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Sustainable Management of Surplus Food in Hotels and Messes: A Dual Approach

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***Abstract*—In today's world, the issue of food wastage has become a significant concern, particularly in the hospitality industry where surplus food is a common occurrence. This research paper explores a dual approach to managing surplus food in hotels and messes. The approach involves categorizing surplus food into two types: eatable food and non-eatable food. Eatable food, which remains safe for consumption, can be distributed to nearby slums to feed hungry individuals in real-time. On the other hand, non-eatable food can be transported to bio gas plants to produce renewable energy. This paper examines the feasibility, benefits, and challenges associated with each approach, highlighting the potential for sustainability and social impact.**

***Index Terms*—component, formatting, style, styling, insert**

I. Introduction

In today's world, the hospitality industry stands at a critical juncture where the imperative of sustainability intersects with the pressing need to address food insecurity. With the staggering amount of food wasted annually, hotels and messes find themselves in a unique position to make a substantial impact on both fronts. Surplus food, a common byproduct of their operations, represents not only a missed opportunity but also a glaring ethical and environmental concern. This research paper delves into a novel approach to managing surplus food in hotels and messes, proposing a dual strategy that aims to maximize social, environmental, and economic benefits. By categorizing surplus food into two distinct types – eatable and non-eatable – this approach offers a pragmatic solution that addresses both immediate hunger relief and long-term energy sustainability. The first category, eatable food, encompasses items that remain safe for consumption but are no longer needed within the establishment. Rather than allowing these edible resources to go to waste, they can be swiftly distributed to nearby slums and vulnerable communities, serving as a lifeline for those facing food insecurity. This real-time distribution model not only provides immediate relief but also fosters community engagement and goodwill. Conversely, non-eatable food, including scraps, trimmings, and other inedible components, presents a unique opportunity for resource recovery. Instead of disposing of this organic waste in landfills, where it contributes to methane emissions and environmental degradation, it can be transported to bio gas plants for conversion into renewable energy. Through anaerobic digestion, these bio gas facilities transform food waste into a valuable resource, yielding bio gas for electricity generation and nutrient-rich dig-estate for agricultural use. By adopting this dual approach, hotels and messes can mitigate their environmental footprint, contribute to local communities, and demonstrate a commitment to sustainability and social responsibility. However, the implementation of such initiatives is not without its challenges, ranging from logistical complexities to regulatory hurdles. Nonetheless, with proper planning, stakeholder collaboration, and innovation, these challenges can be overcome, paving the way for a more resilient and inclusive food system. In the following sections, this paper will explore the feasibility, benefits, challenges, and best practices associated with the proposed approach, drawing on existing literature, case studies, and real-world examples. By shedding light on this innovative strategy, it is hoped that this research will inspire and inform efforts to transform surplus food management in the hospitality industry, ushering in a more sustainable and equitable future.

II. Categorization of Surplus Food

In the realm of surplus food management within hotels and messes, a crucial initial step involves the systematic categorization of surplus food to determine its optimal fate. This categorization process is pivotal in ensuring that surplus resources are effectively utilized while minimizing waste and maximizing social and environmental benefits. The following delineates the two primary categories into which surplus food is classified.

A. Eatable Food:

Eatable food comprises items that retain their safety and quality for consumption but are no longer required within the establishment due to factors such as overproduction, expiration dates nearing, or menu changes. This category encompasses a diverse array of food items, including prepared meals, perishable goods, and packaged foods. Eatable food often retains its nutritional value and pliability, making it suitable for redistribution to individuals facing food insecurity. Examples of eatable food may include freshly prepared dishes, unopened packaged goods, and surplus ingredients.

B. Non-eatable Food:

Non-eatable food refers to food waste that is unsuitable for direct consumption due to contamination, spoilage, or in edibility. This category encompasses various forms of organic waste generated during food preparation, including vegetable peelings, plate scrapings, and spoiled food items. While non-eatable food may no longer be fit for human consumption, it retains inherent value as a resource for alternative uses. In particular, organic waste holds significant potential for conversion into renewable energy through processes such as anaerobic digestion. Examples of non-eatable food include kitchen scraps, food trimmings, and spoiled or expired food items.

