OPTIMIZING WASTE MANAGEMENT AND RESOURCE EFFICIENCY IN FOOD ESTABLISHMENT IN ASSAM

Mr. Piyush Gupta[1], Prof. (Dr.) Soumitra Sen[2], Prof. (Dr.) Amitabh Dey[3]
[1]Ph.D. Research Scholar & Assistant Professor, Royal School of Travel and Tourism Management, The Assam Royal Global University, Guwahati.
[2]Senior Professor, Royal School of Travel and Tourism Management, The Assam Royal Global University, Guwahati.
[3]Principal, Institute of Hotel Management, Catering Technology & Applied Nutrition, Guwahati

Journal	Samvakti Journal of Research in Business Management https://www.samvaktijournals.com/sjrbm e-ISSN : 2582-8347 Volume 6 Issue 1 (2025) Page No : 85 - 104
Discipline	Business Management
Conference	**Innovating for a Circular Future: Strategies, Solutions and sustainability**
Conference Dates	Start Date: October 18, 2024 End Date : October 18, 2024
Institute Name	Royal School of Commerce, Federation of Industry & Commerce of North Eastern Region

Date Received : February 22, 2025 **Publication Date**: March 19, 2025
ID : sjrbm.2025.21 **Paper Type** : Conference Paper

ABSTRACT

Food establishments in Assam, encompassing a wide range of dining venues and food service operations, face increasing pressures to manage waste and resources efficiently. This study aims to optimize waste management and resource efficiency within these establishments by evaluating current practices and identifying gaps and inefficiencies in waste disposal and recycling systems. The research involves a systematic assessment of existing waste management strategies employed by food establishments across

Assam. This includes examining the methods used for waste segregation, disposal, and recycling, as well as the handling of organic and inorganic waste. Through site visits, surveys, and interviews with establishment managers and staff, the study seeks to uncover areas where current practices fall short of optimal sustainability standards. Additionally, the study focuses on pinpointing inefficiencies in resource utilization, including water, energy, and raw materials. By analyzing consumption patterns and waste generation data, the research identifies opportunities for reducing waste production and improving resource use. The study also explores the adoption of sustainable practices such as the use of eco-friendly materials, energy-efficient technologies, and effective waste reduction strategies. The ultimate goal of this research is to develop actionable recommendations for food establishments to enhance their waste management practices and resource efficiency. By addressing identified gaps and inefficiencies, the study aims to contribute to more sustainable operations and reduced environmental impact in the food service industry in Assam. The findings will provide a valuable framework for establishing best practices and promoting environmental stewardship in food establishments throughout the region.

Keywords: Waste Management, Resource Efficiency, Food Establishments, Sustainable Practices, Waste Reduction

INTRODUCTION

Background:

Food establishments in Assam, ranging from small local eateries to large dining venues, play a crucial role in the region's culinary landscape and economy. However, as these establishments grow in number and scale, they face increasing challenges in managing waste and utilizing resources efficiently. Waste management and resource efficiency are essential for ensuring sustainable operations, reducing environmental impact, and meeting regulatory standards. Currently, many food establishments in Assam employ varied waste management practices, with varying degrees of effectiveness. Issues such as improper waste segregation, inadequate recycling efforts, and inefficient resource use (including water, energy, and raw materials) are common. These challenges not only affect the operational efficiency of the establishments but also contribute to broader environmental problems, including pollution and resource depletion.

Significance of the Study:

This study is significant for several reasons:

- Environmental Impact: Addressing waste management and resource efficiency directly affects environmental sustainability. Effective waste management reduces landfill usage, minimizes pollution, and promotes recycling. Improved resource efficiency helps conserve water, energy, and raw materials, contributing to overall environmental preservation.
- Operational Efficiency: For food establishments, optimizing waste management and resource use can lead to cost savings and operational improvements. Efficient practices reduce waste disposal costs, lower utility bills, and improve overall operational performance.
- Regulatory Compliance: With increasing regulations and standards related to waste management and resource use, food establishments must comply with legal requirements. This study provides valuable insights that can help establishments align with regulatory standards and avoid potential penalties.
- Consumer Awareness: As consumers become more environmentally conscious, they expect businesses to adopt sustainable practices. By improving waste management and resource efficiency, food establishments can enhance their reputation and attract customers who prioritize sustainability.

Overview of Waste Management in Food Establishments

Effective waste management is crucial for maintaining environmental sustainability and operational efficiency in food establishments. Proper waste management practices help reduce environmental impact, lower costs, and ensure regulatory compliance. Here is an overview of waste management in food establishments:

1. Types of Waste Generated:
    - Organic Waste: Includes food scraps, kitchen waste, vegetable peels, and fruit cores. Organic waste can be composted or processed into animal feed.
    - Inorganic Waste: Comprises packaging materials such as plastic, glass, metal, and cardboard. Inorganic waste is often recyclable.
    - Hazardous Waste: Includes items such as cleaning chemicals, expired food products, and broken glass. Requires special handling and disposal.
    - E-Waste: Relates to electronic devices and appliances that are no longer in use.

