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ASSESSMENT OF THE FUNCTIONING OF FIFO MODEL IN COLLEGE & UNIVERSITY CAFETERIAS AT BANGALORE

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ABSTRACT

This research evaluates the implementation of the First-In, First-Out (FIFO) inventory system in 11 educational institution cafeterias across Bangalore, aiming to identify operational challenges and propose improvements. Addressing a key gap in existing literature, particularly within the Indian institutional context, the study uses a descriptive research design with data collected through structured interviews and on-site observations. Analysis conducted revealed that perishable items such as bread (60.9%) and fruits and vegetables (48.3%) are the most wasted, primarily due to expiry (37.2%) and freshness loss (29.6%). Contributing factors include weak FIFO practices, poor demand forecasting, and inadequate cold chain and storage infrastructure. The study recommends targeted interventions including staff training, low-cost digital inventory tools, improved forecasting methods, and infrastructure upgrades to enhance inventory efficiency and reduce food waste in institutional cafeterias.

KEYWORDS: *FIFO Model, Food Waste Management, Inventory Management, Food Waste Reduction Technology, Sustainable Food Management*

INTRODUCTION

In recent years, the issue of food waste has become a critical concern across the globe, particularly in food service environments like cafeterias. Colleges and universities, where thousands of meals are prepared and served daily, stand out as spaces where food waste is both prevalent and potentially avoidable. Effective inventory management is fundamental to ensuring the operational success of food service establishments, particularly in high-volume environments such as college and university cafeterias. In this context, inventory refers to the assortment of raw materials, semi-processed goods, and finished food products maintained to meet daily service demands. Considering the perishable nature of food items, efficient inventory practices are critical for minimizing waste, controlling costs, maintaining food safety, and delivering consistent quality. Mismanagement of inventory can lead to substantial financial losses, increased environmental burden through food wastage, and compromised customer satisfaction. Globally, approximately 1.3 billion tons of food are wasted annually, with about one-third of all food produced lost or wasted (Food and Agriculture Organization [FAO], 2013). In India alone, around 40% of total food production is wasted due to inefficiencies in storage, transportation, and consumption. Consequently, academic institutions, which cater to large and diverse populations, require systematic inventory management models that can adapt to fluctuating consumption patterns while upholding principles of sustainability and efficiency.

Among various inventory control methodologies, the First-In, First-Out (FIFO) model has emerged as a standard practice within the food industry for managing perishable goods. The FIFO model mandates that older stock is issued or utilized before newer arrivals, thereby minimizing spoilage risks, maintaining food quality, and ensuring regulatory compliance with food safety standards. Its application is particularly critical in cafeterias, where daily variations in demand and high staff turnover can otherwise compromise inventory integrity. By promoting better stock rotation, improving turnover rates, and reducing economic losses from expired goods, FIFO contributes significantly to operational resilience and sustainability initiatives. Despite its theoretical advantages, the practical implementation of FIFO within institutional cafeterias, especially in developing regions like Bangalore, India, remains underexplored. This study seeks to critically assess the functioning of the FIFO model in college and university cafeterias in Bangalore, identifying current practices, operational challenges, and areas for strategic improvement.

REVIEW OF LITERATURE

Efficient inventory management models like First-In, First-Out (FIFO) are crucial for minimizing food waste, particularly in food service settings such as college and university cafeterias. Studies have shown that improper adherence to FIFO practices often results in increased spoilage and operational inefficiencies (Pikora, Trzaska, & Ponder, 2021; Derqui, Fayos, & Fernandez, 2016). The integration of technologies such as RFID systems has been highlighted as a significant advancement, improving stock rotation and reducing shrinkage in perishable inventory (Bertolini et al., 2013; Huang et al., 2007). In addition, managerial and behavioral factors, including staff training and accurate demand forecasting, have been identified as critical elements influencing the successful implementation of FIFO strategies (Filimonau, Derqui, & Matute, 2019; Teller et al., 2018). Several interventions, such

