

Assessment of Food Waste Management Practices in Restaurants of Bousher, Muscat: Environmental Implications and Pathways toward Sustainability

Zuwina AL-Shukaili, Sazya Firdaus

Abstract: *In this study, the significance of food waste as one of the most critical global problems is emphasized since it has severe environmental, economic, and social impacts. Moreover, food waste generated in the restaurant industry, especially in the service sector, is highly prevalent and poses considerable threats due to operational issues and consumption behaviors. Therefore, this study seeks to examine the methods of managing food waste in some restaurants based in Bousher, Muscat, Sultanate of Oman, and its associated environmental consequences. A research methodology that utilizes both quantitative and qualitative approaches is adopted; it involves the use of questionnaires and data collected through field observations and semi-structured interviews analyzed using Microsoft Excel and thematic analyses, respectively. The findings of this study show a notable variation in food waste generated in the chosen restaurants, with an estimated amount of food waste that comes up to 3704.4 kg/month in selected restaurant, caused mainly by oversized portions, overproduction, poor inventory planning, and insufficient employee knowledge. Landfilling is the dominant practice used by the chosen restaurants; however, it may contribute to methane emissions into the environment. In general, this study underscores the lack of a coherent system regarding waste management systems and reiterates the necessity of implementing sustainable measures, indicating that through the use of an integrated approach to waste management such as portion control, training of employees, and new waste treatments like composting and anaerobic digestion, food waste can be significantly minimized, all while adding to the literature on waste management practices in Oman.*

Keywords: *Food waste management, sustainability, restaurants, environmental impact, methane emissions, Oman*

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Introduction

Food waste is becoming an increasingly alarming global issue since it is inefficiency in food systems and a leading cause of environmental destruction. It is believed that there are losses and wastage of a significant amount of food products that are meant for human consumption, some being contributed by the food services industry.

The restaurant business generates significant amounts of food waste due to reasons such as overproduction, poor management of stock, and unpredictability in demand. Furthermore, the consumer aspect also plays a big role in food wastage due to people ordering excess amounts of food and leaving uneaten food on the plate.

Environmental-wise, food waste is an issue of concern especially in the case of disposing of it in landfills where, under anaerobic conditions, organic waste produces methane (CH_4) gas, which has 25 times more global warming effects compared to CO_2 in the 100-year time frame. For the case of the Sultanate of Oman, food waste forms a considerable fraction of municipal solid waste, raising issues about its environmental and economic effects. Even though the country has continued to invest in sustainable waste management initiatives, no local studies have been conducted to examine the practice of food waste among restaurants. The problem of food waste has recently gained recognition as an important issue that bears significant ramifications for the environment, economy, and society at large. Particularly, restaurants have been acknowledged as some of the greatest sources of food waste because of their operational inefficiencies and consumer behavior. On the one hand, overproduction, poor demand forecasting, improper inventory control, and lack of waste tracking systems are the principal operational factors contributing to the problem of food waste generation in restaurants. This results in excess production of food which then gets wasted and never consumed by customers. At the same time, consumer behavior is another factor that contributes to food waste generation since customers tend to order too much food. First and foremost, from an environmental point of view, the issue of improper disposal of food waste becomes highly concerning especially when there is an intention to throw the waste into landfills. Anaerobic decomposition causes food waste to be broken down to produce methane (CH_4), which has a higher global warming impact compared to that of carbon dioxide over a hundred years (Zhao et al., 2019). Food waste contributes significantly to environmental issues like climate change

