J. Bio. & Env. Sci. 2025



RESEARCH PAPER

OPEN ACCESS

Assessing food waste practices and challenges in food service outlets: A study in Guwahati locality

Prerona Basumatary¹, Barasa Rani Rabha¹, Banita Luitel¹, Avisek Purkayastha², Ashfeeka Islam³, Radali Duarah^{*1}

¹Assam down town University, Panikhaiti, Guwahati, Assam, India ²Assam Institute of Management, Boragaon, Guwahati, Assam, India ³Krishi Vigyan Kendra, Nagaon, Assam, India

Article published on June 03, 2025

Key words: Food waste, Food service outlets, Sustainability, Restaurant

Abstract

Food waste has been a global challenge with significant environmental, economic and social implications. Foodservice outlets, including restaurants, cafeterias, and hotels, are major contributors to this issue, with approximately 26% of food waste originating from this sector. The present study aimed to examine food waste practices and challenges within the food service outlets of Guwahati, a rapidly urbanizing metropolis in Northeast India. The survey targeted Ganeshguri, Chandmari, Six Mile, Bhangagarh and Panikhaiti. The objectives included assessment of the average daily quantity of food wasted and disposal methods employed by food service outlets for managing food waste; identification of the key reasons behind food wastage of food service outlets and evaluation of the effectiveness of storage practices; and exploring the strategies for minimizing food waste. Through surveying 75 outlets across five locations in Guwahati, it was found that a majority of the outlets (81.3%) dispose of waste in municipal collection bins, indicating a minimal engagement in sustainable practices like composting. The average daily food waste per outlet was approximately 7.1 kg, with none of the establishments tracking waste generation. Customer leftovers (68.8%) were the primary reason for food wastage. Factors such as spoilage due to high humidity and overproduction also contributed significantly. Strategies to minimize food waste highlighted the importance of raising customer awareness (53.3%) and staff training (25.3%). Most outlets relied on justin-time preparation and daily buying strategies to reduce waste. This study emphasizes the need for targeted interventions and sustainable practices in the foodservice sector in Guwahati.

*Corresponding Author: Radali Duarah 🖂 radali.duarah@adtu.in

Introduction

Food loss and waste is a global problem with severe consequences for food availability, economic prosperity, and ecological balance. The FAO (Food and Agriculture Organization) has estimated that a ratio of approximately one-third of food produced for human consumption is wasted throughout the entire supply chain globally (FAO, 2011). This is primarily due to the production of food that ends up being wasted, and has shown significant impacts on the environment and its resources. In 2013, FAO determined that the annual amount of greenhouse gas emissions in landfills due to food waste is almost equivalent to the total emissions of Cuba (approx. 3.3 billion tons of CO2e/year) and that food waste accounts for the yearly global water loss of roughly 250 Km³ which is equivalent to three times the volume of Lake Geneva in Switzerland (FAO, 2013; Papargyropoulou et al., 2014). The impact of food waste extends beyond the environment and also contributes to social injustices, especially regarding global hunger. The agricultural production reached 9.5 billion tonnes in 2021 globally (FAO, 2022). However, 828 million continue to experience hunger on a regular basis which is 10% of the population (FAO, IFAD, UNICEF, WFP and WHO, 2022). Food service outlets constitute one of the contributors to food waste on a commercial level. Around 931 million tonnes of food waste were generated in 2019, 26% of which came from food service outlets (Food Waste Index Report, 2021). According to WRAP (Waste and Resources Action Programme), 75% of food wastage produced in the food service sector was perfectly edible before disposal, such as surplus dishes or customer plate leftovers (WRAP-Waste and Resources Action Programme, 2013a). Customer leftovers makeup the largest portion food waste in the sector. Approximately one-third of food waste is generated by customers' plate waste (Papargyropoulou et al., 2016). Beyond the environmental outcomes, tackling food waste also serves to address issues surrounding food availability and self-sufficiency, particularly in developing nations (Sakaguchi et al., 2018; Scialabba, 2010).

