Exploring the Attitudes and Practices of Restaurant Owners Regarding Food Waste Management

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ABSTRACT

The production of organic waste has significantly risen due to the rapid growth of the food sector, thereby posing a significant environmental issue. Restaurants and other food establishments are especially hit by this issue, primarily due to the fact that customers tend to order more than they can consume. This research examines the perspectives and strategies of restaurant operators in Ranau, a small town in Sabah, Malaysia, regarding food waste management. The research applies quantitative and qualitative survey methods as part of mixed methods methodology. Descriptive and thematic analyses were used in the analysis of thirty food service facilities which were under survey to describe the practise of food waste management. The survey indicated that restaurant owners' willingness to adopt effective waste management methods is low despite efforts by the local council to enlighten them on the issue. The prevailing practice among Ranau restaurant operators is the disposal of surplus food by donating it to individuals for use by animals with minimal or no effort to recycle or compost. Based on this study, some of the operators had pledged towards applying composting practice but were faced with the problems of infrastructure and finance. To sum up, there is a need for cooperation between locals, restaurateurs, and local government officials to help combat food wastage in towns such as Ranau.

Keywords: Organic waste, composting, fats, restaurant, sustainability, food waste

INTRODUCTION

Food waste is a big problem globally in terms of social, economic, and environmental conditions. According to FAO the Food and Agricultural Organization (FAO), nearly one-third of food produced yearly, 1.3 billion tons, is wasted (FAO, 2013). This waste consumes an enormous amount of water, energy, and labour, and when the organic waste ends up in landfills, methane, a very powerful greenhouse gas, is released. Both developed and developing countries have problems controlling food waste. Advanced countries have systems like recycling and composting, while developing countries, Malaysia, for example, face a lack of sufficient infrastructure and low levels of education regarding the issue.

Aside from the environmental impacts, food waste results in significant social and economic effects. Aid for reducing hunger and food insecurity still seems impossible because it lowers the economy for farmers, retailers, and food service providers. Also, the environmental aftermath of using landfills to dispose of waste due to organic waste not being processed correctly creates dangerous consequences. With food waste making about 45% of municipal solid waste in Malaysia, the country has a huge problem with controlling food waste (SWCorp, 2021). Keeping pace with rapid urbanization and population growth is difficult with the increasing amount of waste produced from households and businesses.

The government has undertaken efforts to educate the public about waste segregation and recycling; however, these attempts are often unhelpful in small towns and rural places due to infrastructure problems and lax

enforcement. Dealing with these issues is necessary for effective sustainable waste management. The environmental impacts and climate containment of food waste are incredibly detrimental. Anaerobic decomposition of organic waste in landfills creates methane, which is highly dangerous and is considered a greenhouse gas that is 25 times stronger than CO2 (EPA, 2015). In addition to the environmental impacts, food waste is economically difficult, with losses being around $1 trillion annually (Parfitt, Barthel, & Macnaughton, 2010).

LITERATURE REVIEW

To combat food waste, many countries have begun implementing policies on sustainable waste management. The United States, the UK, and Germany have put in place systems for managing food waste that include separating waste from food and composting. In the US, the EPA has implemented the "Food Recovery Challenge" campaign that encourages businesses to donate excess food instead of throwing it away (Chen & Chen, 2018). The United Kingdom also has a campaign called "Love Food, Hate Waste" that works to promote reducing food waste by 21 percent (Xu, 2024). As part of the Circular Economy Action Plan, member states of the EU have also set the goal of reducing food waste by 50% by the year 2030. These examples showcase a commitment to dealing with food waste through policy.

Although developed nations like the UK and the US are making great strides in reducing food waste, developing countries have a tougher time trying to overcome several hurdles. In several low- and middle-income countries, food is wasted mainly in the post-harvest collection and processing stages due to the lack of adequate infrastructural amenities, such as sufficient storage facilities and proper transportation networks. On top of that, more people are now wasting food at the consumer level, especially in cities where there is a higher disposable income coupled with new food consumption patterns (Gustavsson et al., 2011).

Malaysia is dealing with a problem of food waste caused by urbanization and increases in wealth. SWCorp (2021) noted that an average Malaysian household wastes approximately 0.5 kg of food per day, amounting to over 16,000 tons annually. This fact illustrates the gaps in waste management services and unsustainable consumption patterns that need to be remedied.