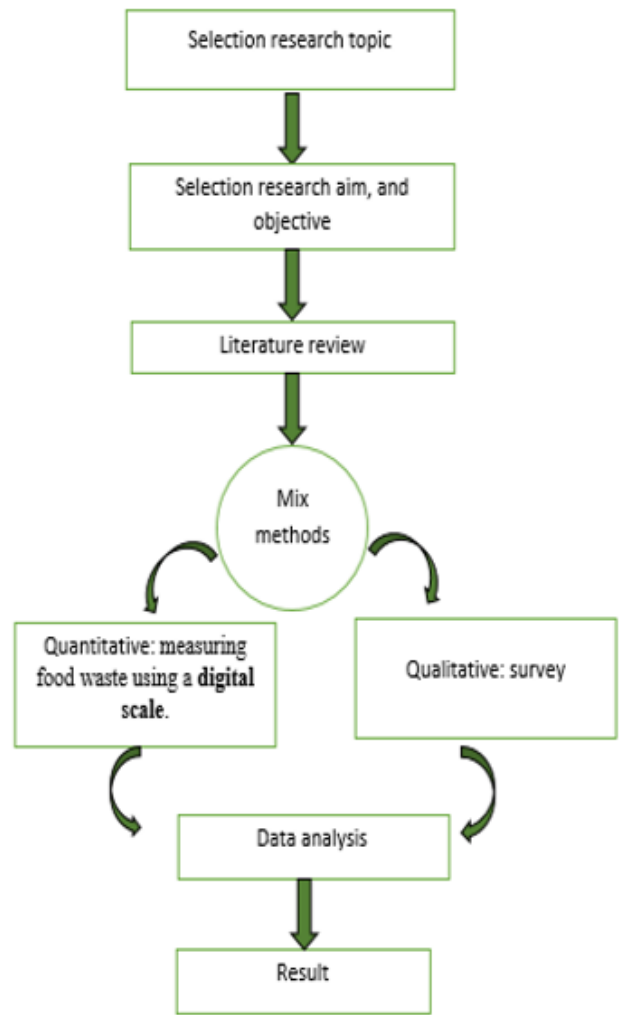
and pollution. It is important to note that food waste signifies the wastage of essential resources used during food production processes.

Several scholars have proposed various measures aimed at tackling food waste in the hospitality industry. Strategies such as composting and anaerobic digestion have been suggested to help mitigate food waste in the sector (Al-Wahaibi et al., 2022). Moreover, the promotion of efficient use of resources within the food supply chain through sustainability measures helps prevent the generation of food waste. Behavioral interventions like consumer education and staff training have also been recommended as ways to reduce food waste. While there has been increasing evidence about the problem of food waste from international studies, a notable deficit is found in the studies conducted locally, especially in Oman. Prior studies have concentrated more on waste management practices in general without paying particular attention to food wastage practices at restaurant level and their impact on the environment. The need to conduct localized studies becomes evident from such a scenario as such studies will take into account local factors, culture, and management practices. This study aims at contributing to such literature by analyzing food waste practices in Bousher restaurants of Muscat.

Bousher is an ideal area to conduct a study, given its dense population and economic activities. Thus, this study aims at addressing the following objectives:

- To identify the key factors contributing to food waste in restaurants
- To evaluate existing food waste management practices
- To assess the level of awareness among restaurant staff
- To propose sustainable strategies for reducing food waste

Methodology



2.1 Research Design

The research methodology used for this study is mixed research methodology that entails the use of quantitative and qualitative methods of collecting data to provide an overall view of food waste management procedures. The data was collected from Bousher, Muscat, Sultanate of Oman and selected restaurants to evaluate differences in food waste and their disposal practices. The data collection methods involved the use of well-structured questionnaires, field observation, and semi-structured interviews. Multiple restaurants were sampled to provide for differences in food waste management processes based on their size and efficiency. This

helped in the assessment of the various factors contributing to the food waste, such as food portions, planning, and employee knowledge.

2.2 Data Collection methods

Data collection was carried out through various techniques for completeness and accuracy. Data was gathered from restaurant staff and managers through structured surveys for quantitative information about food waste management practices, while data for real-time actions and behavior were collected through field observations. Further, in-depth semi-structured interviews were held with selected participants to understand the reasons behind food waste and their management strategies.

2.3 Sampling Technique

Purposeful sampling technique was used in this research to choose four medium-sized/large restaurants located in Bousher, Muscat, Sultanate of Oman that had high demands from customers and high volumes of food production, which made them appropriate candidates to explore food wastage.

Data Analysis

The quantitative data were subjected to descriptive statistics such as frequencies and percentages using the Microsoft Excel and R Studio, whereas qualitative data analysis involved thematic analysis.