The United Nations Environment Programme's food wastage index report reveals that Indian households waste approximately 68.7 million tonnes of food every year. Globally, India ranks second in terms of food wastage at the household level, with only China surpassing it (Food Waste Index Report, 2021). Furthermore, India ranks 111th out of the 125 countries in the Global Hunger Index (Global Hunger Index, 2023). Research on food waste within the Indian food waste has expanded considerably in recent years. According to Dhir et al. (2020), investigations have been conducted in only eight developing nations thus far, with India being one of them. However, India's waste management infrastructure is poor in terms of waste collection, transportation, treatment, and disposal. The present waste management systems in India are insufficient to handle the amount of waste generated due to the increasing urban population (Kumar et al., 2017). The Food Safety and Standards Authority of India (FSSAI) initiated the Indian Food Sharing Alliance (IFSA) in 2017 to promote food donations and curb urban food waste. However, there are no results of the impact on waste reduction yet (Agarwal et al., 2021). Hence significant gaps persist even in countries like India, where studies on food waste have been carried out (Paritosh et al., 2017; Mabaso and Hewson, 2018).

This survey aims to address the gap in research by conducting a comprehensive assessment of food waste practices and challenges in food service outlets within the Guwahati locality. Guwahati, the largest metropolis city in the Northeast has witnessed significant development in recent years with rapid urbanization and increasing population. However, this development is also paving the way to the incidence of increased food wastage in the city. As of December 2022, Guwahati generated 575 TPD solid wastes. Approximately, 85-90 % of waste is transported daily to the composed plant located in Boragaon (Government of Assam report, 2016). However, the quantity of waste generated by food service establishments has yet to be accurately determined or thoroughly investigated. By shedding light on the challenges in Guwahati's food service

sector, this study seeks to contribute to the development of targeted interventions and reducing waste generation in the locality with the objectives of assessing the average daily quantity of food wasted and disposal methods employed by food service outlets for managing food waste; identifying the key reasons behind food wastage of food service outlets and evaluating the effectiveness of storage practices; and exploring the strategies for minimizing food waste.

Materials and methods

The materials and methods used to investigate food wastage in the food service sector of Guwahati, India, involved a survey conducted across multiple locations within the city. The study aimed to assess the extent of food waste, identify contributing factors, and explore potential mitigation strategies.

Selection of study area

The survey was conducted in Guwahati. Guwahati, a prominent riverine port city nestled amidst hills, is one of India's fastest-growing urban centers. It is the largest city in the Indian state of Assam, which also stands as the largest metropolis in northeastern India (Deka and Devi, 2017). Guwahati is situated in the sub-tropical climate of Assam, which is characterized by high humidity and moderate temperature all year round (Desai et al., 2014). The survey was conducted in five locations within Guwahati city, which are, Ganeshguri, Bhangagarh, Chandmari, Six Mile, and Panikhaiti. A total of 75 outlets were selected for the study in Guwahati. 15 outlets were surveyed in each of the locations. The outlets were selected exclusively based on information provided by Google Maps, without considering any reviews or ratings (Fig. 1).



SURVEY LOCATION

Fig. 1. Survey location

Development of questionnaire

The survey, which centers on food wastage in food service sector, was conducted utilizing a structured set of questionnaires. The questionnaire was primarily developed, consisting mainly of multiplechoice questions. The questions were designed to ask about the general information (name of outlet, cuisine, average customers), assessment of food wastage (amount of food wasted per day, estimation of waste, excess food handling), factors contributing to food wastage and storage effectiveness (primary cause, storage facilities, maintenance checks) and strategies for minimization (donation, customer communication regarding food waste). A pre testing was done on 10 randomly selected respondent in different outlets for reliability and validity by using appropriate method. After pre testing the questions were modified accordingly.

Assessment of food service outlets regarding food waste

The survey was carried out between February 2024 and April 2024. The survey was conducted through in-person visits to outlets, wherein questions regarding food wastage were directed to either the manager or an employee. The questionnaire was presented to respondents in a clear and comprehensible manner. Explanations were also provided to ensure accurate understanding. Additionally, respondents were informed that their responses were intended solely for the project purpose and would not be utilized for any unethical activities.