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as smart packaging and dynamic freshness indicators, have been proposed to further support FIFO practices and reduce premature disposal of food items (Poyatos-Racionero et al., 2018; Verghese et al., 2015). Moreover, research into food service operations has underlined the importance of demand planning, portion control, and technology adoption for optimizing food inventory (Reynolds et al., 2019; Joubert & Jokonya, 2021). However, much of the existing literature tends to focus on large-scale retail settings or hospitality sectors like hotels and restaurants, with limited studies specifically examining educational institutions' food service operations (Hermsdorf, Rombach, & Bitsch, 2017; Gössling et al., 2011).
Despite the rich body of knowledge on FIFO models and food waste management, there remains a notable gap in the context of college and university cafeterias, particularly within Indian cities such as Bangalore, a hub of prestigious academic institutions, thus serves as a critical intervention in mitigating food waste and promoting sustainable practices among environmentally conscious youth. Existing studies predominantly target European or American markets and often overlook localized challenges such as fluctuating student demand, infrastructural limitations, and cultural attitudes toward food waste (Mak et al., 2019; Zmieńka & Staniszewski, 2020). Therefore, a focused assessment of the functioning and effectiveness of FIFO models in the cafeterias of educational institutions in Bangalore is essential to bridge this gap and contribute practical insights for food service management improvements in similar urban contexts.

RESEARCH METHODOLOGY

The study adopted a descriptive research design to evaluate the application of the FIFO (First-In-First-Out) system in educational institution cafeterias across Bangalore. This research was conducted in 11 campuses of educational institutions at Bangalore. Primary data was collected from 11 cafeterias, which included:

- 6 from University Cafeterias – 'Category A'
- 4 from Cafeterias of Engineering Colleges affiliated to VTU – 'Category B'
- 1 from Arts & Science College Cafeteria affiliated to BCU – 'Category C'

Data collection involved direct interactions with cafeteria owners and management through structured questionnaires and interviews, complemented by on-site observations. A structured checklist was used to ensure consistency in capturing information about food categories, wastage frequency, and causes such as expiry, freshness loss, cold chain failures, and mechanical damage. The collected data was organized using Microsoft Excel and analyzed with Python, utilizing libraries such as Pandas, Matplotlib, and Seaborn to generate visual insights. Based on the findings, targeted recommendations were formulated to improve FIFO practices, enhance inventory management, and reduce food wastage.

OBJECTIVES OF THE STUDY

1. To evaluate the functioning of FIFO system adopted in University Cafeterias
2. To provide recommendations to the sample units to enhance their functionality of inventory management

RESULTS AND DISCUSSION

This section presents the data collected from 11 educational institution cafeterias in Bangalore. The study is focused on six key food categories: Fruits & Vegetables, Milk, Dairy Products, Frozen Foods, Bread and Drinks.

Table 1. Assessment of the frequency of waste of selected categories of food products in the cafeterias [%]

Sepcification	Answers in %					
	Daily	2-3 times a week	2-3 times a month	2-3 times a year	Less frequently	Lack of losses
Fruits & Vegetables	48.3	34.5	8	3.4	1.1	3.4
Refrigerated products with a very short expiry date(e.g. milk, unpackaged meat)	34.5	23	26.5	3.4	6.9	1.1
Refrigerated products with longer expiry date	23	26.4	23	13.8	10.3	1.1
Frozen products	20.7	10.3	20.7	13.8	26.4	5.7
Bread (including baked sweet rolls)	60.9	14.9	6.9	4.6	6.9	1.1
Drinks	18.4	10.3	23	12.6	28.7	5.7

Table 1 presents an assessment of the frequency of waste across various food product categories in cafeterias, expressed as percentages. The table categorizes waste frequency into six intervals: Daily, 2–3 times a week, 2–3 times a month, 2–3 times a year, Less frequently, and Lack of losses.

- Daily / 2–3 times a week / 2–3 times a month / 2–3 times a year / Less frequently: Frequency categories indicating how often each food product is wasted, expressed as a percentage of responses.
- Lack of losses: Percentage of respondents who reported no waste for that product category.