Result & Discussion

4.1 Introduction

The results from this study shown considerable differences in the production of food waste in the chosen restaurants, where there was an average of about 2269.76 kg of food waste produced. The largest quantity of food waste was observed in Restaurant A, followed by Restaurant B, and Restaurants C and D produced relatively less food waste. These results suggest that there can be substantial differences in the amount of food waste produced despite having similar environmental settings, with a major factor being the demands of the customers, as more customers result in greater food waste production. In addition, the results showed that there were no sustainable food waste management systems in place for the chosen restaurants.

4.1.2 Quantitative Research Results

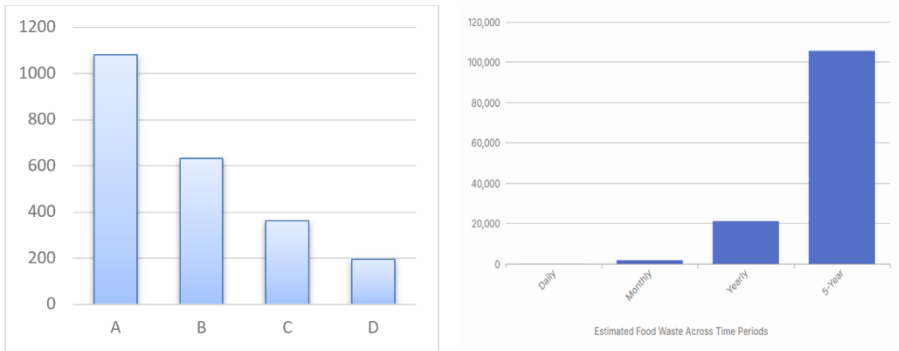


Fig. 1: Total food waste by Restaurants

Figure 1: Illustrates the total amount of food waste generated by the selected restaurants. It is clear that Restaurant A recorded the highest value at approximately 1081.07 kg, followed by Restaurant B at 631.92 kg, while Restaurant C and Restaurant D generated lower amounts of 361.44 kg and 195.33 kg, respectively. This indicates a noticeable variation in food waste generation among restaurants operating under similar conditions. The higher waste levels observed in Restaurants A and B may be associated with higher customer demand and increased food preparation volumes.

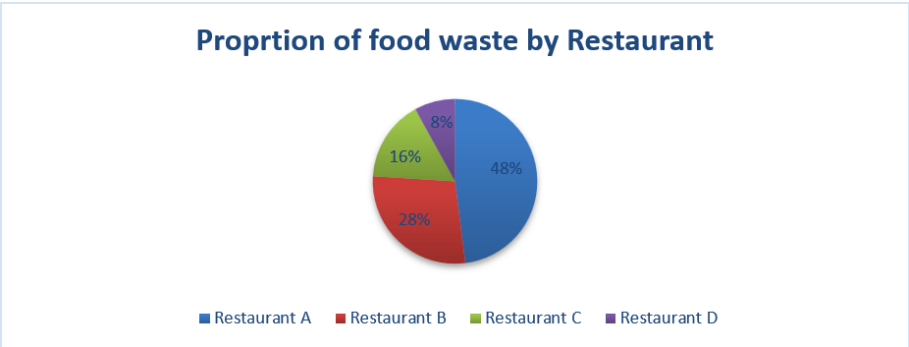


Fig. 2: Proportion of food waste by Restaurant

The figure 2 shows the proportional contribution of each restaurant to the total food waste. Restaurant A accounts for approximately 48% of the total waste, followed by Restaurant B at 28%, while Restaurant C and Restaurant D contribute about 16% and 8%, respectively. These values were calculated by dividing the

waste generated by each restaurant by the total waste and multiplying by 100. The results indicate that food waste is concentrated in a limited number of restaurants, particularly those with higher operational activity.

