

Mitigating food waste through recipe optimization and resource efficiency in university canteen kitchens: a case study of Sri Lankan universities

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Abstract

Food waste has become a critical challenge in institutional food service systems, particularly in university canteens where large quantities of food are prepared daily under uncertain demand conditions. This study examines food waste generation and mitigation practices in university canteen kitchens in Sri Lanka, with specific focus on recipe optimization and internal resource efficiency. A qualitative multiple case study approach was adopted, comparing two rural canteens at Sabaragamuwa University of Sri Lanka and two urban canteens at the University of Moratuwa. Primary data were collected through semi-structured interviews with canteen owners, chefs, and kitchen helpers using purposive sampling. The study is guided by the Resource-Based View (RBV) theory to analyze how internal resources such as staff experience, recipe knowledge, and kitchen practices contribute to waste reduction. Findings reveal that food waste mainly arises from overproduction, spoiled ingredients, poor storage practices, and plate leftovers in both rural and urban settings. Rural canteens rely heavily on seasonal ingredient substitution and experiential knowledge, while urban canteens focus more on portion control and bulk preparation to manage high customer volumes. However, the absence of formal waste tracking systems and limited use of digital tools were observed in all cases. Recipe modification, batch cooking, and reuse of trimmings were identified as effective low-cost strategies for reducing food waste. The study concludes that better utilization of existing human and organizational resources, supported by basic training and simple monitoring tools, can significantly reduce food waste in university canteens. The findings provide practical insights for improving sustainability and operational efficiency in Sri Lankan university food service systems. Nevertheless, the lack of proper waste management tracking, as well as the underutilization of digital technology, was found in all the instances. Recipe alteration, batch processing, and the use of trimmings have been found to be reliable low-cost methods for food waste reduction. This paper concludes that the more efficient use of available human and organizational resources, aided by basic training and simple tracking, would go a long way in keeping food waste down in university messes.

Keywords: food waste, recipe optimization, resource efficiency, university canteens

Extended Abstract

Introduction

Food waste is a critical global challenge with significant economic, environmental, and social consequences. Large-scale food service institutions, particularly university canteens, contribute substantially to food waste due to daily mass food preparation, unpredictable demand, and limited operational flexibility. Inefficient food utilization not only increases operational costs but also results in the unnecessary depletion of natural resources and increased greenhouse gas emissions. Addressing food waste within institutional kitchens is therefore essential for promoting sustainability and resource efficiency.

In Sri Lanka, university canteens play a vital role in providing affordable meals to thousands of students and staff. However, these canteens frequently experience high levels of food waste arising from overproduction, poor storage practices, weak inventory control, and inadequate portion management. The nature and drivers of food waste vary between rural and urban university settings. Rural university canteens often face challenges such as irregular supply chains, seasonal shortages, and limited access to modern storage facilities, while urban canteens struggle with high student volumes, fluctuating demand patterns, and time pressure during peak hours.

This study, titled “Mitigating Food Waste through Recipe Optimization and Resource Efficiency in University Canteen Kitchens: A Case Study of Sri Lankan Universities,” investigates food waste management practices in selected rural and urban university canteens. The study focuses on how recipe optimization, portion control, and efficient use of internal resources can reduce food waste. The Resource-Based View (RBV) and Natural Resource-Based View (NRBV) theories provide the theoretical foundation, emphasizing the strategic role of internal resources such as staff skills, recipe knowledge, and kitchen infrastructure in improving efficiency and sustainability.

By comparing canteens at Sabaragamuwa University of Sri Lanka (rural context) and the University of Moratuwa (urban context), this study addresses a notable research gap in Sri Lankan food waste literature. It moves beyond waste quantification to explore practical, resource-based strategies that can be applied in institutional kitchens. The findings aim to support sustainable food management practices and inform policy and operational improvements in university canteens.