The data provides insights into which product types are most vulnerable to frequent wastage in cafeteria settings, likely due to perishability or overproduction.

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Table 2. Reasons for food waste in retail stores by product category [%]

Sepcification	Answers in %				
	Exceeding the expiry date / date of minimum durability	Mechanical damage to packaging	Failure to provide appropriate storage conditions	Break in the cold / freezing chain	Freshness loss
Fruits & Vegetables	5.7	6.9	3.4	2.3	78.2
Refrigerated products with a very short expiry date(e.g. milk, unpackaged meat)	58.6	9.2	5.7	8	11.5
Refrigerated products with longer expiry date	51.7	20.7	2.3	9.2	11.4
Frozen products	33.3	20.7	10.3	26.4	4.5
Bread (including baked sweet rolls)	18.4	1.1	1.1	4.6	65.3
Drinks	55.2	28.7	1.1	2.3	5.7

Table 2 identifies the primary reasons for food waste in retail stores across different product categories, also represented in percentages. The causes include: Exceeding expiry date, Mechanical damage to packaging, Failure to provide appropriate storage conditions, Break in the cold/freezing chain, and Freshness loss.

- Exceeding the expiry date / date of minimum durability: Waste caused due to products not being sold or consumed before their expiry.
- Mechanical damage to packaging: Waste due to damaged or compromised packaging.
- Failure to provide appropriate storage conditions: Waste resulting from inadequate temperature, humidity, or other storage factors.
- Break in the cold/freezing chain: Waste caused by interruptions in refrigeration during transport or storage.
- Freshness loss: Waste due to the product losing freshness or appeal before being sold or consumed.

The table emphasizes that causes of waste vary notably across product categories, underlining the need for category-specific waste mitigation strategies.

ANALYSIS AND FINDINGS

The data was focused on food categories (Fruits & Vegetables, Refrigerated products with a very short expiry date (e.g. milk, unpackaged meat), Refrigerated products with longer expiry date, Frozen products, Bread (including baked sweet rolls) and Drinks), wastage frequency, and causes like expiry, freshness loss, cold chain failures, and mechanical damage. Using Microsoft Excel for organization and Python for analysis, identified high-waste categories and causes.