To combat this, the Malaysian government has implemented policies, such as the Waste Segregation at Source Initiative in 2015, which attempts to divide waste into recyclable and non-recyclable materials to reduce landfill waste. Also, a campaign seeks to inform the general population on minimizing food waste while solidifying the concept of sustainability as socially engaging.

The implementation is notably low in small towns and rural areas, mainly stemming from the unawareness of food waste mitigation and recycling methods by restaurant operators. Inadequate infrastructure and government intervention worsen the problem (Papargyropoulou et al., 2014). Furthermore, restaurants contribute large amounts of fats, oils, and grease (FOG), which can cause serious environmental problems if left unmanaged. While FOGs are typically blocked by grease traps from entering waste water systems, many restaurants from developing countries like Malaysia, either do not use grease traps, or do not maintain them (Tan et al., 2022). This neglect allows untreated FOG wastewater to be dumped into rivers and oceans, thus resulting in environmental degradation. Some developed nations have implemented grease traps as a regulatory requirement and have stringent provisions on their installation and servicing.

In Malaysia, while there are guidelines, they are often not complied with, especially in smaller municipalities that lack resources for monitoring compliance (Mohamad & Manan, 2018). Besides, the management of food waste differs widely from that in advanced economies to the less developed and the latter is usually more unstructured. In the small towns of developing nations, waste is usually handled by uncontrolled methods that do not involve any form of sorting and recycling. Such inaction creates serious environmental challenges for developing countries, especially with organic waste that makes up a bigger share of total waste and is a potential source of greenhouse gas emissions if dumped into landfills.

The absence of effective government aid has been identified by Mohamad and Manan (2018) as one of the barriers to sustainable food waste management in Malaysia. In cities, especially Kuala Lumpur, restaurant

owners cite economic factors and insufficient composting sinks as significant hurdles. In rural areas, these challenges are compounded by the fact that many local governments do not have the resources or capacities to implement waste management policies (Tan et al., 2022). As a result, this research seeks to explore the perceptions and knowledge of food waste management among restaurant operators in Ranau, Sabah, Malaysia.

RESEARCH METHODOLOGY

Study Area

The study was conducted in Ranau, a town located in the state of Sabah, Malaysia as shown in Figure 1. This region is well-known for its tourist attractions that include Mount Kinabalu and Poring Hot Springs. Therefore, the food service industry in this area has developed in order to serve the locals and tourists. On the other hand, even though there has been an increase in the number of restaurants and food outlets, there seems to be little attention given to research about the region's food waste management practices.

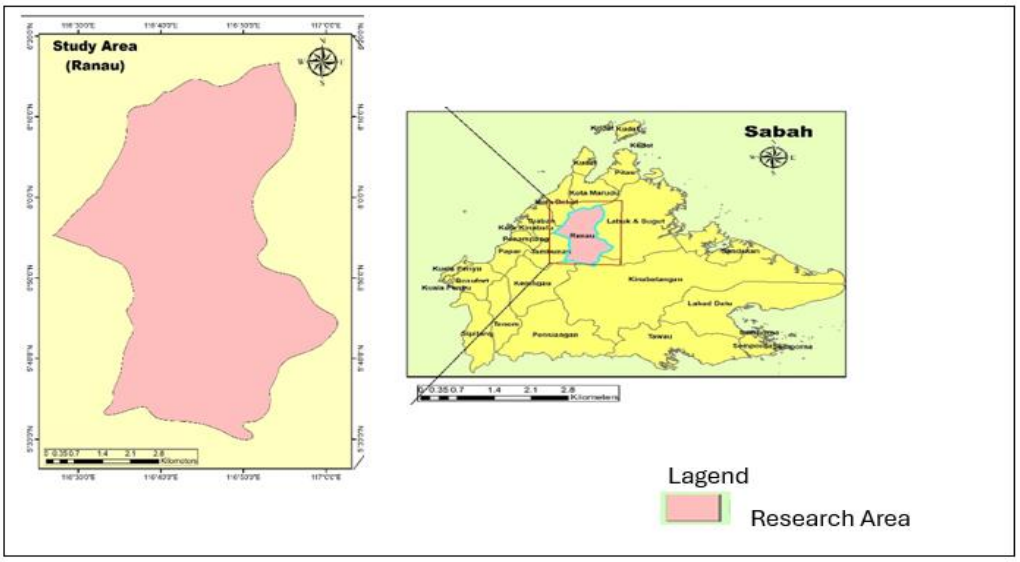

Figure 1. Study area

Research Design

This study focuses on the food waste management practices of restaurateurs in Ranau using a mixed-method approach which analysed quantitative survey data together with qualitative interview data. The study attempts to obtain figures on the amount of waste produced in comparison to the opinions about the problems and perceptions of restaurant managers and operators. In the first part, a sample frame of participating restaurants is constructed using information from the RDC (Ranau District Council) and then the types of food waste to be analysed are defined.

