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FOOD WASTE AND CIRCULAR PRACTICES IN THE HOSPITALITY SECTOR

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Abstract
The global consumption of commodities is anticipated to quadruple in the next forty years, while annual waste production is anticipated to rise by 70% by 2050 (Cesaro and Klontza, 2023). The demand for food by 2050 requires the agricultural global production to increase by 70% (5.1 billion tons) and at the same time, it is strongly affected by severe climate events (droughts, floods, tropical storms, heat waves, and wildfires). Moreover, each year, a third of global food production (around 1.3 109 tons) exits the food supply chain as waste (FAO, 2019). To this extent, the linear economic models based on production-consumption-disposal schemes tend to be replaced by circular and resource-efficient economic models, which focus on the whole material cycle to promote reuse as well as to reduce waste and utilize resources as efficiently as possible. Hotel sector contributes significantly to the global environmental footprint, since they utilize significant single use materials and produce large quantities of food waste (Klontza et al., 2016). Reduction of food loss and waste contributes to food security for all, to the reduction of greenhouse gas emissions as well as water and energy saving along with increased production and economic development at global level (Coudard et al. 2021; Skawińska E., Zalewski, 2022).

The main objective of this study is to map food loss and waste during hotel operation. Data were collected and analyzed from three 5-star hotels. On-site measurements were combined with interviews, and questionnaires. Key performance indicators were calculated; water and energy consumption per guest night and food waste per night and reduction scenarios were evaluated. Food waste was characterized as avoidable and non-avoidable and the unconsumed food was characterized as edible and non-edible. Breakfast buffet seems to be the major source of food waste and the biggest percentage (76%) is unconsumed and non- edible.
Keywords: *food waste, hospitality sector, tourism, circular solutions.*

JEL Classification: Q53, Q56

1. INTRODUCTION

Food waste is a significant environmental concern, particularly within the hospitality sector, where high volumes of food are produced and consumed daily. Research indicates that approximately 1.3 billion tons of food are wasted globally each year, contributing to greenhouse gas emissions and straining natural resources (Khoshnevisan & Pahlavani, 2024). In hotels and restaurants, food waste accounts for a substantial portion of operational waste, with estimates suggesting that between 30% to 50% of prepared food is discarded (Melacini & Perego, 2022). This not only poses environmental challenges but also has economic implications, as hotels incur costs related to purchasing, preparing, and disposing of food that ultimately goes uneaten. The implementation of circular economy principles offers a promising framework for addressing food waste in the hospitality sector. Khoshnevisan and Pahlavani (2024) emphasize that adopting these principles can lead to more sustainable food management practices, focusing on reducing waste, reusing resources, and recycling organic materials. This paradigm shift encourages hotels to rethink their food production and consumption practices, ultimately leading to enhanced resource efficiency and reduced environmental impact. Consumer behavior plays a pivotal role in the generation of food waste within hospitality settings. A systematic review by Kuehnel and Brenner (2024) highlights that guest preferences, dining formats, and portion sizes significantly influence waste generation. Understanding these behavioral patterns is crucial for developing targeted strategies to mitigate waste. For instance, buffet-style dining often results in higher waste levels, as guests tend to over-serve themselves, leading to uneaten food being discarded (Pahlavani *et al*., 2019). Best practices and strategies for food waste management have been extensively documented in the literature. Voukkali, *et al*. (2023) outline various approaches that hotels can adopt, such as implementing waste tracking systems, optimizing menu design, and enhancing staff training. These strategies not only reduce the volume of food waste but also foster a culture of sustainability within the hospitality industry. Moreover, various case studies demonstrate the effective application of these practices across different regions. Hotels that have embraced

waste reduction initiatives have reported significant reductions in food waste, improved operational efficiency, and enhanced guest satisfaction (Melacini & Perego, 2022). By leveraging innovative technologies and fostering collaboration among stakeholders, the hospitality sector can make substantial strides toward minimizing food waste and promoting sustainable practices.

This study aims to explore the current state of food waste management in hotels, investigate the effectiveness of various strategies and technologies, and highlight successful case studies that exemplify best practices in reducing food waste. By addressing the multifaceted challenges of food waste in the hospitality sector, this research seeks to contribute to the ongoing dialogue on sustainability and resource efficiency within the industry.