Table 1: Estimated food waste in different time period

Time Period	Estimated Food Waste (kg)
Daily Estimate	123.48 kg/day
Monthly Estimate	3704.4 kg/month
Yearly Estimate	44,452.8 kg/year
5-Year Estimate	222,264 kg

These calculations have been made by calculating the average amount of food waste collected each month. The average amount of food waste produced by one restaurant was calculated as about 10.29 kg/day. From field work observations, it was observed that there are about twelve restaurants with similar operations in this area. Thus, the calculated total amount of food waste produced by these restaurants is estimated to be about 123.48 kg/day, which is 3704.4 kg/month. In addition, the annual amount is estimated to be about 44,452.8 kg/year, while the forecasted estimate over five years will be 222,264 kg. This suggests that there could be a build-up of food waste over time.

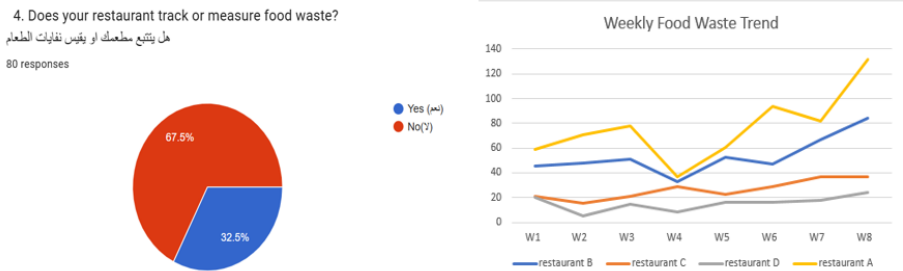


Fig. 3: Measurement of food waste

From the analysis done on the trends per week, it is evident that there are changes in the level of food wastage created by the different selected restaurants. This is because Restaurant A was the one producing the highest quantity of food wastage, while Restaurant D was the least producer of food wastages. On the other hand, Restaurant B and Restaurant C produced an average amount of food wastage, but they had some fluctuations from week to week.

4.2 Qualitative Research Results

According to the results of the study, it was found out that those who participated were composed of managers of the chosen restaurant, the workers, and the clients. These three were seen to be among the major parties concerned about the food waste in the chosen restaurants. The findings clearly reveal that food wastage in the restaurant sector happens very often, as most of the participants answered "sometimes," then "often," and even "very often," while some participants noted that it happens rarely. The fact is that food wastage is a regular thing that keeps happening in the restaurants.

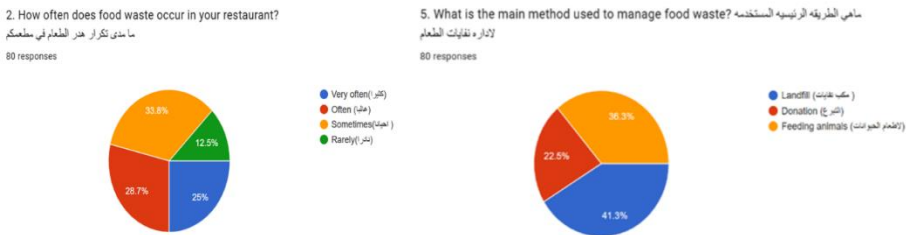


Fig. 4: Management of Food Waste

From the results obtained, it is evident that the biggest percentage of food wastage happens at the level of the consumer through leftover foods as opposed to the process of preparing or cooking the food. This shows that consumer behavior is the key factor contributing to food wastage.

Based on the results obtained, there is no tracking or measuring of the amount of food waste generated in the restaurant. The respondents who indicated “no” were greater than those who chose “yes,” indicating that there is insufficient monitoring of the food waste issue, leading to difficulties in pinpointing the source of food waste.

These results demonstrate that landfilling is the most frequently utilized technique in dealing with food wastes, after which come animal feeding and food donation. Thus, there is a dependency on conventional techniques of disposal, with minimal usage of more eco-friendly approaches, which may lead to adverse environmental effects, including methane gas emissions.

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3. Which stage generates the most food waste?