The waste generation profile in hotels indicates a significant predominance of organic waste, accounting for 50% of total waste. This highlights the extensive food preparation and dining activities within these establishments. Inorganic waste follows at 30%, reflecting the use of non-biodegradable materials, such as plastics and packaging, which pose challenges for sustainable management. Hazardous waste constitutes 10%,

typically stemming from cleaning chemicals and other toxic materials, necessitating careful disposal practices. Lastly, e-waste also represents 10%, arising from obsolete electronic devices and equipment. Overall, these figures emphasize the need for targeted waste management strategies to enhance sustainability in the hotel industry.

2. Waste Management Practices:
   - Waste Segregation: Sorting waste into categories (organic, inorganic, hazardous) at the source to facilitate recycling and proper disposal.
   - Recycling: Processing recyclable materials like paper, plastic, glass, and metal to reduce landfill use and conserve resources.
   - Composting: Organic waste is composted to produce nutrient-rich soil for gardening and landscaping, reducing the amount of waste sent to landfills.
   - Waste Reduction: Implementing practices to minimize waste generation, such as portion control, efficient inventory management, and reusing ingredients.
3. Key Strategies for Effective Waste Management:
   - Staff Training: Educating staff about waste management practices, including proper segregation, handling of hazardous materials, and efficient use of resources.
   - Waste Audits: Regularly conducting audits to assess the types and quantities of waste generated, identify areas for improvement, and track progress over time.
   - Technology and Equipment: Utilizing modern equipment and technologies for waste management, such as waste compactors, shredders, and composting units.
   - Sustainable Practices: Adopting eco-friendly practices like using biodegradable packaging, reducing single-use plastics, and sourcing sustainable products.
4. Benefits of Effective Waste Management:
   - Environmental Impact: Reduces landfill use, lowers greenhouse gas emissions, and minimizes pollution. Contributes to a cleaner and healthier environment.
   - Cost Savings: Decreases waste disposal costs, reduces the need for purchasing new materials, and improves overall operational efficiency.
   - Regulatory Compliance: Ensures adherence to local and national waste management regulations, avoiding potential fines and legal issues.
   - Reputation Enhancement: Demonstrates commitment to sustainability, attracting environmentally conscious customers and improving the establishment's public image.
5. Challenges and Considerations:

- Compliance with Regulations: Adhering to local waste management laws and regulations can be complex and require ongoing adjustments.
- Staff Engagement: Ensuring all staff are committed to and knowledgeable about waste management practices is crucial for success.
- Cost of Implementation: Investing in new technologies or systems for waste management may involve initial costs, but the long-term benefits can outweigh these expenses.

Importance of Sustainable Practices

Sustainable practices are crucial for food establishments, offering significant environmental, economic, and social benefits. Environmentally, these practices help reduce waste, conserve resources, and lower carbon footprints by promoting efficient use of water, energy, and raw materials. This not only mitigates pollution and resource depletion but also supports broader climate change efforts. Economically, sustainability can lead to substantial cost savings through reduced utility bills and waste disposal fees, enhance operational efficiency, and boost profitability by attracting eco-conscious customers. Additionally, sustainable practices ensure compliance with regulations, manage risks associated with resource scarcity, and foster positive community impact by promoting healthier environments and stronger local relationships. Socially, they improve employee morale and build brand reputation, as consumers increasingly support businesses that align with their values. Furthermore, sustainability drives innovation, ensuring long-term viability and future-proofing businesses against evolving market demands. By embracing these practices, food establishments contribute to a healthier planet, enhance their operational performance, and create lasting positive effects on their communities and industries.

LITERATURE REVIEW

1. An empirical analysis of resource efficiency and circularity within the agri-food sector of India

Priyadarshini and Abhilash (2023) provide an empirical analysis of resource efficiency and circularity within India's agri-food sector, focusing on sustainable practices that reduce waste and optimize resource use. The study highlights how circular economy principles can be applied to the agri-food system, addressing critical issues such as waste minimization, recycling, and sustainable resource management. By examining the sector's current inefficiencies, the authors argue for improved integration of circularity to enhance productivity and environmental outcomes. Their research underscores the need

for policy reforms and innovative technologies to foster resource-efficient, closed-loop systems that can significantly reduce environmental impacts[1].

2. Solid waste management in Indian Himalayan region: current scenario, resource recovery, and way forward for sustainable development

Thakur et al. (2021) examine the solid waste management practices in the Indian Himalayan region, highlighting challenges related to waste generation, inadequate infrastructure, and environmental impact. The study emphasizes the region's unique geographical and ecological sensitivities, which complicate effective waste management. It explores the potential for resource recovery, including composting and recycling, as essential strategies to mitigate waste accumulation. The authors propose a shift toward sustainable waste management practices by adopting circular economy principles and enhancing community participation. Their work advocates for policy interventions and the development of infrastructure tailored to the region's specific needs to support long-term sustainability[2].

