller data of the case-study hotel, 2026.

The food cost figures in Table 5 were obtained from the Cost Controller's reports, recording total food-material cost for each operating month, while the food waste saving values were generated automatically by the AI technology as an estimate of the value of ingredients saved through waste reduction. The Cost Controller explained that "affected to food cost" represents an estimate of what food cost would have been had the saving from AI-based food waste management not occurred, obtained by adding the actual food-cost percentage to the food-waste-saving percentage for the same period; the difference between the affected-to-food-cost percentage and the actual food-cost percentage indicates the magnitude of the saving captured within that period's figures.

The implications of AI-based food waste management can be assessed by comparing actual food cost with the hotel's standard food cost of 33.4%. As shown in Table 5, actual food cost from October 2025 through February 2026 remained below the standard, with the contribution of food waste saving ranging from 0.33% to 0.44% of food cost each month. This indicates that, absent the saving generated by AI-based food waste management, food cost would likely have been at or near the standard threshold, meaning the technology's contribution helped keep actual food cost consistently below that threshold.

In March 2026, however, actual food cost reached 35.26%, exceeding the standard even though a food waste saving was still recorded for that month. According to the Cost Controller, this was attributable to a high-tourist-arrival period coinciding with the Nyepi (Day of Silence) holiday in Bali, which required the hotel to offer promotions and prepare food in larger quantities to meet elevated guest demand. This indicates that increases in food cost during specific periods are not driven solely by food waste, but are also influenced by seasonal factors and visitor-arrival levels that lie outside the scope of AI-based food waste management.

The relationship between food waste and food cost can be examined further through each of the five management aspects, summarized in Table 6.

Table 6. Summary of the Implications of Each Food Waste Management Aspect for Food Cost

Aspect	Key Findings	Implication for Food Cost
Menu Planning	Guest-count forecasting, portion adjustment, and overproduction control.	Reduces food-material cost waste caused by excess production.
Purchasing & Storing	Control of overproduction and trimmings; zero stock-outs.	Improves the efficiency of food-material inventory use.
Food Preparation	Cutting standards, trimmings tracking, and menu costing.	Improves the efficiency of raw-material use without compromising quality standards.
Communication with Guest & Staff	Briefings, training, and operational evaluation using AI dashboard data.	Reduces cost waste through behavioral change among staff.
After Service	Reuse via staff food, sampling, and rework of qualifying surplus.	Maximizes the economic value of food materials before they become waste.

Source: research findings, processed by the researcher, 2026.

As Table 6 indicates, each of the five aspects of food waste management contributes differently to food-material cost efficiency according to the nature of the operational activity involved, and each therefore warrants separate discussion in relation to food cost.

The implementation of Menu Planning shows implications for food cost because it relates to planning the quantity of food to be produced during hotel operations. Guest-count forecasting, portion adjustment, and staged production according to operational needs help reduce potential overproduction, making ingredient use more efficient, while evaluation of plate waste provides information on the appropriateness of portion sizes and guest acceptance of the menu offered, which then informs subsequent menu and production adjustments. This finding is consistent with Sigala et al. (2025), who explain that evaluating the production process helps hotels reduce food-cost waste by adjusting production volumes to operational needs, and with Martin-Rios et al. (2021), who state that food waste information serves as a basis for operational decision-making that makes ingredient use more efficient. Susanti and Wiryanata (2024) similarly note that food waste creates financial loss because costs already incurred for procurement, production, and waste handling no longer provide benefit once food becomes waste.

The implementation of Purchasing & Storing carries implications for food cost because it relates to controlling the use of food-material inventory that has been purchased for operational needs. From an accounting standpoint, food materials that leave inventory — whether sold or discarded as food waste — are both recorded as part of Cost of Goods Sold (COGS). The findings show that food waste at the case-study hotel is not recorded as a separate account, but is instead charged to food cost at the outlet level and technically included within COGS, without the value or weight of food waste being itemized separately. This indicates that the financial impact of food waste arising at the purchasing-and-storing stage is already embedded within the hotel's COGS figure, even though it is not conventionally made explicit. The overproduction and trimmings categories provide information used to evaluate the utilization of food materials during operations, consistent with Johannesson et al. (2025), who note that AI supports inventory optimization through demand forecasting, and Principato et al. (2023), who state that effective inventory management allows hotels to match ingredient needs with operational demand, thereby reducing cost waste from excess inventory or suboptimal use.