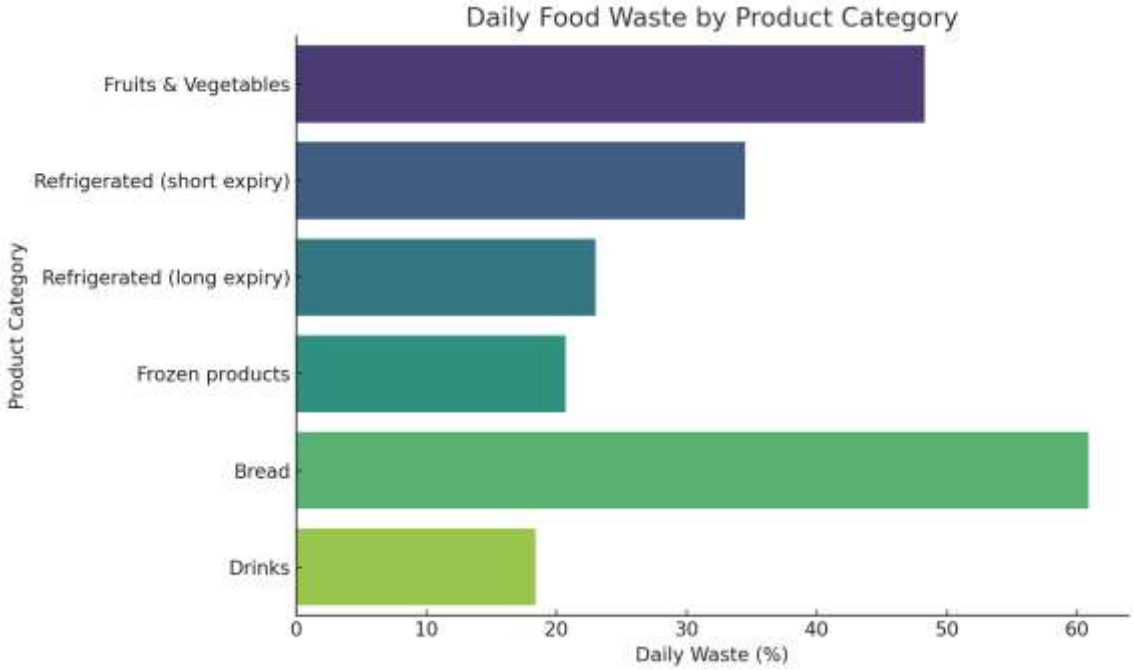


Figure 1. Daily frequency of food waste by product category

- Bread (including baked sweet rolls) is the most frequently wasted item on a daily basis (60.9%), likely due to its short shelf life and freshness sensitivity.
- Fruits & Vegetables follow closely at 48.3%, again reflecting perishability and possibly overstocking.
- Refrigerated products with a short expiry (like milk and meat) also show a high daily waste (34.5%).
- Drinks and Frozen products show relatively lower daily waste, indicating better shelf life and storage practices.

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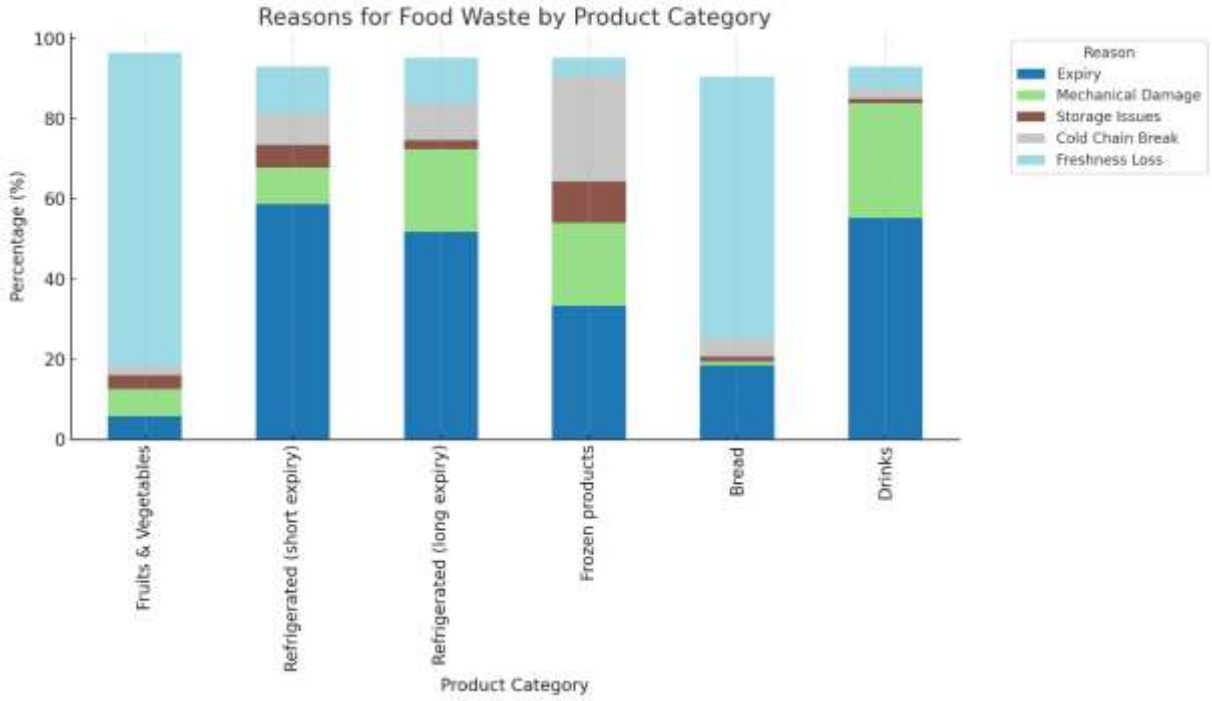