By systematically categorizing surplus food into these distinct types, hotels and messes can devise targeted strategies for its management and utilization. Eatable food can be earmarked for immediate redistribution to nearby communities in need, thereby addressing food insecurity and fostering social cohesion. Meanwhile, non-eatable food can be redirected towards bio gas plants or composting facilities for energy production or soil enrichment, respectively. This dual approach to surplus food categorization enables establishments to maximize the value of their resources while minimizing their environmental footprint, contributing to a more sustainable and equitable food system.

III. Eatable Food Distribution

Once surplus eatable food has been identified within hotels and messes, the next crucial step is its efficient and ethical distribution to individuals and communities facing food insecurity. Eatable food, comprising items that remain safe and suitable for consumption, holds immense potential to alleviate hunger and provide essential nutrition to those in need. The following outlines key considerations and strategies for the effective distribution of surplus eatable food:

A. Real-time Redistribution Channels

Establishing real-time redistribution channels is paramount to ensuring that surplus eatable food reaches individuals in a timely manner. Collaborating with local non-profit organizations, community centers, or food banks can provide established networks through which surplus food can be efficiently distributed. Additionally, establishing direct partnerships with nearby slums, shelters, or low-income neighborhoods enables hotels and messes to directly engage with and support marginalized communities.

B. Food Safety and Hygiene Protocols:

Prioritizing food safety and hygiene is essential throughout the distribution process to safeguard the health and well-being of recipients. Surplus eatable food must be carefully handled, stored, and transported in compliance with food safety regulations and best practices. Implementing rigorous quality control measures, such as temperature monitoring and packaging inspections, helps mitigate the risk of foodborne illness and ensures the integrity of distributed food items.

C. Community Engagement and Empowerment:

Fostering community engagement and empowerment lies at the heart of sustainable eatable food distribution efforts. Involving local residents, community leaders, and volunteers in the distribution process not only enhances its efficiency but also promotes social cohesion and solidarity. Empowering recipients to actively participate in decision-making processes, such as menu planning or meal preparation, fosters a sense of ownership and dignity while respecting their diverse cultural preferences and dietary needs.

IV. Non-eatable Food Utilization:

In parallel with the distribution of surplus eatable food, the effective utilization of non-eatable food presents a critical opportunity for hotels and messes to minimize waste and maximize resource efficiency. Non-eatable food, comprising organic waste that is unsuitable for direct consumption, holds significant potential for conversion into valuable resources, particularly through processes such as anaerobic digestion. The following outlines key strategies and considerations for the utilization of non-eatable food:

A. Transportation to Bio gas Plants:

Transporting non-eatable food waste to bio gas plants serves as a primary means of converting organic waste into renewable energy. Bio gas plants utilize anaerobic digestion processes to break down organic matter, including food scraps and kitchen waste, in oxygen-free environments. This biological decomposition produces biogas, a methane-rich fuel that can be used for electricity generation, heating, or cooking purposes. Additionally, the residual digestate generated during the process serves as a nutrient-rich fertilizer for agricultural applications, closing the loop on organic waste management.

B. Anaerobic Digestion Process:

The anaerobic digestion process involves several stages, including feed stock preparation, digestion, and bio gas recovery. Non-eatable food waste, once transported to the bio gas plant, undergoes initial processing to remove contaminants and optimize its suitability for digestion. Subsequently, the waste material is introduced into anaerobic dig-esters, where microbial activity breaks down organic compounds, releasing biogas as a byproduct. Bio gas recovery systems capture and store the generated bio gas for subsequent use as a renewable energy source.

C. Renewable Energy Generation:

The primary output of anaerobic digestion, biogas, serves as a versatile and renewable energy source with numerous applications. Bio gas can be combusted in gas turbines or engines to produce electricity, offering a sustainable alternative to fossil fuels and reducing greenhouse gas emissions. Additionally, bio gas can be purified to yield bio methane, a high-purity form of methane suitable for injection into natural gas pipelines or use as a transportation fuel. By harnessing the energy potential of non-eatable food waste, hotels and messes contribute to the transition towards a low-carbon energy infrastructure.