Data Collection Methods

Well-structured questionnaires are vital instruments for collecting quantitative data in research. They serve the purpose of collecting great amounts of data from different domains (Akmal et al., 2023; Bruhns, 2015). Formulating a structured questionnaire is difficult and requires consideration of an appropriate design element because inaccuracy can compromise data validity and reliability (Murray, 1999). To aid in clarity and comprehension, response options should be kept short and simple, avoiding technical terms (Thwaites Bee & Murdoch-Eaton, 2016).

This research compiled quantitative data and qualitative data on the volume and variety of food waste, the current management practices, and the barriers to adopting sustainable practices. There was a mixed approach that combined close-ended with open-ended questions, including the use of a Likert scale to gauge respondents' level of agreement with certain statements.

The study applied a purposive sampling technique to select 30 food service establishments to participate. The selected sample included an elaborate selection of eateries like Malay restaurants, Chinese restaurants, Indian restaurants, and casual dining restaurants. This broad choice enabled the sample to be representative of the food service industry in Ranau. Factors noted in the selection included the popularity of the establishment, their size, and the type of cuisine offered.

The primary strategy employed in collecting data was the distribution of the detailed questionnaire to all 30 restaurant owners. This questionnaire consisted of both multiple-choice [i]and open-ended questions designed to assess the volume (only four restaurants will be sampled) and type of food waste generated, current waste management practices, and barriers to implementing greener strategies. The survey also collected demographic information from respondent related to their experience in the food service industry and the food waste composition study was limited to four restaurants due to time and cost consuming to carried such study.

Qualitative data was gathered through two interviews conducted with Ranau District Council (RDC) waste management officials, which offered perspectives on waste management across several businesses in the food industry. This approach provides rich detail and a comprehensive understanding of social phenomena. The semi-structured interviews, lasting 30 to 45 minutes, focused on participants' perceptions regarding the knowledge, attitude, policies, and implementation of effective sustainable waste management procedures, including composting and recycling.

Data Analysis Methods

The quantitative data derived from the surveys were subjected to a rigorous descriptive statistical analysis, focusing on measures such as mean, frequency, and percentage distributions. This analytical approach yielded insights into prevalent food waste management strategies employed by restaurateurs in Ranau, as well as the various categories of waste generated. Concurrently, qualitative data obtained from the interviews underwent thematic analysis. This involved systematic coding of interview transcripts to extract recurring themes and patterns, facilitating the categorization of the data. The key themes that emerged from this analysis highlighted issues such as "cost constraints," "lack of infrastructure," and "limited awareness of composting."

RESULTS AND DISCUSSION

The interview with officer from Ranau District Councils (MDC) revealed that they have licensed 183 food establishments in Ranau and Kundasang Towns, with 132 in Ranau Town and 51 in Kundasang. These can be categorized into three types:

1. Casual Dining Restaurants: Everyday venues serving modern international cuisines, including Indian food.

2. Upscale Dining Venues: High-end restaurants located in hospitality complexes, such as Hotel Perkasa and Hotel Cottage in Kundasang.

3. Traditional Eateries: Rural venues specializing in Dusun tribal dishes like *linopot* (rice in a leaf), *Bosou* (fermentedmeat), and *ulam-ulam* (salad).

The council has initiated several programs aim to educate restaurant operators on systematic food waste management protocols. Typically, MDR organizes one major initiative per annum; however, in 2022, they successfully conducted two distinct waste management programs, including a crucial initiative regarding the maintenance and emptying of oil traps in food service establishments. In 2010, it was recommended that all restaurants install oil traps to mitigate environmental impacts. The installation of oil traps was officially mandated by 2019. Non-compliance with this regulation may result in penalties for restaurant operators, with fines ranging from a minimum of RM 50.00 (approximately $11.41) to RM 100.00 (around $22.82) for those failing to adhere to these requirements.