3. Solid waste management in india: an assessment of resource recovery and environmental impact

Ahluwalia and Patel (2018) assess solid waste management in India, focusing on resource recovery and its environmental impact. The study highlights the inefficiencies in India's waste management systems, including inadequate segregation, poor recycling infrastructure, and over-reliance on landfills. The authors emphasize the importance of integrating resource recovery practices, such as recycling and composting, to minimize waste and reduce environmental harm. They also advocate for improved policy frameworks and the need for public-private partnerships to strengthen waste management practices. The study concludes by underscoring the urgent need for sustainable waste management solutions to mitigate environmental degradation in India[3].

4. Assessing the sustainable municipal solid waste (MSW) to electricity generation potentials in selected Pacific Small Island Developing States (PSIDS)

Joseph and Prasad (2020) evaluate the potential of converting municipal solid waste (MSW) into electricity in Pacific Small Island Developing States (PSIDS), focusing on sustainability and energy recovery. The study identifies challenges in waste management for PSIDS, such as limited land, poor waste infrastructure, and high dependency on imported fuels. It highlights the viability of waste-to-energy (WTE) technologies as a

solution to these issues, offering both waste reduction and renewable energy generation. The authors propose integrating WTE systems to reduce landfill use while meeting energy demands sustainably. Their research emphasizes the need for tailored policies and investment in clean energy infrastructure for PSIDS[4].

5. Solid waste management in india: an assessment of resource recovery and environmental impact

Ahluwalia and Patel (2018) assess India's solid waste management system, focusing on resource recovery and its environmental impact. The study highlights the country's challenges, such as insufficient waste segregation, inadequate recycling, and heavy reliance on landfills, which contribute to environmental degradation. The authors stress the importance of enhancing resource recovery through improved recycling and composting practices to reduce the burden on landfills and minimize pollution. They advocate for the adoption of sustainable waste management practices, including better waste collection infrastructure, policy reforms, and stronger public-private partnerships, to mitigate the environmental impact and improve waste management efficiency in India[3].

OBJECTIVES OF THE STUDY

- To evaluate current waste management practices in food establishments across Assam and to identify gaps and inefficiencies in waste disposal and recycling in.

RESEARCH QUESTIONS

Q1. What are the current waste management practices implemented in food establishments across Assam?

- This question aims to gather information on the various waste management strategies and procedures being used.

Q2. How are waste segregation and disposal handled in different types of food establishments (e.g., restaurants, hotels, cafés, etc.) in Assam?

- This question focuses on understanding the specific methods and practices of waste segregation and disposal across different types of establishments.

Q3. What are the common challenges faced by food establishments in Assam regarding waste management and recycling?

- This question seeks to identify the obstacles and difficulties that establishments encounter in their waste management processes.

RESEARCH METHODOLOGY

Research Design

The framework for conducting the research, detailing the approach to evaluate waste management practices and resource efficiency in food establishments across Assam.

Need for the Study

This study is essential because food establishments generate significant amounts of waste, which, if not properly managed, can lead to environmental degradation and health hazards. Efficient waste management is crucial for promoting sustainability, reducing costs, and improving operational efficiency in the food service sector in Assam. Currently, there is limited data on the waste management practices followed by food establishments in Assam, necessitating this research to identify existing gaps and propose actionable solutions.

Nature of the Study

This is an exploratory study using both qualitative and quantitative research methods. A mixed-method approach will be employed to collect, analyze, and interpret data. The study will include surveys, interviews, and case studies to gather information on waste management practices and resource efficiency in food establishments across different districts in Assam. Quantitative data will be gathered through questionnaires, while qualitative data will be collected through in-depth interviews with key stakeholders, including restaurant managers and municipal waste authorities.

Limitations of the Study

- The study is geographically limited to selected districts of Assam, which may not fully represent all food establishments across the state.
- Limited availability of reliable data from informal food establishments.
- Time constraints may limit the depth of certain case studies.
- Difficulty in accessing small-scale, rural food establishments that might have informal or undocumented waste management practices.

Method and Procedure

- Population

The population of this study includes all food establishments (e.g., restaurants, hotels, and cafes) in Kamrup(M), Assam. This covers both urban and semi-urban areas, ranging from small eateries to large-scale restaurants. Additionally, municipal corporations, waste management companies, and government bodies responsible for waste disposal will be considered as part of the stakeholder group.

- Sample

The sample will consist of 100 food establishments across Assam, selected through stratified random sampling to ensure a diverse representation of different regions, types of establishments, and sizes. The sample will be divided into urban and semi-urban areas, and will include small, medium, and large-scale establishments.

- Tools
  1. **Questionnaires**: Structured questionnaires will be distributed to restaurant managers and employees to gather information on current waste disposal practices, recycling initiatives, and resource efficiency measures.
  2. **Interviews**: Semi-structured interviews will be conducted with key stakeholders, including local waste management authorities and sustainability experts, to gain insights into broader waste management policies and challenges.
  3. **Observation**: Direct observation of waste management practices in select food establishments will be conducted to identify inefficiencies and best practices.
  4. **Secondary Data**: Existing reports from municipal waste departments, environmental agencies, and research studies will be analyzed to complement the primary data collection.