Out of the total of 90 outlets targeted for the survey, 83.33% (75 outlets) expressed willingness to participate, while the remaining 16.66% (15 outlets) opted not to participate, which resulted in 15 outlets responding from each location. The reason for nonparticipation in the survey was as due to limited familiarity of the employees regarding the topic to provide input. Additionally, some managers expressed hesitation in completing the survey forms in the absence of the outlet owners.

Data analysis

The responses collected from the questionnaire were subsequently entered into Google Forms. Following this, the data were analyzed by using MS Excel. Percentages and pie charts were also generated and created for better visibility.

Results and discussion

Average quantity of food waste per day

The general information section of the outlets regarding duration of business, cuisine of the restaurant and average no. of customers in a day are presented in the Table 1. The data has been collected from comparatively new establishment (less than one year of establishment) to old establishment (more than 10 years). The outlets cater to 10-30 customers to more than 70 customers per day. These outlets offer variety of cuisines such as Indian, Chinese, and Continental etc.

It was observed that the majority of outlets (34.7%) waste between 1 to 5 kg of food regularly. 10-20 kg is wasted by the next 28% of outlets. After detailed calculation, it was found that approximately 7.1 kg of food is wasted per day within the food sector. However,

out of the 75 samples assessed, none of them track and document the amount of waste generated. Table 2 shows that none of these establishments followed any weight accounting methods. The figures were obtained based on visual estimation, and plate counts which confirm an absence of data-driven waste management practices. A recommendation for outlets in Guwahati is to implement manual food waste accounting tools based on purchase and inventory sheets, similar to practices followed in Berkeley, California. 24% of restaurants in Berkeley track both the quantity of food purchased and the amount of leftovers discarded. By monitoring the food entering the kitchen and what is thrown away, restaurants can estimate the regular waste generated and identify patterns in food waste (Sakaguchi et al., 2018).

Waste disposal practices

In Guwahati, 81.3% of foodservice outlets dispose of waste in the dustbins or collection bins which are subsequently collected by the dumper trucks provided by Guwahati Municipal Corporation. This practice aligns with the common food waste treatment method in developing countries, where dumping or landfills account for over 90% but composting, a more sustainable approach, is less prevalent (1-6%) (Sahoo *et al.*, 2024).

In contrast, countries like Japan, South Korea, and Taiwan have implemented effective food waste management strategies, leveraging legislative laws to promote the use of food waste as animal feed (Wang *et al.*, 2021; Rahman *et al.*, 2024). However, in developing countries, inadequate separation and collection of food waste mixes with municipal solid waste, rendering it unsuitable for animal feed or other uses (Sahoo *et al.*, 2024).

Identification of key reasons for food wastage

The survey findings reveal the major reason for food wastage in food service outlets is customer leftovers (56%). This is in line with research done in Chinese restaurants which established that plate leftovers as the main drivers of food waste (Filimonau *et al.*, 2021; FAO, 2013).

Variable	Category	No. of outlets	Percentage
Duration of business	Less than a year	34	45.3%
	1-5 years	15	20%
	5-10 years	13	17.3%
	More than 10 years	13	17.3%
Cuisine of restaurant	Indian	40	53.3%
	Chinese	12	16%
	Continental	2	2.6%
	All	21	28%
Average no. of customers in a day	10-30	23	30.7%
	30-50	19	25.3%
	50-70	12	16%
	More than 70	- 21	28%