ماهي المرحلة التي تولد اكبر قدر من نفايات لطعام

80 responses

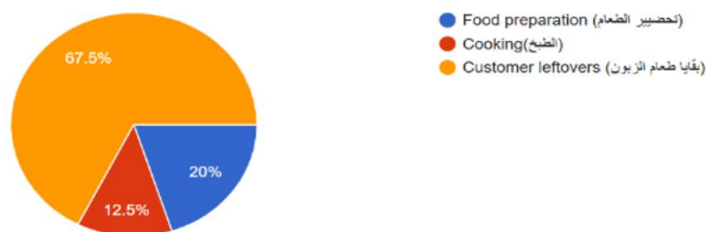


Fig. 5: Generates food waste

4.3 Key Drivers of Food Waste

The analysis of the findings indicates that various factors, which work interrelatedly, have an influence on food waste production within the chosen restaurant settings. They include oversized food servings, excessive production based on erroneous estimation of the demand for food products, and insufficient control mechanisms. Besides, consumer behavior influences the food waste production since consumers often eat only part of food items they order. It can be seen that the food waste is caused not by one factor, but by a number of aspects that also prove findings revealed during the literature review.

4.4 Waste Management Practices

Based on the results obtained, it can be seen that landfilling is the main means of disposing of food wastes in the chosen restaurants. Sustainable practices like recycling or composting were not used at all in the sampled restaurants. This underscores poor environmental consciousness and inadequate sustainability measures adopted by the restaurants. Inefficient means of waste management are another factor responsible for poor management of food waste.

4.5 Environmental Implications

The disposal of food waste through landfilling has environmental consequences. The disposal of food waste in landfills causes anaerobic digestion of the organic material in the landfills, resulting in the formation of methane gas. Methane gas is a greenhouse gas with higher global warming potential than carbon dioxide. Landfilling of food waste causes environmental degradation due to emission of greenhouse gases that affect the environment and contribute to global warming and

climate change. The results from the new estimation process will show food waste generation up to around 44,452.8 kg per annum.

Conclusion and Recommendation

5.1 Conclusion

- This study clearly showed that there was variation in the creation of food waste among the sampled restaurants under almost similar circumstances, implying that the food waste was not uniformly created.
- In comparison to Restaurants C and D, both Restaurant A and B produced much more food waste than these two restaurants, which indicates that customer flow and restaurant size have a significant impact.
- It has been proven by this study that food waste is highly related to operational aspects such as overproduction, misestimating of customer demand, and food portions, along with customer leftovers.
- In addition, the lack of efficient food waste management systems and the lack of food waste awareness among the employees contribute to food waste production.
- Estimation analysis revealed that the amount of food waste generated could drastically rise over time and reach around 44,452.8 kg per year.
- Since landfilling is still the most popular disposal method, there are several environmental problems including greenhouse gas emission such as methane due to organic waste decomposition.

5.2 Suggestions

- Enhance demand forecasts and planning to ensure that there is no overproduction, which would lead to wastage of excess food being cooked.
- Employ portion control techniques to address the problem of wasted food from customer plates.
- Create food waste tracking and quantification systems for restaurants to gain insight into their sources and amounts of food waste.
- Raise staff awareness on food waste reduction and sustainable practices.
- Encourage sustainable waste management strategies like composting and food donations, among others, rather than landfills.
- Encourage the implementation of policy measures that promote sustainable food waste management in the restaurant industry.

Limitations & Future Scope

6.1 Limitation

- It is carried out on a small scale since four restaurants were only observed.
- The period for collecting data is very brief, and it does not give a true picture about how much food waste the restaurants produce on a daily basis.
- Information on the exact number of customers per day is unavailable; therefore, observations had to be taken into consideration in analyzing the results.
- Estimation of total food waste depends on the assumed number of restaurants that can generate such wastes. This makes the information not reliable.
- There is an emphasis on food waste generation from only a few restaurants, without specifying where these foods come from.

6.2 Future Scope

- There is a need for more extensive studies to include a higher number of restaurants, which would make the results more generalized.
- The inclusion of longitudinal studies that cover multiple seasons would help understand variations in food waste generation.
- The installation of more sophisticated monitoring systems will help in identifying specific sources of food waste in restaurant operations.
- It is important to conduct additional research regarding consumer behavior and its implications for the food waste generation process.
- Various forms of advanced waste management techniques, such as food recycling and redistributing programs, should be analyzed.

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