2. THE BIG PICTURE

The Food and Agriculture Organization (FAO) reports that approximately one-third of food produced globally is wasted, highlighting the need for targeted interventions in the hospitality industry. Recent reports by the World Tourism Organization (UNWTO) and the European Union (EU) have underscored the urgency of addressing food waste within the tourism sector. The UNWTO's report on sustainable tourism emphasizes that food waste is a significant contributor to the overall environmental impact of tourism, accounting for a substantial portion of greenhouse gas emissions. The organization highlights the need for the industry to adopt sustainable practices and implement effective waste management strategies. They recommend that tourism stakeholders, including hotels and restaurants, engage in initiatives aimed at reducing food waste, thereby promoting sustainability and improving their environmental footprint. Similarly, the European Union has recognized food waste as a critical issue in its Circular Economy Action Plan. The EU has set ambitious targets to reduce food waste by 50% by 2030, in line with the United Nations Sustainable Development Goals (SDGs). The EU's reports stress the importance of collaboration among various stakeholders, including the hospitality sector, to achieve these goals. Initiatives such as the EU Food Waste Prevention Program encourage hotels and restaurants to implement practices that minimize waste generation, such as better inventory management, portion control, and the donation of surplus food. Moreover, the EU's Green Deal emphasizes a holistic approach to sustainability, urging businesses to transition toward more circular practices. This includes not only reducing food waste but also improving resource efficiency and promoting sustainable sourcing of ingredients.

The hospitality sector, as a significant player in the tourism industry, is expected to lead by example in adopting such practices. In response to these growing concerns, this study aims to map food loss and waste during hotel operations, utilizing data collected from three 5-star hotels through on-site measurements, interviews, and questionnaires. Key performance indicators

(KPIs) will be established to assess water and energy consumption per guest night and quantify food waste generated per night.

Key Performance Indicators (KPIs)

To assess water and energy consumption per guest night alongside food waste generation, key performance indicators (KPIs) were calculated. This included metrics such as:

- Water Consumption per Guest Night: Measured by tracking total water usage in relation to guest occupancy.
- Energy Consumption per Guest Night: Analyzed by monitoring energy usage associated with food preparation and storage.
- Food Waste per Night: Quantified by weighing collected food waste daily.

Food waste should be categorized into avoidable and non-avoidable, with further classification of unconsumed food into edible and non-edible categories. The data collection process aims to provide a comprehensive overview of food waste generation and identify major sources of waste within hotel operations.

Food waste production varies significantly across different types of accommodations in the hospitality sector. A study by the World Wildlife Fund (WWF) found that 5-star hotels generate between 2.5 to 5 kg of food waste per guest per day, primarily due to extensive buffet offerings and high food variety (WWF, 2019). In contrast, 3-star hotels typically produce around 1.5 to 3 kg per guest per day, as they often have fewer dining options and smaller-scale buffets. All-inclusive resorts tend to produce even more food waste, averaging 3 to 6 kg per guest per day. This is largely due to the nature of all-inclusive dining, where guests may overindulge in food options available at all hours (Harrison *et al*., 2020). A report from The Green Hotelier noted that these resorts could waste up to 40% of the food they prepare, emphasizing the need for better inventory management and portion control. Bed and breakfast establishments generally produce less food waste, averaging around 0.5 to 1 kg per guest per day, due to their smaller scale and more personalized dining options (Smith *et al*., 2021). However, even these smaller operations can accumulate substantial waste when considering the total number of guests served over time. A comprehensive study by The Ellen MacArthur Foundation highlighted that across the European hospitality sector, hotels and restaurants contribute to about 8-10 million tons of food waste annually, with buffets being the largest source of waste (Ellen MacArthur Foundation, 2021). The report stressed the importance of implementing circular economy principles, such as better meal planning and food donation programs, to mitigate waste across all types of accommodations.

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Best practices and strategies for food waste management have been extensively documented in the literature. There are various approaches that hotels can adopt, such as implementing waste tracking systems, optimizing menu design, and enhancing staff training. These strategies not only reduce the volume of food waste but also foster a culture of sustainability within the hospitality industry.

Moreover, various case studies demonstrate the effective application of these practices across different regions. Hotels that have embraced waste reduction initiatives have reported significant reductions in food waste, improved operational efficiency, and enhanced guest satisfaction (Melacini & Perego, 2022). By leveraging innovative technologies and fostering collaboration among stakeholders, the hospitality sector can make substantial strides toward minimizing food waste and promoting sustainable practices.

2.1. Applications in European Islands

Several real-world applications of food waste management technologies and projects have been reported in hotels and hospitality settings across European islands, showcasing effective strategies to reduce food waste.