Food Waste Composition Study

This comprehensive study evaluates four distinct restaurants, each representing a unique culinary tradition: Chinese, Malay, Indian, and Dusun. Mr. Sabah Restaurant, specializing in Chinese cuisine, commenced

operations on September 20, 2022. The establishment employs five male staff members and operates from 7:00 am to 3:30 pm. Waste management includes two oil traps—one located in the washing area and the other in the kitchen. Leftover food is redistributed among employees, while customer-generated waste is consolidated into a single plastic bag designated for pet consumption. Jawa Timur Restaurant, licensed on February 9, 2015, offers Javanese cuisine alongside other options. Operating daily from 7:30 am to 7:30 pm, the restaurant employs five staff members, all holding food-handling certifications. It adheres to MDR recommendations with two waste traps in place. Excess food is either allocated to pets or distributed to individuals in need. Puan Saddia reported that the predominant waste consists of animal bones, vegetable remnants, rice, and fried noodles, with edible leftovers being donated to local mosques and homeless individuals in Ranau Town. Muslim Best Curry Taste Sabah Restaurant, which began operations on March 5, 2014, focuses on Indian cuisine but also incorporates non-traditional dishes with an Indian flair. The establishment employs two oil traps for effective waste management and collects leftovers in containers for redistribution. However, improper management of food waste has resulted in pest infestations and unpleasant odours. D' Kobujang Coffee Shop Restaurant, licensed on April 29, 2019, operates from 8:00 am to 2:30 pm, six days a week, and specializes in traditional dishes featuring local vegetables. The café employs three staff members, with two being permanent.

The restaurant utilises oil traps in both the dishwashing and cooking areas for waste management. Small baskets are employed to collect food scraps, which are typically taken home for personal use, such as pet feeding. While the proprietors acknowledge the principles of waste management, composting practices have yet to be implemented. Food waste from this establishment and refuse from other kitchens are managed separately. Plastic waste is systematically placed in designated containers and subsequently disposed of in MDR-provided bins post-operational hours. Additionally, the owner strategically purchases cooking ingredients based on demand to minimize waste and lower production costs. Table 1 presents the results of a survey conducted to assess various types of food waste generated in selected eateries over a two-day period, encompassing both weekdays and weekends.

Table 1: Food Waste Composition

Survey Period	Waste Type	Time	Restaurant	Weight (g)
Weekend (Saturday)	Noodle	AM	Restaurant Mr. Sabah	100
	Rice	AM	Restaurant Jawa Timur	500
			Restaurant Muslim Best Curry Taste Sabah	80
			Kedai Kopi D' Kobujang	60
		PM	Restaurant Mr. Sabah	1000
			Restaurant Jawa Timur	150
			Restaurant Muslim Best Curry Taste Sabah	320
	Bones	AM	Restaurant Jawa Timur	120
			Restaurant Muslim Best Curry Taste Sabah	120
			Kedai Kopi D' Kobujang	10
		PM	Restaurant Jawa Timur	500
			Restaurant Muslim Best Curry Taste Sabah	480
			Kedai Kopi D' Kobujang	290

	Vegetable	AM	Restaurant Jawa Timur	100
		PM	Restaurant Jawa Timur	300
			Kedai Kopi D' Kobujang	40
Weekdays (Monday)	Noodle	AM	Restaurant Mr. Sabah	150
			Restaurant Jawa Timur	150
			Kedai Kopi D' Kobujang	50
	Rice	AM	Restaurant Muslim Best Curry Taste Sabah	80
		PM	Restaurant Mr. Sabah	600
			Restaurant Jawa Timur	1000
			Restaurant Muslim Best Curry Taste Sabah	800
	Bones	AM	Kedai Kopi D' Kobujang	150
			Restaurant Jawa Timur	50
			Restaurant Muslim Best Curry Taste Sabah	120
		PM	Restaurant Jawa Timur	500
			Restaurant Muslim Best Curry Taste Sabah	120
			Kedai Kopi D' Kobujang	100
	Vegetable	AM	Restaurant Jawa Timur	20
		PM	Restaurant Jawa Timur	50

The research categorized food waste into four specific types: noodles, rice, bones, and vegetables. Findings indicate that leftover noodles represent the least prevalent form of waste across most surveyed establishments. The data also revealed a notable trend: food waste generation is significantly lower in the morning compared to the evening, which can be attributed to reduced customer volume during morning hours. Typically, morning patrons favour fried noodles and hot beverages, such as coffee and chocolate, leading to a predominant production of fried noodle waste. Customer traffic rises considerably between 10:00 AM and 2:00 PM, coinciding with peak dining times, particularly influenced by the arrival of foreign tourists. During this busy period, diners generally opt for more substantial meals, resulting in increased quantities of rice, bones, and vegetable waste. In comparison, Betz et al. (2015) identified that the food industry in Switzerland generates various waste types, including fruit, yoghurt, and cheese. However, the waste profile in the Ranau district exhibits distinct differences, influenced by the sociocultural dynamics of the local community.