V. Feasibility Assessment:

Implementing initiatives for the distribution of surplus eatable food and the utilization of non-eatable food presents both opportunities and challenges for hotels and messes. A comprehensive feasibility assessment is essential to evaluate the viability and sustainability of these initiatives, considering various factors such as economic, environmental, and social considerations. The following outlines key aspects of the feasibility assessment for surplus food management in hospitality establishments:

A. *Economic Feasibility:*

- Cost-Benefit Analysis: Conducting a thorough cost-benefit analysis is essential to assess the economic viability of surplus food management initiatives. This involves evaluating the costs associated with food collection, transportation, storage, and distribution against the potential savings from reduced waste disposal fees and operational efficiencies. - Return on Investment (ROI): Calculating the potential ROI from surplus food management initiatives helps quantify the financial benefits over time. Investments in infrastructure upgrades, such as bio gas plant installations or distribution logistics, should be evaluated based on their expected returns and payback periods. - Revenue Generation Opportunities: Exploring revenue generation opportunities, such as selling surplus food-derived bio gas or by-products, can further enhance the economic feasibility of initiatives. Additionally, leveraging corporate social responsibility (CSR) funds or grant opportunities can offset initial investment costs and support ongoing sustainability efforts.

B. *Environmental Impact Analysis:*

- Lifecycle Assessment: Conducting a lifecycle assessment enables hotels and messes to quantify the environmental impacts associated with surplus food management initiatives. This includes assessing emissions reductions from diverting organic waste from landfills, as well as the environmental benefits of renewable energy generation from biogas. - Waste Reduction Metrics: Tracking and monitoring waste reduction metrics, such as diversion rates and greenhouse gas emissions savings, provides valuable insights into the environmental performance of surplus food management initiatives. Comparing baseline data against post-implementation results helps measure progress towards sustainability goals. - Resource Efficiency Improvements: Identifying opportunities for resource efficiency improvements, such as optimizing food production processes or implementing energy-saving measures, can further enhance the environmental benefits of surplus food management initiatives.

C. *Social Impact Assessment:*

- Community Engagement: Assessing the social impact of surplus food management initiatives involves evaluating their effects on local communities, including improvements in food security, nutrition, and social cohesion. Engaging stakeholders through participatory processes, such as community consultations or beneficiary feedback mechanisms, ensures that initiatives align with community needs and priorities. - Equity and Inclusivity: Evaluating the equity and inclusivity of surplus food distribution efforts is essential to ensure that vulnerable populations, such as low-income households or marginalized communities, are adequately served. Implementing targeted outreach strategies and culturally sensitive approaches promotes equitable access to surplus food resources. - Health and Well-being Outcomes: Assessing the health and well-being outcomes of surplus food management initiatives involves monitoring indicators such as nutritional intake, food safety compliance, and community satisfaction. Collaborating with public health agencies or academic institutions can provide expertise in evaluating these outcomes and informing program improvements.

Despite the potential benefits of surplus food management initiatives in hotels and messes, several challenges may arise during implementation. Addressing these challenges requires proactive strategies and innovative solutions to ensure the effectiveness and sustainability of surplus food management efforts. The following outlines key challenges and potential solutions:

VI. Challenges and Solutions:

A. *Regulatory Considerations:*

Challenge: Compliance with food safety regulations and legal requirements presents a challenge for surplus food management initiatives, particularly regarding liability issues and liability protection. Solution: Collaborating with legal experts and regulatory authorities to navigate relevant regulations and obtain necessary permits or certifications ensures compliance with food safety standards. Developing standardized operating procedures and training staff on food handling and safety protocols mitigates the risk of liability and ensures the integrity of distributed food items.

B. *Public Awareness and Acceptance:*

Challenge: Overcoming societal stigma and misconceptions surrounding surplus food, particularly regarding safety and quality concerns, can hinder public acceptance and participation in surplus food redistribution efforts. Solution: Implementing targeted public awareness campaigns and educational initiatives helps dispel myths and raise awareness about the safety and nutritional value of surplus food. Engaging with local media outlets, influencers, and community leaders amplifies messaging and fosters positive perceptions of surplus food redistribution efforts.