Table 1. General information of the selected outle

	50-70	12	16%
	More than 70	21	28%
Table 2. Food wastage, disposal practi	ces, reasons behind food waste and ef	fective storage practices	of the outlets
Variable	Category	No. of outlets	Percentage
Food waste disposal method	Compost/ animal feed	9	12%
	Donation	5	6.7%
	Govt. dumper truck	61	81.3%
	Others	1	1.3%
Method for estimation of food wastage Plate count		11	14.7%
	Visual Estimation	65	86.7%
	Weighing discarded items	0	0%
Estimated average daily food waste	Less than 1 kg	10	13.3%
0.	1-5 kg	26	34.7%
	5-10 kg	18	24%
	10-20 kg	21	28%
Period involving highest amount of	January-April	13	17.3%
food wastage	May-August	28	37.3%
0	September-December	2	2.7%
	No difference	32	42.7%
Handling of excess food waste	Store it for later use	21	28%
0	Adjust portion size	19	25.3%
	Discard it	28	37.3%
	Compost/animal feed	7	9.3%
Major reasons for food wastage	Customer leftover	42	56%
5	Overbuying	6	8%
	Over-production	13	17.3%
	Spoilage	14	18.7%
Storage of raw ingredients	Dry, cool place	22	29.3%
6 6	Refrigerators/Freezers	51	68%
	Sealed container	2	2.7%
	Others	0	Ó
Storage of prepared dishes	Bain-Marie/Food warmers	18	24%
	Covered container	50	66.7%
	Separate area	7	9.3%
	Others	Ō	0
Frequency of maintenance checks on	Monthly	21	28%
refrigeration and storage equipment	Once in a year	2	2.7%
0 0 1 1	Once in three months	13	17.3%
	Weekly	39	52%
Items that contribute to high food	Cereals and pulses	20	26.7%
wastage	Meat and milk	13	17.3%
0	Fruits and vegetables	23	30.7%
	Processed products	19	25.3%

To tackle this issue, India can draw inspiration from South Korea's innovative approach to food waste management by implementing a system where consumers are charged for food waste collected by local authorities and for waste generated in buffets (FAO, 2013). Spoilage and overproduction are the other contributors to food waste. Table 2 depicts that in 18.7% of outlets, spoilage has been identified as a contributing factor to food wastage. The high humidity levels in Guwahati play a pivotal role in accelerating food spoilage. While newer outlets

reported no difference, older and long-running outlets reported that the majority of the waste occurs from May to August, as demonstrated in Table 2. During summer, Guwahati's temperature ranges from 24.0°C to 35.3°C. The combination of high humidity and heat leads to rapid bacterial growth which significantly accelerates food spoilage (Singh and Anderson, 2004; Amit *et al.*, 2017).

Over-production stood as a minor reason for food wastage (17.3%). It is common for restaurant employees to rely on their experience to estimate daily dish sales. A study by Bharucha (2018) indicates that 75% of restaurants prepare 10%-20% more food as a safety margin to accommodate unexpected crowds. Interviews with restaurant owners and managers reveal that they predict daily needs and prepare only the necessary food. Therefore, significant overproduction is uncommon which aligns with the present study. While this method is often effective, there are occasions when this method results in the preparation of excess food due to miscalculations.

Further, regarding the contributors to food wastage across various categories, the findings indicate that the contribution to food wastage is relatively uniform across these categories. Fruits and Vegetables top the list, contributing to the highest wastage (30.7%) followed by cereals and pulses (26.7%), processed products like noodles and flour (25.3%) and meat and milk products (17.3%).

Handling of excess food

Another reason for food waste is connected with the concerning and wasteful practice of the discarding of perfectly edible food as admitted by 37.3% of the outlets. While some outlets do make an effort to save excess food for later use (28%) or reduce portion sizes to prevent unnecessary waste (25.3%), only a mere 9.3% engage in responsible practices such as composting or repurposing food as animal feed.

This is in contrast to past research done by Bharucha in Mumbai where 43% of the participating restaurants immediately refrigerate their surplus food. It also mentioned how most restaurants followed a policy where they distributed the surplus food among their staff (Bharucha, 2018). While some restaurants in Guwahati follow this practice, the existence of a clear policy on the matter is unheard of.