The implementation of Food Preparation carries implications for food cost because it relates to raw-material use during ingredient preparation prior to cooking and service. The trimmings generated as a consequence of applied cutting standards cannot be eliminated entirely, but evaluating their quantity and value remains an important part of controlling raw-material use, helping the hotel ensure that ingredients are used efficiently without compromising established quality standards. This is consistent with Sigala et al. (2025), who note that evaluating food waste at the preparation stage helps identify sources of waste for kitchen-process improvement, and with Principato et al. (2023), who state that monitoring food waste during preparation informs decisions that increase raw-material-use efficiency.

The strengthening of Communication with Guest & Staff carries implications for food cost because it relates to staff behavior in using food materials during operations. Briefing, training, and operational evaluation help increase staff understanding of the importance of reducing food waste at every operational stage, encouraging more careful use of ingredients in line with established standards, and thereby helping minimize potential waste arising from operational errors. This finding is consistent with Principato et al. (2023), who note that staff awareness and involvement are critical success factors in food waste management, and with Sigala et al. (2025), who find that staff involvement in the evaluation process supports continuous corrective action that helps reduce food waste and its associated costs.

The implementation of After Service carries implications for food cost because it relates to maximizing the use of food materials that still meet quality standards, alongside the management of food waste that can no longer be reused. Surplus food that still meets quality standards is reused through staff food, sampling, and rework, so that produced ingredients continue to provide operational benefit and help offset losses on food-material costs already incurred, while food waste that cannot be reused is separated and channeled to a third party for further processing. This finding is consistent with Susanti and Wiryanata (2024), who explain that after-service practices emphasize reuse of still-edible surplus alongside third-party waste-management partnerships, and with Karvounidi et al. (2024), who identify food reuse and structured waste management as part of best practice in hospitality food waste management.

Overall, the findings indicate that AI-based food waste management at the case-study hotel is implemented consistently with all five aspects of Karakas' (2021) framework, with AI technology functioning as a real-time provider of data on the type, quantity, and value of food waste, supporting evaluation and decision-making at each stage. The implications for food cost are evident through the reduction of food-material cost waste, reflected in the decline in overproduction value and the reuse of still-usable food materials. Because food waste is recorded within COGS without a dedicated account, however, its financial impact is not yet fully explicit in the hotel's financial statements, an accounting-visibility gap that echoes the limited attention given in prior studies (Susanti & Wiryanata, 2024) to the direct relationship between food waste and food cost, and that AI-generated operational data alone cannot resolve without complementary changes in cost-accounting practice.

CONCLUSION AND RECOMMENDATIONS

Conclusion

First, AI-based food waste management at the case-study hotel has been implemented consistently with the five aspects proposed by Karakas (2021) — Menu Planning, Purchasing & Storing, Food Preparation, Communication with Guest & Staff, and After Service — supported by AI technology as a real-time provider of data on the type, quantity, and value of food waste. AI technology supports evaluation and decision-making at each aspect; however, the Communication with Guest & Staff aspect encountered early staff resistance during implementation, indicating that continuous training and coaching are required for consistent system use.

Second, the implementation of food waste management has implications for food cost through the reduction of food-material cost waste, reflected in the decline in overproduction value and the reuse of still-usable food materials, contributing an estimated saving of 0.33% to 0.44% of food cost per month over most of the observation period. From an accounting perspective, food waste is recorded as part of Cost of Goods Sold (COGS) without being itemized as a separate account, so its financial impact is not yet fully explicit in the hotel's financial statements. Plate waste was recorded at a value of Rp0 because, as post-consumption residue, its underlying food cost has already been captured within guest sales transactions, in contrast to categories such as trimmings and overproduction, which occur before food is sold and therefore generate no offsetting revenue.

Recommendations

For the case-study hotel, continued and expanded use of AI technology in food waste management is recommended, given its demonstrated contribution to identifying sources of waste and supporting food-cost control during the observation period; this practice may also serve as a reference for other hotel business units and restaurants in Bali seeking to adopt AI technology to support operating-cost efficiency and environmental sustainability.

For future research, a longer observation period than the six months used in this study is recommended to provide a more comprehensive picture of food waste patterns and their implications for food cost. Comparative studies across multiple hotels are also recommended to examine the extent to which AI-based food waste management yields consistent results under different operational characteristics, together with further inquiry into cost-accounting practices that could make the financial impact of food waste more explicit within hotel financial reporting.