Materials and Methods

This study adopted a qualitative, interpretivist research approach to explore food waste management practices in university canteens. A multiple case study design was used to allow in-depth investigation and comparison between rural and urban institutional settings. Four university canteens were selected purposively: two canteens at Sabaragamuwa University of Sri Lanka representing a rural context, and two canteens at the University of Moratuwa representing an urban context.

Primary data were collected through semi-structured interviews conducted with canteen owners, managers, chefs, and kitchen helpers who were directly involved in food preparation and resource management. A total of four to six key informants participated in the study. The interviews were guided by a structured questionnaire but allowed flexibility to explore participants' experiences, perceptions, and practical challenges related to food waste, recipe optimization, and ingredient management. Each interview lasted approximately 45–70 minutes and was conducted in Sinhala or English based on participant preference. All interviews were audio-recorded with consent, and supplementary field notes were taken.

A purposive sampling technique was employed to ensure that participants possessed relevant knowledge and experience. Ethical considerations were strictly followed, including informed consent, voluntary participation, and anonymity of respondents.

Data were analyzed using thematic analysis following the framework proposed by Braun and Clarke. Interview transcripts were coded to identify recurring patterns and themes related to sources of food waste, recipe modification practices, ingredient tracking methods, and resource constraints. A cross-case comparison was conducted to identify similarities and differences between rural and urban canteens.

The Resource-Based View (RBV) and Natural Resource-Based View (NRBV) theories were applied to interpret how internal resources and environmental considerations influence food waste reduction practices. Due to the qualitative nature of the study, no statistical analysis was conducted. Standard qualitative research protocols were followed without unnecessary methodological detail.

Results, Discussion, Conclusions and Recommendations

The findings reveal that food waste is prevalent in both rural and urban university canteens, although the causes and management approaches differ by context. Across all canteens, the most common sources of food waste included overproduction, spoiled or expired ingredients, plate leftovers, inefficient portioning, and poor storage practices. Demand unpredictability emerged as the primary driver of waste in both settings.

Rural canteens experienced waste largely due to seasonal ingredient availability, inconsistent supplier quality, and limited refrigeration facilities. Urban canteens, despite better access to suppliers, faced waste due to high student volumes, variable lecture schedules, and pressure to prepare food in bulk. These findings are consistent with previous studies on institutional kitchens, which highlight overproduction and poor forecasting as major contributors to food waste.

Recipe optimization practices were evident in both contexts. Portion size reduction, ingredient substitution, seasonal recipe modification, and reuse of trimmings were commonly used strategies. Rural canteens relied heavily on seasonal substitutions and experiential knowledge, while urban canteens focused more on portion adjustments and bulk preparation. Approximately 86% of respondents reported experimenting with recipes to reduce waste without compromising food quality, demonstrating the importance of staff creativity and experience.

However, formal tools for ingredient tracking and waste monitoring were largely absent. All canteens relied on manual inventory checks, and none used digital systems. This lack of structured monitoring limited the ability to forecast demand accurately and identify high-waste items. From an RBV perspective, although human resources such as staff experience and practical knowledge were strong, they were underutilized due to insufficient complementary resources such as training and technology.

The application of RBV and NRBV theories highlights that food waste reduction does not necessarily require expensive technological investments. Instead, better utilization of existing internal resources such as standardized recipes, portion control guidelines, and staff coordination can significantly improve efficiency. At the same time, NRBV emphasizes the environmental benefits of waste reduction through practices such as composting, reuse of safe leftovers, and pollution prevention.

The study concludes that recipe optimization and resource efficiency are effective, low-cost strategies for reducing food waste in university canteens. However, their success depends on supportive infrastructure, staff training, and basic monitoring systems. Differences between rural and urban canteens suggest the need for context-specific solutions rather than uniform policies.

Based on the findings, the study recommends regular staff training on portion control, proper storage, and sustainable cooking techniques. Introducing simple waste tracking systems, improving storage facilities (especially in rural canteens), and aligning food preparation with academic schedules in urban universities are also recommended. Establishing clear canteen-level

food waste policies and promoting student awareness can further support sustainable food management.

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