C. *Financial Constraints:*

Challenge: Limited financial resources and budget constraints may pose barriers to the implementation and scalability of surplus food management initiatives, particularly for smaller establishments or those operating on tight margins. Solution: Exploring creative financing mechanisms, such as public-private partnerships, grants, or crowdfunding campaigns, can

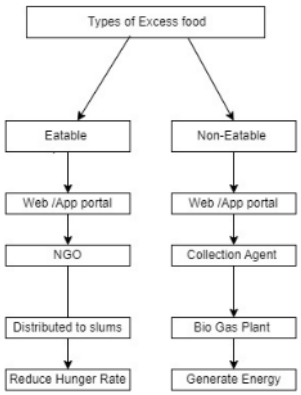
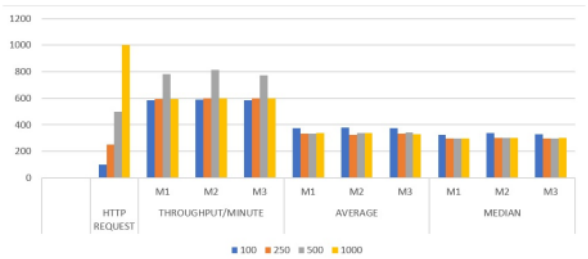


Fig. 1.

HTTP REQUEST	THROUGHPUT/MINUTE			AVERAGE			MEDIAN		
	M1	M2	M3	M1	M2	M3	M1	M2	M3
100	585.943	589.87	584.96	373	377.8	375	325	340	327.2
250	595.147	598.98	600.87	334	323	335	296	300	298
500	779.412	812.87	770.54	333	336	345	296	300	296
1000	593.564	600.43	598.45	336	340	330	297	300	301

Fig. 2. Testing Input and Results,M=Machine



provide additional funding to support surplus food management initiatives. Demonstrating the economic benefits, such as cost savings from reduced waste disposal fees or potential revenue streams from biogas production, strengthens the business case for investment in surplus food management.

VII. Results and Testing:

A. Hosted on Microsoft Azure Virtual Machine:

Our website is hosted on Microsoft Azure Virtual Machine, leveraging the power and flexibility of cloud computing. With Azure VM, we benefit from high-performance infrastructure, scalability to accommodate fluctuating traffic demands, and robust security features to safeguard our data and applications. Azure's global network of data centers ensures reliable up time and low latency, delivering a seamless user experience to our visitors worldwide. Additionally, Azure VM offers a range of management and monitoring tools, empowering us to optimize performance, control costs, and streamline operations. Overall, hosting our website on Azure VM provides a reliable and scalable solution for our online presence.

B. JMeter Testing:

Testing website performance using JMeter provides valuable insights into its ability to handle various levels of traffic and user interactions. The results obtained from JMeter tests, including graphs depicting throughput, average response time, and median response time, offer critical metrics for assessing the website's performance under load. This analysis is crucial for identifying potential bottlenecks, optimizing resource allocation, and ensuring a seamless user experience.

•Throughput:

Throughput is a key metric measured in transactions per unit of time, indicating the number of HTTP requests processed by the website within a given timeframe. The throughput graph generated by JMeter illustrates the website's capacity to handle concurrent user requests. A high throughput value signifies robust performance, indicating that the website can efficiently process a large volume of requests without experiencing slowdowns or failures. Conversely, a low throughput value suggests potential performance issues or constraints that may require optimization.

•Average: Average response time, another essential metric derived from JMeter tests, quantifies the time taken for the website to respond to user requests. The average response time graph provides insights into the website's responsiveness and efficiency in serving user interactions. A lower average response time indicates faster website performance, ensuring prompt delivery of content and services to users. Conversely, a higher average response time may indicate latency issues or resource constraints that could degrade the user experience.

•Median: Median response time complements the average response time by providing a measure of the central tendency of response times observed during testing. The median response time graph depicts the distribution of response times across user requests, highlighting the typical or median time taken for the website to respond. Similar to the average response time, a lower median response time indicates better website performance and user satisfaction. Monitoring both average and median response times enables a comprehensive assessment of website performance and helps identify outliers or anomalies in response time distribution.