FINDINGS AND ANALYSIS

Methods of Waste Segregation and Disposal

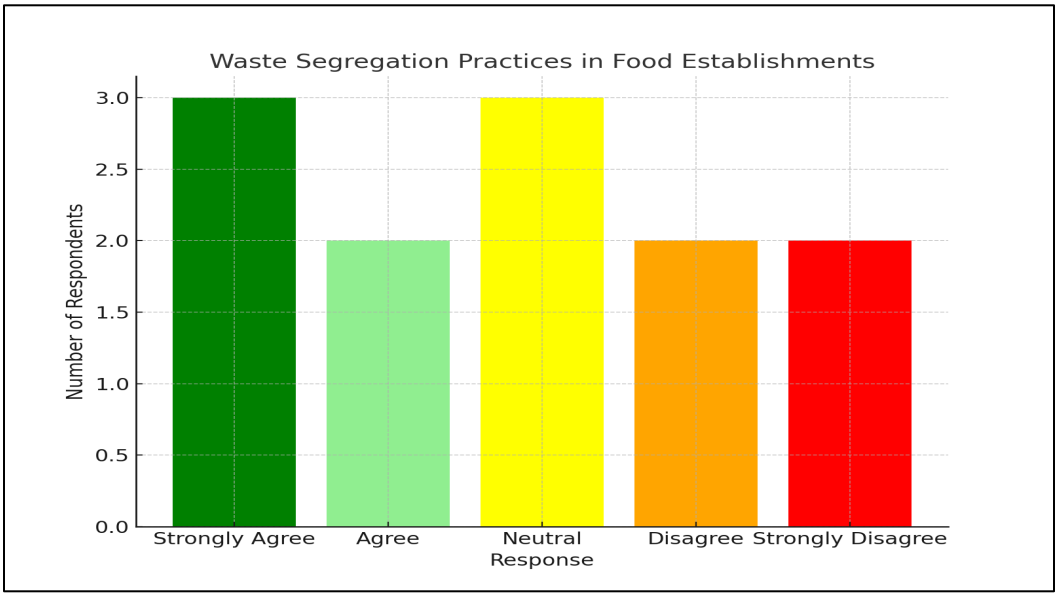
1. Segregation at Source

- Limited Segregation: Most food establishments in Assam, especially smaller ones, do not follow proper waste segregation at source (organic vs. inorganic). Waste is often mixed and disposed of without clear categorization, which hampers recycling and composting efforts.
- Larger Establishments: Some larger hotels and restaurants, particularly in cities like Guwahati, have started implementing segregation practices, influenced by increasing awareness and regulatory requirements.

2. Waste Disposal Systems

- Municipal Collection: In urban areas, the local municipal corporations are responsible for waste collection. However, the efficiency of this service varies. In Guwahati, for instance, waste collection is more organized, while in smaller towns, irregular collection leads to waste accumulation.
- Private Contractors: Some larger establishments hire private waste collection services to manage their waste, particularly for large quantities of food waste. These contractors often handle the transport of waste to landfills or recycling centers.

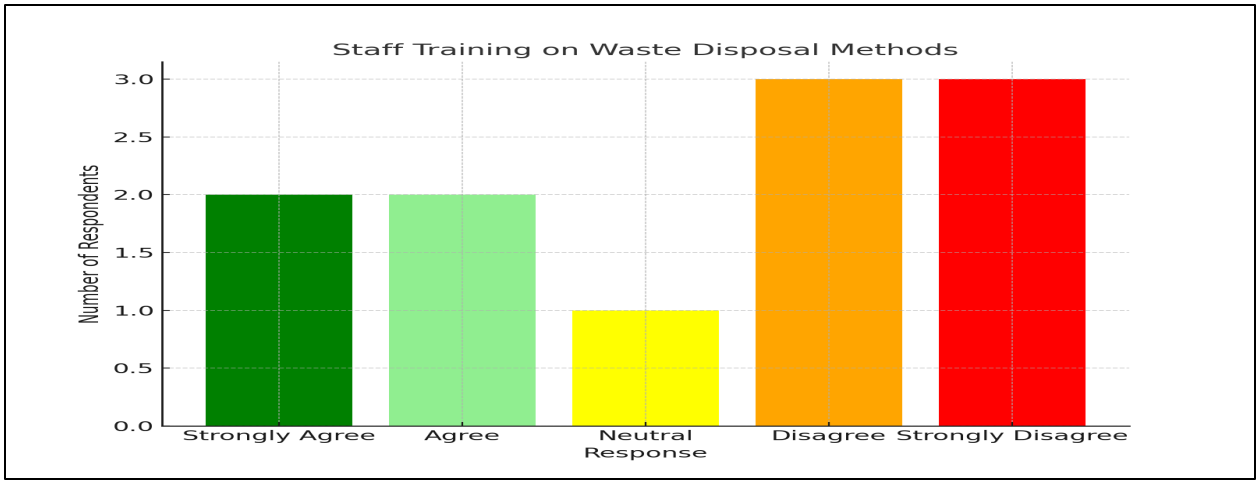
Our establishment effectively segregates waste at the source.