Figure 2. Causes of food waste across product categories

1. Fruits & Vegetables
   - Major Cause - Freshness loss (78.2%)
   - Implication: Suggests poor stock rotation, improper FIFO application, and potentially high ambient storage times.
2. Refrigerated Products (Short Expiry)
   - Major Cause - Exceeding expiry date (58.6%)
   - Indicates inadequate demand forecasting and improper FIFO usage.
   - Freshness loss is relatively low (11.5%), which means spoilage happens before it can go stale.
3. Refrigerated Products (Long Expiry)
   - Major Causes - Expiry (51.7%) and mechanical damage (20.7%)
   - May imply overstocking or inadequate stock visibility.
4. Frozen Products
   - Balanced Issues - Expiry (33.3%), mechanical damage (20.7%), cold chain break (26.4%)
   - Reflects operational challenges, especially maintaining the cold chain and product handling.
5. Bread & Baked Goods
   - Major Cause - Freshness loss (65.3%)
   - Since bread is wasted daily at the highest rate (60.9%), this strongly indicates lack of proper inventory rotation or stocking beyond daily demand.
6. Drinks
   - Top Reasons: Expiry (55.2%) and mechanical damage (28.7%)
   - Shows neglect in shelf stock rotation and possible poor packaging or handling.

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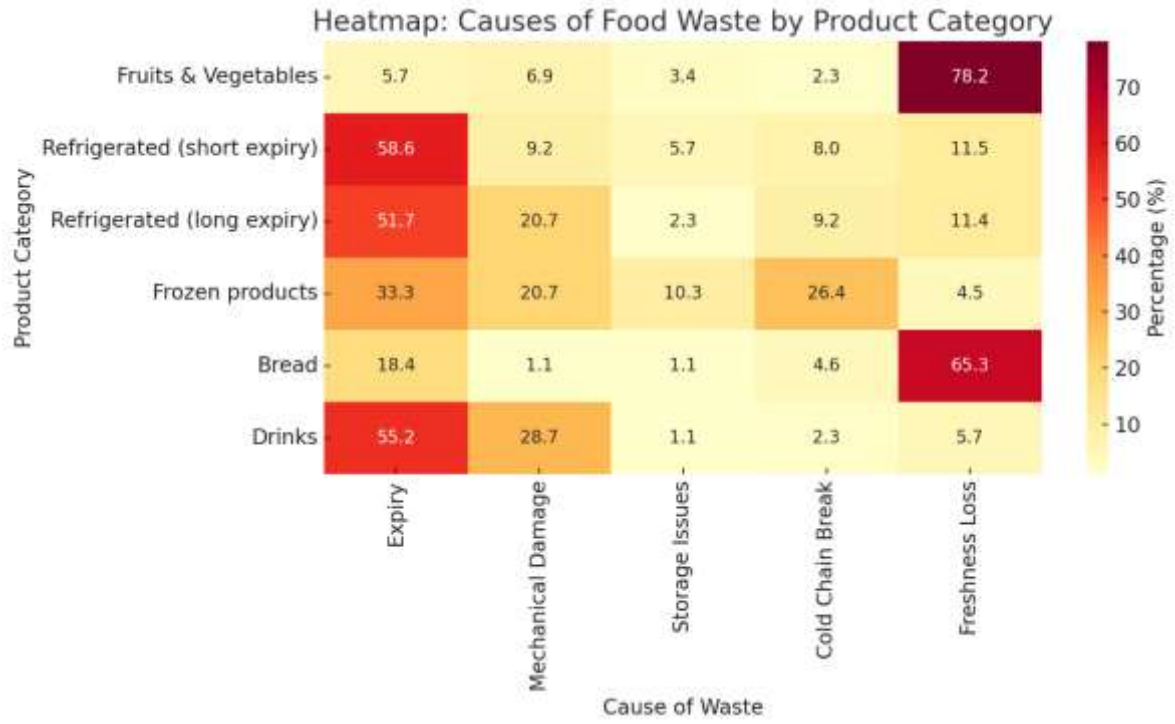


Figure 3. Cause of waste most dominant for each product category

Darkest (red) areas = highest waste causes:

- Freshness loss is clearly the biggest problem for Fruits & Vegetables and Bread.
- Expiry dominates for Short-expiry refrigerated items, Drinks, and Long-expiry refrigerated items.
- Cold chain break stands out for Frozen products.
- Mechanical damage is particularly high in Drinks and Long-expiry items.