Effectiveness of storage facilities

Other than the humidity, the lack of proper storage facilities contributes to this spoilage. The majority of the establishments use refrigerators (68%) to store perishable items like meat and fish. However, due to lack of necessity or space constraints, most of them store other items openly in dry and cool places or a separate area.

Additionally, while 66.7% of establishments utilize covered containers to store cooked food, only a meager 24% reported utilizing advanced storage equipment such as Bain-Maries, food warmers and freezers (Table 2). The reason for not utilizing advanced storage technology in many small restaurants is its expense. As a result, most small restaurants rely on a daily buying strategy, opting not to invest in advanced technology for storage. Instead, they typically store raw products such as vegetables in dry, cool places. While this approach may seem simplistic, it serves as a cost-saving method for these establishments.

There is a favorable result regarding the frequency of maintenance checks on storage facilities as demonstrated in Table 2 as specifically, 52% of respondents reported conducting maintenance checks on a weekly basis. However, even after proper cooking, there might exist hazards during food storage. Storing cooled foods in large containers (e.g., 5-gallon buckets, stock pots, soup kettles, tall pans), refrigerator temperatures higher than 4.4°C, lack of sufficient rack space for shallow food pans in refrigerators can lead to promoting foodborne illness and reduced shelf-life of products resulting spoilage (Martynoga and Chapman, 2012). Hence, safety and quality should be ensured before serving the food.

Variable	Category	No. of outlets	Percentage
Excess food donation	Yes	26	34.7%
	No	49	65.3%
Mode of communication with	Signs and posters	7	9.3%
customers about food waste reduction	Social media	13	17.3%
	Both	8	10.6%
	None	47	62.6%
Strategy for contributing to lowered	Collaboration with shelters and NGOs	4	5.3%
food waste	Customer awareness	40	53.3%
	Latest storage equipment	12	16%
	Staff Training	19	25.3%
Likelihood of adopting a 'zero-waste'	Somewhat likely	20	26.7%
goal	Very likely	42	56%
	Neutral	12	16%
	Not likely	1	1.3%

Table 3. Strategies for minimization section of the outlets

Strategies to minimize waste

It has been observed that the actions of customers play a crucial role in minimizing waste across the entire food supply chain. 53.3% of respondents believe that raising customer awareness could significantly contribute to reducing food waste (Fig. 2).





Fig. 2. Strategies to minimize waste

Additionally, 25.3% highlighted the necessity of staff training. Training programs aimed at kitchen staff to improve skills needed to minimize waste throughout the production process is vital. This includes strategies such as reducing overproduction and overbuying, as well as implementing practices for reusing leftovers creatively.

When queried about the strategies to avoid food waste, the majority of the restaurants followed the method of just-in-time preparation, i.e., food is cooked or assembled when customers order. Moreover, most small restaurants rely on a daily buying strategy for purchasing ingredients and raw foods, opting not to invest in advanced technology for storage. Instead, they typically store raw products such as vegetables in dry, cool places. While this approach may seem simplistic, it serves as a cost-saving method for these establishments.

Another strategy that Guwahati can follow is installing organic waste converters. This approach is exemplified by a restaurant in Mumbai that transforms kitchen leftovers into valuable manure for its hotel garden. Additionally, two other establishments have invested in waste recycling and processing units, harnessing biogas and energy (Bharucha, 2018). Restaurants in Guwahati can draw inspiration from this and implement similar initiatives.

Charitable initiatives

From the Table 3, it was observed that 62.6% of outlets admitted to either not engaging or completely avoiding communication regarding food waste reduction. To prioritize customer satisfaction and maintain politeness, all orders are prepared without communicating about any excess leftovers. This issue can be addressed by posting signs and posters. These visual cues serve as gentle reminders and maintain a polite environment within the outlet as well.

Approximately 34.7%, have shown a willingness to address the issue of food waste through charitable means. These outlets have either donated excess food to shelters, distributed it to beggars, street animals or contributed to charitable organizations. Over 5.3% (Table 3) also believed collaborating with NGOs and shelters could significantly reduce waste and ensure that excess food is redirected to those in need rather than being discarded. However, despite this belief, none of these outlets have established collaborations with shelters or NGOs. Many establishments perceive the process of donating excess food as an additional hassle, citing concerns about the challenges involved.