On Saturday, the recorded food waste stood at 4.17 kilograms; this was slightly lower on Monday, when the waste was recorded at 4.11 kilograms, showing a variance of six grams. Sucheran and Olanrewaju (2021) postulate that factors such as individual taste preferences alongside cultural backgrounds, customs and traditions, strongly influence food choice. This variability in the preferences of foods explains why people, motivated by the search for Flavors that suit their preferences, seek to access culinary offerings in less familiar places.

Research indicates that the amount of food waste produced is heightened during school holidays and weekends compared to during the week and regular school days. A comprehensive analysis of the gathered data showed that periods when school breaks are aligned with weekends coincide with a peak in customer traffic in eateries,

which leads to heightened food wastage in these establishments. Sucheran and Olanrewaju (2021) note that during school holidays, the food waste generated is approximately double that recorded during school days. Households with younger children tend to generate significantly more waste than those without, a change that markedly contributes to this dynamic. The tendency among very young children to ask for food that they will not eat is a major cause of this problem.

Food Waste Management Practices

The food waste disposal practices used by restaurant operators in Ranau are rather informal and unorganized, almost as if they are crafted on a whim. It is concerning to note that a large part of Restaurateurs (60%) treat food waste by simply dumping it into landfills, while 30% prefer donating excess food to pets. Only 10% of operators practice its separation for composting, which indicates low sustainable efforts. This corresponds with other small towns literature in Malaysia wherein drop-off points with little or no education in the area combustion are noted as major obstacles towards more integrated sustainable waste methodologies (Papargyropoulou et al., 2014). The lack of primary self-regulated waste classification poses a serious problem in the formulation of efficient and rational plans concerning food waste disposal, on account of severe restrictions to recycling and composting organic material witch forms waste in such parlors. Restaurant operators are shaped by a myriad of factors like type of food offer as a training policy, which influence sought-after results. Studies show targeted employee training is crucial in reducing food waste, where trained serves bear less waste, creating worthwhile expenses (Montesdeoca-Calderón et al., 2024).

Attitudes and Awareness of Restaurant Operators on Food Waste Management

The attitudes and awareness of food waste management among restaurant operators in Ranau reveal an inadequate knowledge and application of sustainable practices. Interviews with the operators show an understanding of the environmental impacts of waste disposal, but there is a critical gap in the understanding of food waste management. Many operators claimed to understand the idea of composting but did not know how to implement it. One restaurant owner articulated,

"We know that composting is good for the environment, but we don't know where to start and do not have the time or space to do it right."

Significant numbers of restaurant operators believe that the set up of effective composting and recycling waste management systems requires a great deal of money. Hence, there is a common perception that sustainable practices tend to be expensive and require a lot of labour. This perception is in agreement with results from earlier studies done in other parts of Malaysia which noted that small businesses often consider environment-related initiatives to be prohibitively expensive to adopt (Mohamad & Manan, 2018). In addition, some respondents expressed scepticism about the feasibility of composting in a small town like Ranau.

One respondent noted the complications accompanying such initiatives,

"*Even if we wanted to start composting, there's no place in town where we can send the composted material. We would need help from the local council to set up a system."*

This cites local counsels as additional stakeholders because municipalities must take on these roles to help enable more sustainable waste management.

Role of Local Authorities

The Ranau District Council has commenced programs to train local restaurant owners on proper waste management practices. However, our review suggests that these attempts are shallow and lack effectiveness. Conversations with local government stakeholders suggest that while there are some policies in place concerning the use of grease traps and waste separation, there is minimal enforcement due to lack of resources. Insufficient budgeting, poor institutional frameworks, and absence of specialized and qualified personnel are major obstacles to effective waste management practices (Manga et al., 2022). Such lack of resources severely

undermines the enforcement of waste segregation policies and regulations. One council officer shared this comment:

"Sure, we do make an effort to educate local businesses on the importance of waste management. However, to properly implement regulations, trained personnel, funds, and other resources— which we don't have— are necessary. It is most often a choice for the business themselves if they want to comply."

