



## Reducing food waste at school canteens: The behaviour of school communities

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### Abstract

Efforts to achieve effective food waste management at the school level can be enhanced by knowing the consumers' behavioural aspects, such as the determinants, perception, and driving force behind food waste. However, most of the previous studies tend to focus on household behavioural aspects in food waste management rather than in the context of hospitality, much less at the school canteen level. The objective of this study is to investigate the behaviours of food waste management among school communities. A questionnaire was distributed to 692 primary school students, secondary school students, and teachers in ten public schools in Hulu Selangor. Interviews were conducted with canteen managers, and observations were made during the fieldwork. From the findings, it can be concluded that 81% of primary school students, 72% of secondary school students, and 91% of teachers are aware of the importance of reducing food waste and personal responsibility in protecting the environment. However, there is a lack of knowledge in food waste management in a sustainable manner, particularly about converting the waste into compost. Meanwhile, the canteen staff could manage kitchen food waste through systematic and effective management, but they are still unable to control the plate waste generated by the students and teachers. These findings may provide necessary information for improving food waste management at the school level, which helps address the guidelines and recommendations that would have a better impact on reducing FW generation, which may be applicable in Malaysia and other countries well.

**Keywords:** Behaviour; food waste; school canteens; school communities; school students

### Introduction

Worldwide, almost one-third of food is wasted, and about 1.3 billion tonnes of food waste is accumulated annually (Food and Agriculture Organisation, 2013). Food waste will be losing

valuable resources such as water, land, and energy needed for daily human activities. Food waste is considered a severe issue both in developed or developing countries. According to Thi et al. (2015), population growth and community participation in food waste management have influenced the differences in food waste generation between developing and developed countries. In the United States (developed country), most food waste is generated at the final consumption level, about 188 kg per capita per year, with an estimated value of \$ 165.6 billion (Garcia-Garcia et al., 2015). In Europe and North America, food waste is estimated to be 280 kg to 300 kg per capita (Garrone et al., 2014). Whereas in Southeast Asia (developing countries), 33% of food is wasted, much at the agricultural production stage due to the lack of technology, transport, and expertise (Garcia-Garcia et al., 2015; Yang et al., 2016). Such a production pattern may change if the developing countries continue to urbanise, develop economies, and change their nutrition structure (Thi et al., 2015). The average household in Malaysia produces 0.5 kg to 0.8 kg of food waste per day (Chien Bong et al., 2017), and the food waste component is 63.1% (Karim Ghani et al., 2013). Therefore, reducing food waste is necessary to create a sustainable food supply chain (Garcia et al., 2015).

The generation of a large amount of food waste generation harms the environment, society, and economy (Kasavan et al., 2019). Food waste is generated along the food supply chain, from the early stages of agriculture production until the final consumption stage (Kasavan et al., 2018). Furthermore, food waste could significantly impact the environment, such as the depletion of soil fertility, groundwater pollution, toxic gas emissions, air pollution, leachate, and odour (Karim Ghani et al., 2013). The issue of food waste complex not only relates to the economic, social, and environmental aspects; it also has a repercussion on the ethical aspects that need to be taken seriously (Thi et al., 2015). According to a report by SWCorp, by 2020, the total amount of food waste will be able to fill-up sixteen Twin Towers of Malaysia (Zaki, 2019). It is also estimated that by that time, Malaysians will generate 16,688 tonnes of food daily, an amount that can feed about 2.2 million people three times per day (Zaki, 2019). A large amount of food waste would end up in landfills due to poor implementation of food waste treatment in Malaysia (Lim, et al., 2016). Therefore, food waste reduction strategies need to be adopted to establish a food supply chain towards sustainability while fulfilling the increasing food demand and reducing the pressure on food production and disposal (Garcia-Garcia et al., 2015). Such initiatives are also in line with the sustainable development goals (SDG 12.3) of reducing 50% of global food waste at the retail and consumer level by 2030 (Kasavan et al., 2019; Wang et al., 2017).

According to Derqui & Fernandez, (2017), food waste disposal in school canteens is higher than in other school locations. Students at most eat at least one meal at school, and consequently, the school food service providers need to provide them with proper and balanced meals daily. The providers are also required to handle a large amount of food waste daily, and consequently, schools are seen as one of the highest food waste generators (Boschini et al., 2018). A study by Wilkie et al. (2015) at three schools in Florida (USA) found that the food waste component produced between 58 per cent and 69 per cent compared to other solid waste components. It is evident, therefore, that food waste is a significant component of a school's food service waste stream compared to other solid wastes. The question that arises is how far a school community has been adopting the concept of sustainable food waste management?