REFERENCES

Barnard, M. W. (2009). A case study to examine the application of food cost theories in menu pricing and cost control management within a new restaurant operation. https://doi.org/10.34917/1651750

Cejas, R. (2025). Food waste reduction AI technologies in restaurant management: An MS-TORO approach. Processes, 13(8). https://doi.org/10.3390/pr13082419

Clark, Q. M., Kanavikar, D. B., Clark, J., & Donnelly, P. J. (2024). Exploring the potential of AI-driven food waste management strategies used in the hospitality industry for application in household settings. Frontiers in Artificial Intelligence, 7. https://doi.org/10.3389/frai.2024.1429477

Conrad, S. (2024). Conrad Shanghai case study.

Dittmer, P. R., & Keefe, J. D. J. (2009). Principles of food, beverage, and labor cost controls (9th ed.). John Wiley & Sons, Inc.

Egan, B. (2020). Introduction to food production and service. https://psu.pb.unizin.org/hmd329/

FAO. (2025). The state of food and agriculture 2025. https://doi.org/10.4060/cd7067en

Johannesson, A., Itzhak, M., & Rosenlind, O. (2025). Leveraging artificial intelligence for minimized food waste: Analysis of the restaurant industry in Gothenburg. https://hdl.handle.net/2077/88665

Karakas, K. M. (2021). Food waste management in luxury hotels—Best practices and limitations. Journal of Environmental Science and Engineering B, 10(3). https://doi.org/10.17265/2162-5263/2021.03.003

Karvounidi, M., Alexandropoulou, A., Fousteris, A. E., Karvounidi, M. D., & Alexandropoulou, A. P. (2024). Sustainable food waste management in the hospitality industry: Innovations and best practices. IOSR Journal of Environmental Science Toxicology and Food Technology, 18, 26–34. https://doi.org/10.9790/2402-1806022634

Kurnia, S., Politeknik, J. A., Ujung, N., Syamsinar, P., Jurusan, A., Politeknik, A., & Pandang, N. U. (2020). Akuntansi manajemen limbah industri perhotelan (Studi kasus: Sebuah hotel bintang empat di Makassar). AKUNSIKA: Jurnal Akuntansi Dan Keuangan, 1(1). http://jurnal.poliupg.ac.id/index.php/akunsika

Martin-Rios, C., Hofmann, A., & Mackenzie, N. (2021). Sustainability-oriented innovations in food waste management technology. Sustainability (Switzerland), 13(1), 1–12. https://doi.org/10.3390/su13010210

Principato, L., Marchetti, S., Barbanera, M., Ruini, L., Capoccia, L., Comis, C., & Secondi, L. (2023). Introducing digital tools for sustainable food supply management: Tackling food loss and waste in industrial canteens. Journal of Industrial Ecology, 27(4), 1060–1075. https://doi.org/10.1111/jiec.13391

Sadyasmara, C. A. B., Yuarini, D. A. A., Antares, A., Satriawan, I. K., Wiranatha, A. A. P. A. S., Yoga, I. W. G. S., Wartini, N. M., Nitivattananon, V., & Arnata, I. W. (2025). Quantification and classification of food waste from hotels and restaurants in Bali as a potential database towards sustainable food waste management. BIO Web of Conferences, 186. https://doi.org/10.1051/bioconf/202518604002

Sigala, E. G., Gerwin, P., Chroni, C., Abeliotis, K., Strotmann, C., & Lasaridi, K. (2025). Reducing food waste in the HORECA sector using AI-based waste-tracking devices. Waste Management, 198, 77–86. https://doi.org/10.1016/j.wasman.2025.02.044

Sugiyono. (2023). Metode penelitian kuantitatif, kualitatif, dan R&D. www.cvalfabeta.com

Susanti, C., & Wiryanata, G. N. A. (2024). Penerapan manajemen limbah makanan di industri perhotelan. Guna Sewaka: Jurnal Manajemen, 3(2). http://e-journal.iahn-gdepudja.ac.id/index.php/GSJ

Tracey, J. B. (2009). Cornell hospitality tools, 1(15), 6–32. https://scholarship.sha.cornell.edu/chrtools

UNEP. (2021). Food waste index report 2021. https://www.unep.org/resources/report/unep-food-waste-index-report-2021

Winnow. (2013). Winnow solutions. Winnow Solutions Ltd. https://www.winnowsolutions.com/

Wiryanata, I. A., & Susanti, C. (2025). Manajemen food waste: Pendekatan berkelanjutan dalam operasional hotel (1st ed.). Politeknik Pariwisata Bali.