Lanzarote, Canary Islands - The Food Waste Project in Lanzarote, a pilot project aimed at reducing food waste in hotels was launched, involving a collaboration among local authorities, hotels, and the University of Las Palmas de Gran Canaria. The project utilized smart waste management technologies, including automated weighing systems to monitor food waste in real-time. Results indicated a 30% reduction in food waste within participating hotels over a six-month period. The project emphasized the importance of staff training and guest awareness programs to maximize waste reduction (Universidad de Las Palmas de Gran Canaria, 2021).

Santorini, Greece – Smart Waste Solutions on the island of Santorini, a project implemented by Stop Waste focused on integrating smart waste management systems in several hotels. The project utilized a combination of waste monitoring sensors and staff training to facilitate better food inventory management. Findings revealed a 25% decrease in food waste over one year, with participating hotels reporting significant cost savings from reduced disposal fees. The project also highlighted the need for ongoing monitoring and support to sustain waste reduction efforts (STOP WASTE, n.d.).

Malta - Food Waste Reduction Initiative in Hotels; a food waste reduction initiative was launched in Malta, supported by the Malta Chamber of Commerce and local environmental organizations. The initiative involved several hotels adopting the Winnow Solutions smart meter system to track food waste. A study

conducted over 12 months revealed that participating hotels achieved a 40% reduction in food waste. The hotels implemented changes based on insights gained from the data, such as optimizing menu offerings and portion sizes to better align with guest consumption patterns (Winnow Solutions, n.d.).

Crete, Greece – KITRO Implementation in Crete, the KITRO system was adopted by numerous hotels to automate food waste tracking and analysis. The system provided real-time data on waste generation, allowing hotels to identify trends and implement targeted strategies for waste reduction. Findings from a recent evaluation showed an average reduction of 35% in food waste within the first year of implementation. Additionally, participating hotels reported enhanced operational efficiency and reduced food purchasing costs (KITRO, n.d.).

These applications illustrate how innovative technologies and collaborative efforts can lead to significant reductions in food waste within the hospitality sector on European islands. The projects not only resulted in environmental benefits but also provided economic advantages for participating hotels, demonstrating the feasibility of sustainable practices in the industry.

3. CONCLUSIONS

Food waste presents a significant challenge for the hospitality sector, with profound implications for environmental sustainability and economic viability. As global consumption continues to rise, projecting a quadrupling of commodity use in the next forty years, the urgency to address food waste becomes increasingly critical. The anticipated increase in food demand by 2050 necessitates a 70% increase in agricultural production, all while climate change exacerbates food insecurity through severe weather events, including droughts and floods (Cesaro & Klontza, 2023). The hospitality industry, characterized by high volumes of food production and consumption, is a major contributor to this waste, with estimates indicating that up to one-third of food produced globally is wasted each year (FAO, 2019). Adopting circular economy principles offers a transformative pathway for the hospitality sector. By shifting from linear production-consumption-disposal models to circular resource-efficient practices, hotels can significantly reduce food waste while enhancing sustainability. This involves not only minimizing waste at the source but also promoting practices such as recycling, composting, and food recovery programs. The findings from this study underscore the potential for circular solutions to contribute to broader environmental goals, including greenhouse gas emissions reduction and resource conservation (Coudard *et al*., 2021; Skawińska & Zalewski, 2022). Effective strategies for managing food waste in hospitality settings include portion control, dynamic pricing, and comprehensive education programs for both staff and guests. By implementing innovative technologies, such as waste tracking systems, hotels can gain insights into food waste patterns, enabling them to optimize their operations and align food offerings more closely with guest consumption

behaviors (Kuehnel & Brenner, 2024; Voukkali *et al* 2023). Furthermore, initiatives that foster collaboration among stakeholders – ranging from suppliers to local communities – can amplify the impact of these strategies, driving a more sustainable dining experience. The study's analysis of food waste generation in three 5-star hotels highlighted that breakfast buffets accounted for the largest share of waste, with 76% of food waste classified as unconsumed and non-edible. This finding points to the need for targeted interventions in buffet settings, such as enhancing menu planning and offering smaller portion sizes to reduce overproduction and excess waste. Continued research is essential to explore innovative solutions tailored to the unique challenges of food waste in the tourism industry. This includes investigating the behavioral aspects of guests and how their choices contribute to waste generation. Future studies should also consider the economic implications of food waste reduction initiatives, examining the return on investment for hotels implementing these practices. In conclusion, addressing food waste in the hospitality sector is not merely an operational issue; it is a vital component of a sustainable future. By embracing circular economy principles and implementing effective waste management strategies, the hospitality industry can lead the way in promoting environmental stewardship and enhancing food security, ultimately benefiting both the industry and society as a whole.

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