Lack of enforcement has exacerbated the problem of waste management, leading to the stagnation of integrated waste management strategies by restaurateurs in Ranau. Moreover, Ranau District Council has not placed sufficient policy incentives to drive businesses toward adopting eco-friendly practices.

Many restaurant operators would be more ready to spend on a composting system or a grease trap if there were some financial relief in the form of tax credits or subsidies that would shift the burden of capex onto operating expenses. One of the respondents said that:

"More businesses would be interested in using grease traps if the council gave out some kind of subsidy for installing them. But at the moment, the costs are just too high for us."

In Ranau, the key problem for local government authorities is the absence of a centralized facility for composting waste. Inadequate access to composting facilities reduces the motivation for service food businesses to practice waste separation and segregation on a more advanced level. The construction of a central facility could considerably reduce the amount of organic waste sent to landfills while also providing a renewable resource for agriculture practiced in the region. The compost produced could be used by farmers as a highly fertile supplementary substance for improving the soil, thus enhancing the yield as well as supporting sustainable agriculture.

Revolutionary Concepts Regarding Composting

The issue of food waste in Ranau could benefit tremendously from composting. In the simplest terms, composting is one of the processes in the biological cycles of nutrients and involves the recycling of organic waste to produce fertilizers, making it beneficial for the environment. Numerous reports highlight the monetary and environmental gains of composting, particularly in developing regions where space in landfills tends to be scarce (Kuo and Ruan, 2018). However, in the present study, managers of restaurants in Ranau seem to be lacking that feature. The respondents often talked about being logistically challenged in terms of having little space, too much time, and not enough available infrastructure to support the composting practices. Looking back at one of the interviews, at least one person expressed how these barriers are related to composting, stating:

"To us, composting is not an option because there is no space available to provide compost as a service and no infrastructure for supporting composting in the town."

These statements shows clearly that there is a serious gap for local authorities who should sponsor the development of a local composting site which can be utilized by businesses for disposing organic waste properly. Alongside enhancements in the infrastructure, there is a higher need for training and awareness campaigns on the importance of composting. Some restaurant owners expressed willingness to learn more about composting techniques, but few knew how to go about the initial steps. "I feel that a lot of us would give it a try if the council or someone organized workshops on how to compost," said one participant. The results indicated that, with the right support and resources, it is very probable that composting would be an effective strategy for dealing with food waste in Ranau.

Grease Trap Utilization

One of the most important findings of the current research is the inefficient use of grease traps in restaurants located in Ranau. The use of grease traps plays a fundamental role in controlling the discharge of fats, oils, and grease (FOG) into wastewater systems as they may cause clogging and further deteriorating the quality of

water. In many developed countries, grease traps are a requirement for food service establishments and they are routinely checked for compliance with legal requirements (Tan et al., 2022).

The some of the facility's owners provided a highlight into the operational difficulties and maintenance regimes concerning grease trap systems within their establishment...

"Well, we don't have a grease trap because it is too expensive to install and the council doesn't really check if we have one."

His/her comments reveal how the lack of enforcement as well as limited funding from local authorities has contributed to the notorious problem of letting raw sewage wastewater free into the environment. The untreated fats, oils, and grease (FOG) sewage disposal have dire environmental consequences. FOG build-up in sewer lines usually causes hydraulic blockages which triggers the overflow of sewage that spills out onto surfaces including strrets as well as water bodies like rivers. This is a great risk not only to public health but also to marine life as seas become contaminated and dissolved oxygen levels deplete to a large extent resulting in the death of numerous fish or other aquatic organisms. One participant observed,

"Of course, we understand that releasing oil waste into a drain harms nature, but without any investment from the system, not much action can be taken."

In addition, providing financial bonuses to enhance compliance by businesses will facilitate adherence to these standards. Regular inspection is a critical component of the best practice treatment of fats, oils, and grease (FOG) disposal within a given facility. With the adoption of these strategies, the local authority stands to limit, to a great extent, the environmental damage resulting from the mismanagement of food waste and wastewater in Ranau.