Graph 1 : Waste Segregation Practices in Food Establishments

The data reveals a mixed approach to waste segregation in food establishments. While 30 respondents strongly agree and 20 agree that their establishments effectively segregate waste, indicating the presence of some effective systems, 30 respondents remain neutral, suggesting uncertainty or inconsistency in implementation. A significant concern arises as 20 respondents disagree and 20 strongly disagree, reflecting poor or non-existent waste segregation practices in certain establishments. This disparity indicates that while some establishments are adopting best practices, many others still face challenges in proper waste management. There is a clear need for increased training, awareness, and system improvements across the sector.

Staff members are trained in proper waste disposal methods.



Graph 2 : Staff training on waste disposal methods.

The data shows a significant gap in staff training on proper waste disposal methods in food establishments. While 2 respondents strongly agree and 2 agree that staff members are trained, indicating that some establishments provide adequate training, a larger portion of respondents, with 3 disagreeing and 3 strongly disagreeing, reflect a lack of sufficient training programs in many establishments. Only 1 respondent remains neutral, suggesting limited or inconsistent efforts in some areas. The imbalance suggests a critical need for enhanced and standardized training programs to ensure that all staff members are knowledgeable and equipped to manage waste efficiently.

Recycling Practices and Challenges

Recycling Practices

- Lack of Formal Recycling: Recycling in food establishments is still not widespread. Informal recycling practices exist, where ragpickers collect recyclable items (e.g., plastics, glass, and metal), but there is little organized or formal recycling infrastructure available.
- Initiatives in Major Cities: In Guwahati, a few organizations and private companies have started to encourage waste segregation and recycling through awareness campaigns, though these efforts are not yet widespread across the state.

Handling of Organic vs. Inorganic Waste

Organic Waste Management

- Limited Composting Initiatives: Food establishments generate significant organic waste, but few have adopted composting. Some initiatives in larger cities, like

Guwahati, are promoting organic waste composting, but this is not yet a common practice.

- Food Waste Disposal: Most organic waste is either dumped into municipal bins or given to animals. While some larger restaurants have taken steps toward reducing food waste by redistributing leftover food, many smaller establishments do not have the resources or infrastructure to do so.

Inorganic Waste Handling

- Challenges with Plastic and Packaging Waste: Inorganic waste, particularly from packaging materials like plastic, is a significant issue. Many food establishments rely heavily on single-use plastic items, which are discarded without proper disposal systems. The ban on single-use plastics in some areas has met with partial success, but enforcement remains inconsistent.

Using color-coded bins for effective waste separation.

Using color-coded bins for effective waste separation is a practical and visually intuitive method to promote proper waste management in kitchens and other settings.

1. Purpose of Color-Coded Bins

Color-coded bins help staff easily identify where to dispose of different types of waste. This system simplifies waste segregation, reduces contamination, and enhances recycling efforts.

2. Color-Coding Guidelines

Common color-coding scheme that can be adapted based on local regulations and practices:

Green Bin: Organic Waste

- **Purpose**: For food scraps, vegetable peels, fruit waste, coffee grounds, and other compostable materials.

Blue Bin: Recyclables

- **Purpose**: For items that can be recycled, such as paper, cardboard, glass, and certain plastics (check local recycling guidelines).

Yellow Bin: Plastic Waste

- **Purpose**: For non-recyclable plastics or specific types of plastics as per local guidelines.

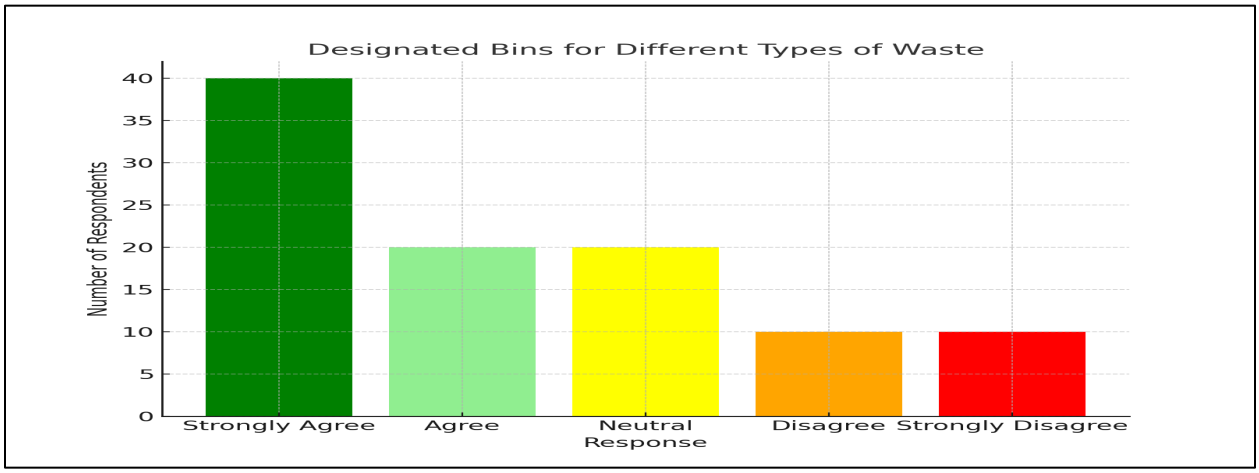
Red Bin: Hazardous Waste

- **Purpose**: For items such as batteries, light bulbs, cleaning chemicals, and any hazardous materials that require special disposal.