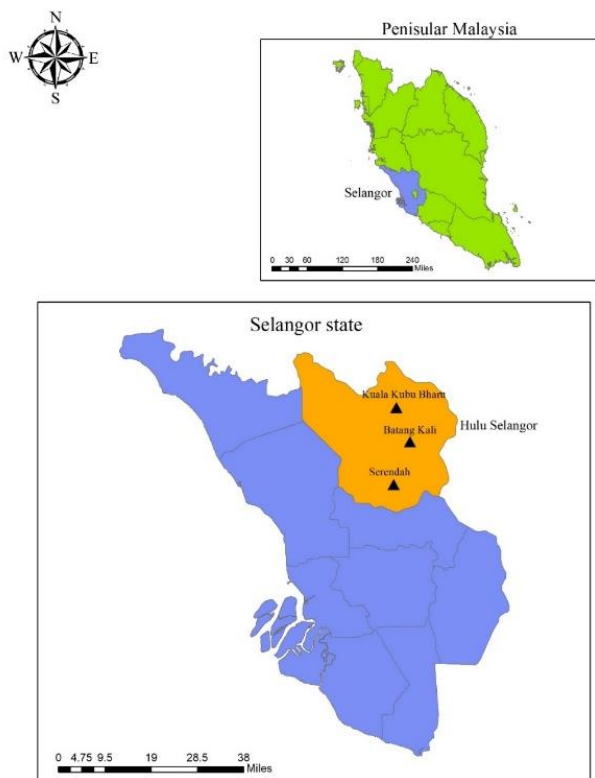
Waste generation at the school level is related not only to the number of students and teachers but also to the way waste management is implemented and the intention to reduce waste among students and teachers. For better or worse, individual behaviour would affect food waste generation. Efforts towards sustainable food waste management at the school level can be

enhanced by knowing the consumers' behaviour, including their knowledge and awareness. Yet, most studies have emphasised the aspects of household behaviour on food waste management instead of hospitality (Mapa et al., 2019; Zamhari & Ali, 2014). Fewer studies have been conducted in a school canteen setting (Boschini et al., 2018). Therefore, the current study intends to study food waste management behaviour among school communities, using primary and secondary schools. To achieve these objectives, the research survey was conducted in school canteens of Hulu Selangor, Malaysia in 2019.

## Research method

### *Study location*

This study was conducted at Hulu Selangor, a district located in the north of the state of Selangor. Hulu Selangor is one of Selangor's largest districts with an area that spans 175,670.11 hectares of land and locates a population of around 178,500 (Hulu Selangor District Council, 2021). Hulu Selangor is a rural area far from the development but has begun to progress towards development. This district consists of thirteen subdistricts: Hulu Bernam, Kalumpang, Kerling, Kuala Kubu Bharu, Rasa, Batang Kali, Hulu Yam, Serendah, Sg. Choh, Bandar Baru Bukit Beruntung, Bandar Baru Bukit Sentosa, Bandar Baru, Sg Buaya, and Bandar Lembah Beringin. The current study involved ten public schools located in Kuala Kubu Bharu ( $3^{\circ} 34'27.2''$  N and  $101^{\circ} 39'24.6''$  E), Batang Kali ( $3^{\circ} 27'31.3''$  N and  $101^{\circ} 39'56.4''$  E) and Serendah ( $3^{\circ} 27'9.8''$  N and  $101^{\circ} 35'15.4''$  E) as the sampling points (Figure 1).



**Figure 1.** Geographic location of the study area: Hulu Selangor, Malaysia.

*Method*

Questionnaires were distributed to primary and secondary school students as well as teachers in each of the ten public schools, the purpose being to obtain an overall representation of their behaviour towards reducing food waste. Table 1 shows the total number of the school community for each school. The total population of students and teachers in all then ten schools are 8,307 people. The sample size is based on a margin error of 5% and a confidence level of 99%, and therefore, the sample size is about 615. The number of questionnaires distributed in each school was between 59 and 80 sets. A descriptive analysis (percentage) was used to identify behaviour levels among school communities related to food waste at school canteens. The questionnaire was a self-administered closed-ended questionnaire. The study also used a Guttman scale questionnaire which seeks either a *yes* or *no* answer and contains questions that allow respondents to give more than one answer (Gothwal et al., 2009).

**Table 1.** Total Population and Size Sample of School Communities.

School	Number of students	Size sample of students	Number of teachers	Size sample of teachers	Total population	Size sample of the population
SK Batang Kali	906	66	54	12	960	78
SK Antara Gapi	622	61	42	14	664	75
SK Ampang Pecah	473	51	47	16	520	67
SK Kuala Kubu Bharu	244	43	40	14	284	57
SK Kuala Kubu Bharu 1	324	43	34	16	358	59
SK Kuala Kubu Bharu 2	268	66	29	14	297	80
SK Bandar Baru Batang Kali	1532	59	98	19	1630	78
SMK Ampang Pecah	954	47	73	21	1027	68
SMK Dato' Haji Kamarudin	739	52	56	16	795	68
SMK Bandar Baru Batang Kali	1659	46	113	23	1772	69
	<b>7721</b>	<b>534</b>	<b>586</b>	<b>165</b>	<b>8307</b>	<b>699</b>

Semi-structured interviews were also conducted with canteen managers to understand food waste management challenges at the ten selected public schools. In-depth interviews were conducted using a general, semi-structured script. The researchers observed the food waste management process at the school level. Each observation was carried out with a specific focus and was recorded with note-taking. All observations were carried out in the main places that generate the highest food waste, such as waste storage, food raw material stores, kitchens, food distribution place, and canteen. The observations allowed the researchers to observe the process at the schools in Hulu Selangor carefully. The research was conducted using qualitative content analysis (interview and observation) with interpreted through systematic classification process of coding and identifying themes.