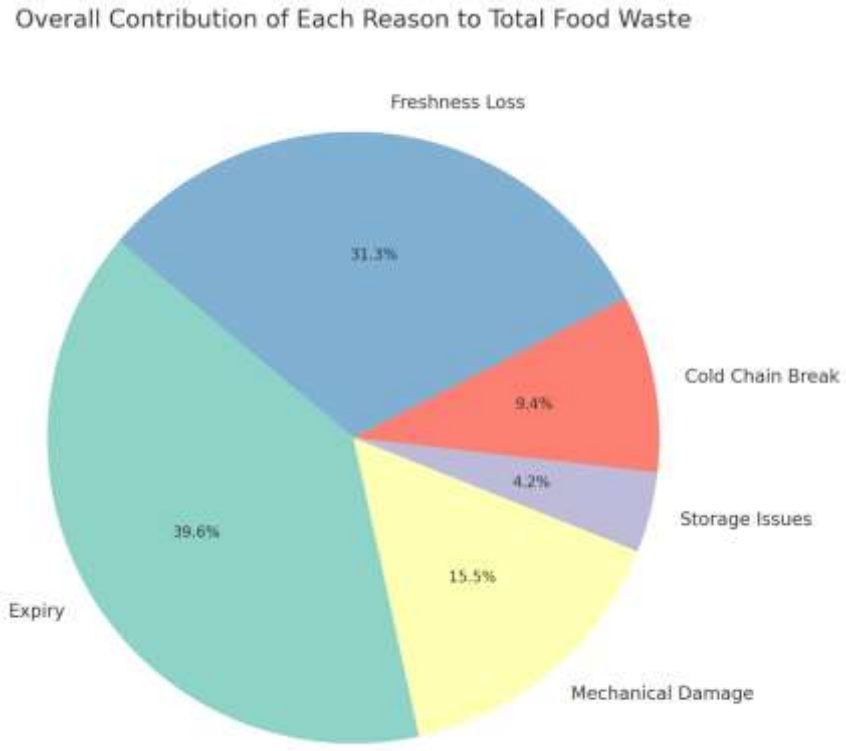


Figure 4. Contribution of each reason to overall food waste

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- Expiry (39.6%) for refrigerated and packaged items is the leading cause overall which makes it a major red flag for FIFO adherence.
- Freshness Loss (31.3%) is also a significant contributor, especially for Fruits and Vegetables.
- Mechanical Damage (15.5%) and Cold Chain Breaks (9.4%) reflect logistical and handling issues.
- Storage Issues (4.2%) are the least, but still notable.

Recommendations

Based on the findings from 11 educational institution cafeterias in Bangalore, several recommendations are proposed to improve FIFO implementation and reduce food waste.

1. Regular staff training and use of visual aids can strengthen FIFO awareness
2. Low-cost digital tool such as mobile apps or Excel dashboards with barcode/QR code scanning can streamline inventory tracking
3. Improved demand forecasting using historical consumption data and adjusting orders to align with seasonal and academic patterns will help minimize overstocking.
4. Procurement strategies should prioritize smaller, frequent deliveries for perishable items and better coordination with suppliers for items prone to expiry.
5. Enhancing cold chain infrastructure and using temperature monitoring devices will reduce spoilage, particularly in frozen and refrigerated items.
6. Weekly wastage audits and maintaining a logbook will help monitor inventory efficiency.
7. Lastly, fostering a culture of sustainability through student engagement and partnerships with NGOs for food redistribution can further support waste reduction efforts.

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