Conclusion

Wastage of food in food service outlets remains a concern and neglected topic that needs urgent interventions to reduce the overall country's solid waste. The findings of the study revealed the waste practices in the food service outlets of Guwahati. The primary waste disposal practice observed in Guwahati involves discarding food waste into dustbins, which are subsequently collected by municipal trucks (GMC). This method, while common in developing countries, often leads to significant environmental impacts due to the reliance on landfills. A shift towards more sustainable practices, such as composting, could mitigate these impacts. By applying an assessment approach, the amount of wastage was quantified, and subsequently, the results obtained were validated within a sample of Guwahati's food service outlets. It was observed that on average, food service outlets in Guwahati waste approximately 7.1 kg of food per day. A key challenge was assessing the accurate amount of food waste produced because of the lack of waste tracking and weight accounting methods. The present data suggests that customer leftovers play a major role in the amounts of food discarded in outlets. Increasing customer awareness about food waste and providing staff training can play an essential role in minimizing waste. Donations and charitable initiatives can be encouraged more to ensure that the excess food reaches those in need instead of being discarded. Most of the surveyed outlets did not collaborate with any organizations to donate excess food because it was seen as an extra hassle. Advocating for increased governmental support and policy implementation can address food waste at a systemic level. Overall, the findings stress the urgency of improved waste management strategies with technological solutions,

behavioral changes, and awareness campaigns to foster sustainability in the food service sector.

Acknowledgement

Authors deeply express their heartfelt thanks to Assam down town University and the Programme of Food Nutrition and Dietetics, for allowing us to work on the project.

References

Agarwal M, Agarwal S, Ahmad S, Singh R, Jayahari KM. 2021. Food loss and waste in India: The knowns and the unknowns. World Resources Institute 10.

https://doi.org/10.46830/wriwp.20.00106

Amit SK, Uddin MM, Rahman R, Islam SR, Khan MS. 2017. A review on mechanisms and commercial aspects of food preservation and processing. Agriculture & Food Security **6**, 1–22. https://doi.org/10.1186/s40066-017-0130-8

Bharucha J. 2018. Tackling the challenges of reducing and managing food waste in Mumbai restaurants. British Food Journal **120**(3), 639–649. https://www.emerald.com/insight/content/doi/10.11 08/bfj-06-2017-0324/full/html

Deka PP, Devi MK. 2017. Problems and prospects of development in Guwahati, Assam. In Sustainable Smart Cities in India: Challenges and Future Perspectives, 109–122. https://doi.org/10.1007/978-3-319-47145-7_7

Desai R, Mahadevia D, Mishra A. 2014. City profile: Guwahati. Centre for Urban Equity Working Paper **19**.

Dhir A, Talwar S, Kaur P, Malibari A. 2020. Food waste in hospitality and food services: A systematic literature review and framework development approach. Journal of Cleaner Production **270**, 122861.

https://doi.org/10.1016/j.jclepro.2020.12286

FAO, IFAD, UNICEF, WFP, WHO. 2022. The state of food security and nutrition in the world. Repurposing food and agricultural policies to make healthy diets more affordable. Rome, FAO.

https://doi.org/10.4060/cc0639en

FAO. 2011. Global food losses and food waste – Extent, causes and prevention. Rome. https://www.fao.org/4/mbo60e/mbo60e00.pdf

FAO. 2013. Climate-smart agriculture sourcebook. Rome. https://www.fao.org/4/i3325e/i3325e.pdf

FAO. 2013. Tackling climate change through livestock. A global assessment of emissions and mitigation opportunities. Rome. https://www.fao.org/4/i3437e/i3437e.pdf

FAO. Agricultural production statistics 2000–2020. FAOSTAT analytical brief series no. 41. https://doi.org/10.4060/cc3751en