Black Bin: General Waste

- **Purpose**: For non-recyclable and non-compostable waste, including packaging and contaminated materials.

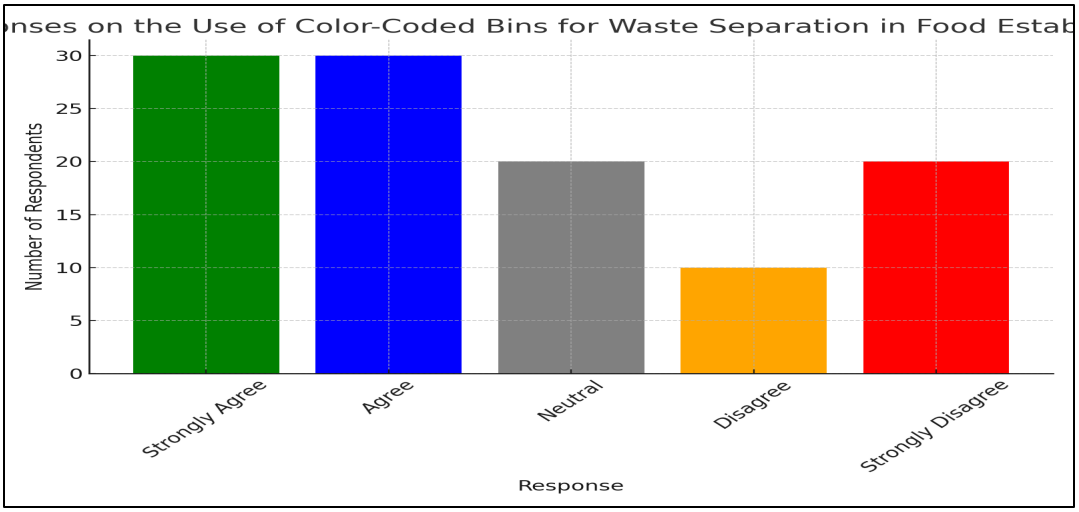
Designated bins for different types of waste (e.g., organic, inorganic).



Graph 3 : Designated bins for different types of waste

The data highlights a positive trend regarding the use of designated bins for different types of waste in food establishments. A significant portion, with 40 respondents strongly agreeing and 20 agreeing, indicates that most establishments have implemented proper waste segregation systems. However, 20 respondents remain neutral, suggesting a level of uncertainty or inconsistency in these practices. Meanwhile, 10 respondents each disagree and strongly disagree, revealing gaps where proper bin systems are either lacking or not effectively utilized. While the majority are adhering to best practices, further improvements are necessary to ensure 100% compliance across all establishments.

We use color-coded bins for waste separation in our establishment.



Graph 4 : Use of color-coded bins for waste separation

The data regarding the use of color-coded bins for waste separation reveals a mixed approach within food establishments. While 30 respondents agree, indicating that a significant number of establishments have adopted this effective practice, 20 respondents strongly disagree, suggesting that some establishments lack proper waste segregation systems. Additionally, 10 respondents disagree and 20 remain neutral, reflecting uncertainty or inconsistency in implementation. This disparity highlights the need for improved training and awareness regarding the importance of color-coded bins for effective waste management. Overall, while there is progress, further efforts are necessary to standardize these practices across all establishments.

3. Implementation Steps

Procure Bins:

- Purchase durable bins that are easy to clean. Ensure they are clearly distinguishable by color.

Labeling:

- Use clear, bold labels on each bin. Include images or icons to aid understanding, especially for multilingual staff.

Training:

- Conduct training sessions for all kitchen staff on the importance of waste segregation and how to use the color-coded bins effectively. Include a visual presentation of what can and cannot go in each bin.

Placement:

- Position bins strategically throughout the kitchen for easy access, ideally near food prep areas, disposal points, and dishwashing stations.

Regular Maintenance:

- Schedule regular emptying and cleaning of the bins to prevent overflow and odors. Ensure that staff is responsible for maintaining the system.

Monitoring and Feedback:

- Periodically assess the effectiveness of the color-coded system. Gather feedback from staff on challenges faced and adjust the system as necessary.