Analyzing the results of JMeter tests involves interpreting the generated graphs and identifying patterns or trends that may indicate areas for improvement. For example, spikes or dips in throughput graph may signify fluctuations in traffic volume or unexpected surges in user activity. Similarly, increases in average or median response times may indicate performance degradation under load, necessitating further investigation into underlying causes such as server overload, network latency, or inefficient code execution.

Upon identifying performance issues or bottlenecks, web-

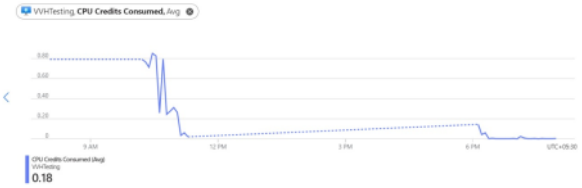


Fig. 3. CPU Credit Used

Fig. 4. Platform Analysis

site administrators can take proactive measures to optimize performance and enhance scalability. This may involve scaling resources, optimizing code and database queries, caching static content, or leveraging content delivery networks (CDNs) to reduce latency and improve response times. Additionally, fine-tuning server configurations, load balancers, and caching mechanisms can help distribute traffic more evenly and improve overall website performance.

In conclusion, testing website performance using JMeter and analyzing the resulting graphs provide valuable insights into the website's capacity, responsiveness, and scalability under varying levels of user load. By monitoring metrics such as throughput, average response time, and median response time, website administrators can identify performance bottlenecks, optimize resource allocation, and ensure a seamless user experience. Continuous testing and optimization are essential for maintaining optimal website performance and meeting user expectations in an increasingly competitive online landscape.

VIII. Conclusion:

The management of surplus food in hotels and messes presents a multifaceted challenge with far-reaching implications for sustainability, social responsibility, and environmental stewardship. Through the dual approach of distributing surplus eatable food to address immediate hunger needs and utilizing non-eatable food for renewable energy production, establishments have the opportunity to transform surplus food from a liability into a valuable resource.

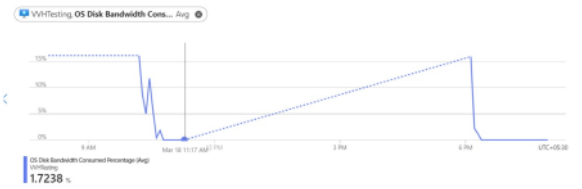


Fig. 5. Bandwidth

This research paper has explored the feasibility, benefits, challenges, and best practices associated with surplus food management initiatives in hospitality settings. By categorizing surplus food into eatable and non-eatable types, establishments can devise targeted strategies that maximize social impact while minimizing waste. Eatable food distribution programs provide essential nutrition to individuals and communities facing food insecurity, fostering social cohesion and empowerment. Meanwhile, non-eatable food utilization initiatives harness the energy potential of organic waste, contributing to renewable energy generation and climate change mitigation.

Despite the inherent complexities and obstacles, numerous case studies and best practices demonstrate the tangible benefits of surplus food management initiatives. From luxury hotels to military mess facilities, establishments across the hospitality sector have successfully implemented innovative solutions to reduce food waste, support local communities, and advance sustainability goals. By leveraging partnerships, technology, and stakeholder engagement, hotels and messes can replicate and adapt these strategies to their unique contexts, driving positive change within their operations and beyond.

As the hospitality industry continues to evolve, surplus food management remains a pressing priority, requiring ongoing commitment and collaboration from all stakeholders. By embracing the principles of sustainability, social responsibility, and innovation, hotels and messes can not only minimize their environmental footprint but also make meaningful contributions to food security, poverty alleviation, and climate resilience. Through concerted efforts and collective action, we can build a future where surplus food is no longer wasted but instead serves as a catalyst for positive social, economic, and environmental transformation.

In conclusion, surplus food management in hotels and messes is not merely a challenge to be addressed but an opportunity to be seized—a chance to create a more equitable, resilient, and sustainable food system for generations to come.

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