Filimonau V, Nghiem VN, Wang LE. 2021. Food waste management in ethnic food restaurants. International Journal of Hospitality Management **92**(1), 102731. https://doi.org/10.1016/j.ijhm.2020.102731

Global Hunger Index (GHI). 2023. Peer-reviewed annual publication designed to comprehensively measure and track hunger at the global, regional, and country levels.

https://www.globalhungerindex.org/india.html

Government of Assam, Guwahati Development Department, Guwahati Municipal Corporation. Solid waste management.

https://gmc.assam.gov.in/frontimpotentdata/solidwaste-management

Kumar S, Smith SR, Fowler G, Velis C, Kumar SJ, Arya S, Rena, Kumar R, Cheeseman C. 2017. Challenges and opportunities associated with waste management in India. Royal Society Open Science **4**(3), 160764.https://doi.org/10.1098/rsos.160764 **Mabaso CH, Hewson DS.** 2018. Employees' perceptions of food waste management in hotels. African Journal of Hospitality, Tourism and Leisure 7(4), 0–15.

Martynoga F, Chapman E. 2012. A handbook of Scotland's wild harvests: The essential guide to edible species, with recipes and plants for natural remedies, and materials to gather for fuel, gardening and craft. Saraband.

Papargyropoulou E, Lozano R, Steinberger JK, Wright N, bin Ujang Z. 2022. The food waste hierarchy as a framework for the management of food surplus and food waste. Journal of Cleaner Production **176**(1), 106–115. https://doi.org/10.1016/j.jclepro.2014.04.020

Papargyropoulou E, Wright N, Lozano R, Steinberger J, Padfield R, Ujang Z. 2016. Conceptual framework for the study of food waste generation and prevention in the hospitality sector. Waste Management **49**(1), 326–336. https://doi.org/10.1016/j.wasman.2016.01.017

Paritosh K, Kushwaha SK, Yadav M, Pareek N, Chawade A, Vivekanand V. 2017. BioMed Research International **201**7(1), 2370927.

Rahman T, Alam MZ, Moniruzzaman M, Miah MS, Horaira MA, Kamal R. 2024. Navigating the contemporary landscape of food waste management in developing countries: A comprehensive overview and prospective analysis. Heliyon **10**(12), e33218.

https://doi.org/10.1016/j.heliyon.2024.e33218

Sahoo A, Dwivedi A, Madheshiya P, Kumar U, Sharma RK, Tiwari S. 2024. Insights into the management of food waste in developing countries: With special reference to India. Environmental Science and Pollution Research **31**(12), 17887–17913.

https://doi.org/10.1007/s11356-023-27901-6

Sakaguchi L, Pak N, Potts MD. 2018. Tackling the issue of food waste in restaurants: Options for measurement method, reduction and behavioral change. Journal of Cleaner Production **180**, 430– 436.

https://doi.org/10.1016/j.jclepro.2017.12.136

Scialabba N. 2011. Food availability and natural resource use. In: Natural Resources Management and Environment Department, FAO. FAO/OECD Expert Meeting on Greening the Economy with Agriculture, Paris, 5–7.

Singh RP, Anderson BA. 2004. The major types of food spoilage: An overview. In Understanding and Measuring the Shelf-Life of Food, 3–23.

United Nations Environment Programme. 2021. Food Waste Index Report. Nairobi. https://catalogue.unccd.int/1679_FoodWaste.pdf

Wang Y, Yuan Z, Tang Y. 2021. Enhancing food security and environmental sustainability: A critical review of food loss and waste management. Resources, Environment and Sustainability 1(4), 100023. ttps://doi.org/10.1016/j.resenv.2021.100023

WRAP – Waste and Resources Action Programme. 2013a. Overview of waste in the UK hospitality and food service sector. WRAP Technical Report, Project Code HFS001-006. WRAP, Banbury. https://bfff.co.uk/wp-

content/uploads/2014/01/WRAP-Waste-in-the-UK-Hospitality-and-Food-Service-Sector-2012-Report.pdf