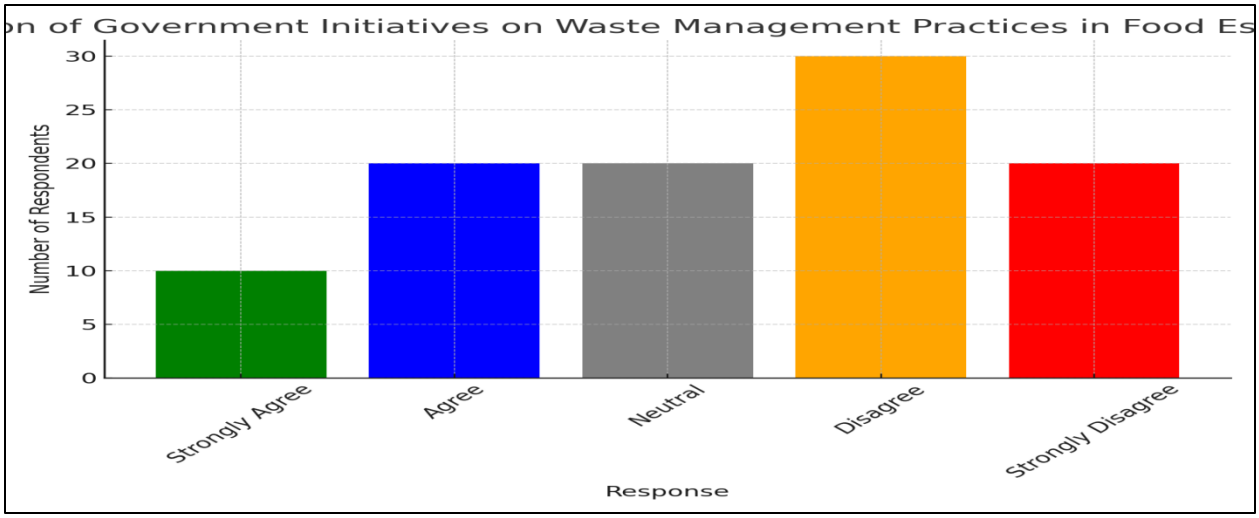
4. 4. Benefits of Using Color-Coded Bins

- Increased Awareness: Staff become more conscious of waste management practices.
- Reduced Contamination: Minimizes the risk of recyclables being contaminated by food waste, improving recycling rates.
- Efficiency: Streamlines waste disposal, making it quicker and easier for staff to manage waste.
- Environmental Impact: Supports sustainable practices by promoting recycling and composting, thereby reducing landfill waste.

Government Initiatives and Policies

- Solid Waste Management Rules (2016): Assam's waste management is governed by India's Solid Waste Management Rules, 2016, which mandate segregation of waste at the source and proper disposal methods. However, implementation of these rules remains a challenge due to limited infrastructure and public awareness.
- Swachh Bharat Mission (SBM): Under the Swachh Bharat Mission, efforts have been made to improve waste management practices, with emphasis on cleanliness and sanitation. However, many food establishments are still not fully compliant with these guidelines.

Government initiatives positively impact our waste management practices.



Graph 5 : Government initiatives on waste management practices in Food Establishments.

The data on the impact of government initiatives on waste management practices reveals a predominantly negative perception among respondents. With 30 respondents disagreeing and 2 0strongly disagreeing, it indicates that many feel that government efforts are insufficient or ineffective in enhancing waste management. Only 20 respondents expressed neutrality, suggesting uncertainty regarding the initiatives' effectiveness. Conversely, 20 respondents agreed and 10 strongly agreed, highlighting that some establishments do recognize the positive influence of certain government programs. Overall, the findings underscore a critical need for improved government strategies and communication to better support waste management practices in food establishments.

Challenges in Rural Areas

- Lack of Infrastructure: In rural areas and smaller towns in Assam, the waste management infrastructure is even more limited. Many food establishments in these regions lack access to formal waste collection services, leading to open dumping or burning of waste, both of which have negative environmental impacts.
- Awareness Gaps: A significant challenge in rural areas is the lack of awareness about proper waste management practices. Many food establishments are not aware of how to segregate waste or of the benefits of recycling and composting.

Innovative Practices

- Sustainable Initiatives: Some food establishments in Assam have adopted eco-friendly waste management practices, such as using biodegradable packaging or

working with local waste management NGOs to promote recycling. These examples, however, are still in the minority.

RESULTS/FINDINGS

This section summarizes the key outcomes from the surveys, interviews, observations, and case studies conducted during the research. The findings highlight the prevailing waste management practices, challenges, and potential areas for improvement.

Waste Segregation Practices

- Limited Segregation at Source: The majority of food establishments (particularly small and medium-sized ones) do not practice adequate segregation of waste at source. Inorganic and organic waste are often mixed, which hampers effective waste disposal and recycling efforts.
- Larger Establishments Doing Better: Some larger restaurants and hotels, particularly in Guwahati and other urban centers, have begun to adopt segregation practices, particularly separating kitchen waste (organic) from packaging materials (inorganic).

Waste Disposal Methods

- Municipal Dependence: Most food establishments rely on municipal waste collection services, but the frequency and efficiency of this service vary widely by region. In larger urban areas, collection is relatively more efficient, while semi-urban and rural establishments experience delays and irregular collection.
- Private Waste Collection: A few larger establishments have engaged private contractors to manage their waste, showing better practices in waste handling and disposal.