In general, this study's findings correspond with prior research performed in some of the small towns and rural areas of Malaysia. Papargyropoulou et al. (2014) listed several barriers toward the implementation of sustainable waste management practices, watching lack of infrastructure, low public awareness, and budgetary constraints as the foremost barriers. In addition, Mohamad and Manan (2018) pointed out that restaurant managers in Kuala Lumpur and Penang faced severe difficulties in implementing effective composting and recycling programs because of the high costs related to these actions.

Critical gaps remain in developing regions, such as Ranau, as compared to more advanced urban centers like Singapore and Hong Kong, which enjoy compliance with composting and recycling initiatives due to sophisticated regulatory policies and infrastructure (Yong et al., 2020). For example, Singapore has introduced a comprehensive food waste management system that requires the segregation of waste at the source and the construction of composter units (Yong et al., 2020). These policies have significantly reduced food waste being landfilled and created new opportunities for businesses to engage in circular economy initiatives.

An evaluation of Singapore's policies and initiatives for managing food waste demonstrates that with the right policies, infrastructure, and incentives, significant food waste reduction can be achieved even in highly populated urban areas. In terms of Ranau, lacking funding due to the smaller size of the town does not prevent them from implementing policies at a local level. These policies include separating waste for compost, making financial reimbursement incentives, and implementing foundational strategies which can all improve food waste management.

Presented within the investigation results are some specific recommendations that relate to the management of organic waste in Ranau. One of the main constraints the study participants cited was the non-existence of a central composting site which makes it less attractive for restaurant managers to engage in waste separation practices. Additional measures need to be taken in terms of legislation that require the food servicing of all types to have grease traps installed. The research ascertained that the improper disposal of fats, oils, and grease (FOG) in the region is a glaring environmental challenge. Therefore, it is important for the district council of Ranau to legislate auxiliary policies that concern the effective installation and servicing of grease traps. Furthermore, non-taxable grants could be provided as a means of encouraging compliance within the

businesses. Also, regular monitoring is needed towards fulfilling the steps required by maintenance guidelines of grease traps and provided with suggested practices in FOG discharge standards. All these objectives are meant to advance the practices of waste management and improve the environment in Ranau.

A social shift aimed at reducing food waste should complement growing awareness about the ecological and economic consequences of waste minimization. It requires the active participation of municipal marketing branches, environmental groups, and the private sector to teach both buyers and sellers the importance of food waste reduction, along with the benefits of composting and recycling. Financial factors are also critical in this context. Many restaurateurs have pointed to rigid budgets as a primary reason for not adopting green waste practices. Government authorities might need to explore options of offering financial assistance in form of grants, subsidies, or low-interest loans for purchasing composting equipment, grease interceptors, or other waste management systems. Policymakers must accord utmost consideration to shaping consumer behaviour since restaurant food waste is comprised largely of consumer-generated food waste (Mumtaz et al., 2022). In addition, policies should target the promotion of sustainable behaviour and the establishment of enabling conditions that support food waste minimization, reuse, and recycling. It is also essential that policymakers support the Food Waste Hierarchy and promote sustainable actions that align with the United Nations Sustainable Development Goals (Kattiyapornpong et al., 2023). From the different aspects, policymakers can visualize efficient programs to deal with and reduce food wastage in restaurants. Also, enforcement of regulations on the segregation of waste at Ranau needs to be improved. There is some form of standard operating procedure on the use of grease traps and waste segregation, but adherence remains patchy. Local governments need to properly fund staff to conduct inspections and hold companies accountable for failure to comply. Consideration should also be given to the introduction of punitive sanctions for breaching the requirements in order to better persuade the business community to shift toward sustainable development.

CONCLUSION

This research analysis has shown how food waste is managed in Ranau, Malaysia, and it highlights the importance of formulating better food waste management strategies. Although the local authorities have taken some measures towards sustainability, restaurant operators are increasingly bound with conditions that do not allow for the effective implementation of waste management systems. Major factors that are barring most people from employing the practice of composting or installing grease traps include ignorance, lack of adequate facilities, and low funding. Overcoming these problems requires a comprehensive approach that includes engaging local government, restaurant owners, and the general community. This particular research study provides food waste management optimizations for Ranau which includes creating directed public awareness campaigns, enforcing grease trap installation policies, and developing full fledged public education campaigns for a clear framework around composting. If these policies are effectively enacted, they would be able to change Ranau's perception from backward to an exemplary town in Malaysia, which would in turn serve Malaysia’s goal of enhancing counter food loss and fostering greater environmental stewardship.

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