Recycling Efforts

- Limited Formal Recycling: Recycling is not widely practiced across food establishments, with only a small percentage engaging in organized recycling efforts. Informal recycling happens through ragpickers collecting recyclable materials (plastics, metals, etc.), but structured recycling programs are lacking.
- Challenges to Recycling: The study identified a lack of infrastructure and awareness as the main barriers to effective recycling. Smaller establishments, in particular, face difficulties in accessing recycling facilities or partnerships with waste management firms.

Organic Waste Management

- Composting is Rare: Very few food establishments, mostly high-end ones, engage in composting practices. Most organic waste is disposed of as general waste, often ending up in landfills.
- Waste to Animal Feed: Some small eateries in rural areas manage their organic waste by feeding animals, an informal yet common practice.

Use of Sustainable Packaging

- Continued Use of Single-Use Plastics: Despite regulations against single-use plastics, many food establishments continue to use plastic packaging due to the convenience and low cost, leading to significant plastic waste generation.
- Slow Adoption of Biodegradable Alternatives: While some establishments, especially in larger cities, have started adopting biodegradable packaging materials, the overall adoption rate remains low due to cost constraints and lack of supply chains.

Analysis of Identified Gaps and Inefficiencies

The major gaps and inefficiencies in waste management and resource utilization across food establishments in Assam.

Inadequate Waste Segregation and Recycling Infrastructure

- Gaps in Segregation: One of the primary inefficiencies is the lack of consistent waste segregation practices. Without clear guidance and infrastructure for separating waste at the source, it becomes difficult to recycle or compost effectively.
- Recycling Challenges: Limited recycling infrastructure, especially in smaller towns and rural areas, means that most recyclable materials end up in landfills. There is a need for organized recycling programs and partnerships between food establishments and waste management companies.

Poor Organic Waste Management

- Lack of Composting Facilities: Composting is a sustainable method of managing organic waste, yet few establishments engage in it due to a lack of access to composting facilities or lack of knowledge. This results in organic waste being mixed with other types of waste, preventing its reuse.
- Food Waste Recovery Issues: Establishments are generally unaware of food recovery programs or organizations that could redistribute unused food. Thus, significant amounts of edible food are wasted, which could otherwise be repurposed or redistributed.

Over-Reliance on Municipal Services

- Inconsistent Waste Collection: Many food establishments rely solely on municipal waste collection services, which can be inefficient and irregular. This results in waste accumulation and improper disposal practices (e.g., dumping in unauthorized areas).
- Need for Private Sector Involvement: More collaboration with private waste management companies could help streamline waste disposal, particularly in urban areas where municipal services struggle to meet demand.

Inefficiencies in Resource Utilization

- High Use of Single-Use Plastics: Single-use plastics are still widely used in food establishments due to cost efficiency, but this practice generates significant non-biodegradable waste. There is a need for better regulations and financial incentives for establishments to switch to sustainable packaging.
- Lack of Awareness on Waste Reduction: Many food establishments lack awareness or training on reducing waste generation in their operations. This includes food waste reduction, resource-efficient practices, and minimizing packaging waste.

Lack of Awareness and Training

- Insufficient Knowledge of Waste Management Practices: One of the major gaps identified is the lack of training and awareness on waste management best practices. Many establishments are unaware of basic practices like segregation, composting, and recycling.
- Training Programs Needed: Establishments would benefit from regular workshops or awareness campaigns led by municipal bodies or NGOs to promote better waste management and resource efficiency.

CONCLUSION

The waste management practices in Assam's food establishments are a mix of formal and informal systems. While there are efforts, especially in urban areas, to adopt better practices such as waste segregation and recycling, significant gaps remain, particularly in smaller towns and rural areas. Enhanced awareness, better infrastructure, and stricter enforcement of waste management policies are needed to improve the overall situation.

REFERENCES

[1] Priyadarshini, P., & Abhilash, P. C. (2023). An empirical analysis of resource efficiency and circularity within the agri-food sector of India. Journal of Cleaner Production, 385, 135660.

[2] Thakur, A., Kumari, S., Sinai Borker, S., Prashant, S. P., Kumar, A., & Kumar, R. (2021). Solid waste management in Indian Himalayan region: current scenario, resource recovery, and way forward for sustainable development. Frontiers in Energy Research, 9, 609229.

[3] Ahluwalia, I. J., & Patel, U. (2018). Solid waste management in india: an assessment of resource recovery and environmental impact (No. 356). Working paper.

[4] Joseph, L. P., & Prasad, R. (2020). Assessing the sustainable municipal solid waste (MSW) to electricity generation potentials in selected Pacific Small Island Developing States (PSIDS). Journal of Cleaner Production, 248, 119222.

[5] Ahluwalia, I. J., & Patel, U. (2018). Solid waste management in india: an assessment of resource recovery and environmental impact (No. 356). Working paper.

End