## Results and discussion

Knowledge and awareness are the essential aspects in determining a business organisation or society's behaviour, which consequently influence decision-making (Kasimu et al., 2012). According to Azjein and Fishbein (1980), knowledge is a well-known cognitive factor (thinking ability) and a significant contributing factor to constructing a social structure and creating awareness. Therefore, the current study selected primary and secondary students as well as teachers to explore their knowledge and awareness of food waste management. The finding shown in Table 2 indicates that the majority of the respondents (92% of the primary school students, 86% of secondary school students, and 100% of school teachers) know about food waste. The practice of composting food waste is one of the essential components of an integrated waste management hierarchy. Some of the respondents (38% of primary school students, 41% of secondary school students, and 67% of teachers) admitted that they understood the concept of food waste composting. They know that food waste can be turned into compost, but they do not know how to process it.

**Table 2.** Knowledge and Awareness of Food Waste Management.

	Primary school students		Secondary school students		Teachers	
	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)
Knowledge on food waste term	92	8	86	14	100	0
Knowledge on food waste composting concept	38	62	41	59	67	33
Intention to generate food waste	60	40	59	41	85	15
Intention to mix food waste with other solid waste	64	36	48	52	69	31
The intention to learn about food waste management	90	10	77	23	97	3
Awareness on the impact of food waste issue	81	19	72	28	91	9

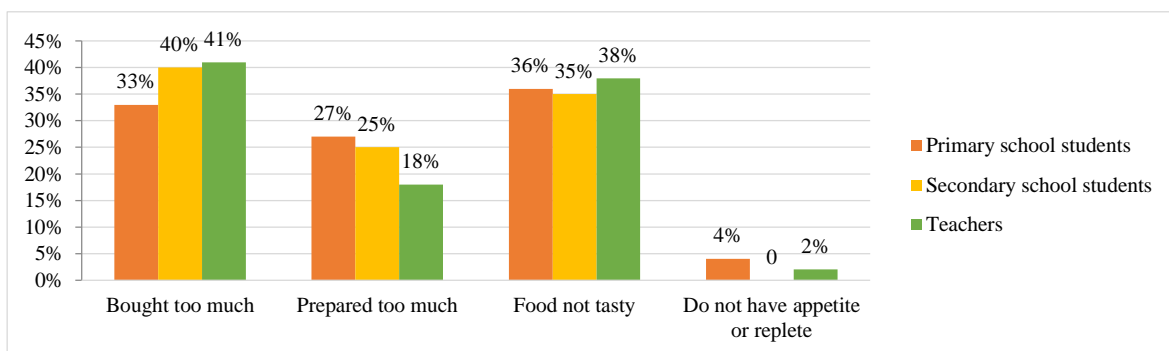
In the interviews, the school canteen managers mentioned that they have sufficient knowledge to carry out all the efforts towards reducing kitchen waste. As usual, the practice of purchasing raw food until the preparation of food is under the control of the canteen management. The canteen staff has been managing the kitchen food waste through systematic and effective management, but they still are unable to control the plate waste generated by the students and teachers. As shown in Table 2, the majority of the primary school students (60%), secondary school students (59%), and teachers (85%) have the intention to generate food waste. One of the canteen managers (key informants) stated that the canteen food's low price has also influenced the school community's behaviour towards increasing quantity food purchases and, consequently, generating plate waste. The results of this study are in line with the findings by Diaz-ruiz (2017), Gössling et al. (2011), and Salihoglu et al. (2017), who found a significant increase in food purchases when food prices became cheaper, thus leading to the production of higher volumes of food waste.

Some of the respondents (64% of primary school students, 48% of secondary school students, and 69% of teachers) also agreed that they intended to disposal food waste together with other solid waste in the school canteen. They do not know the proper way to manage waste, and they do not have a specific school rule that can encourage them to manage food waste. From the observations, most of the students and teachers placed their plates with food waste in the containers provided by the canteen staff. The food waste is not separated correctly by using specific trash bins. At times, half of the students (50%) threw away food waste in the trash bin (disposal together

with other solid waste) before putting their plates in the container, probably to make it easy for the cafeteria staff to wash their plates. Some of the respondents (90% of primary school students, 77% of secondary school students, and 97% of teachers) stated that they are willing to learn more about food waste management. Some of them argued that food waste has only a small impact on the school environment, but they do realise that food waste can cause pollution and affect daily life if not appropriately managed. Most of the respondents (81% of primary school students, 72% of secondary school students, and 91% of teachers) are aware that food waste negatively affects the environment.

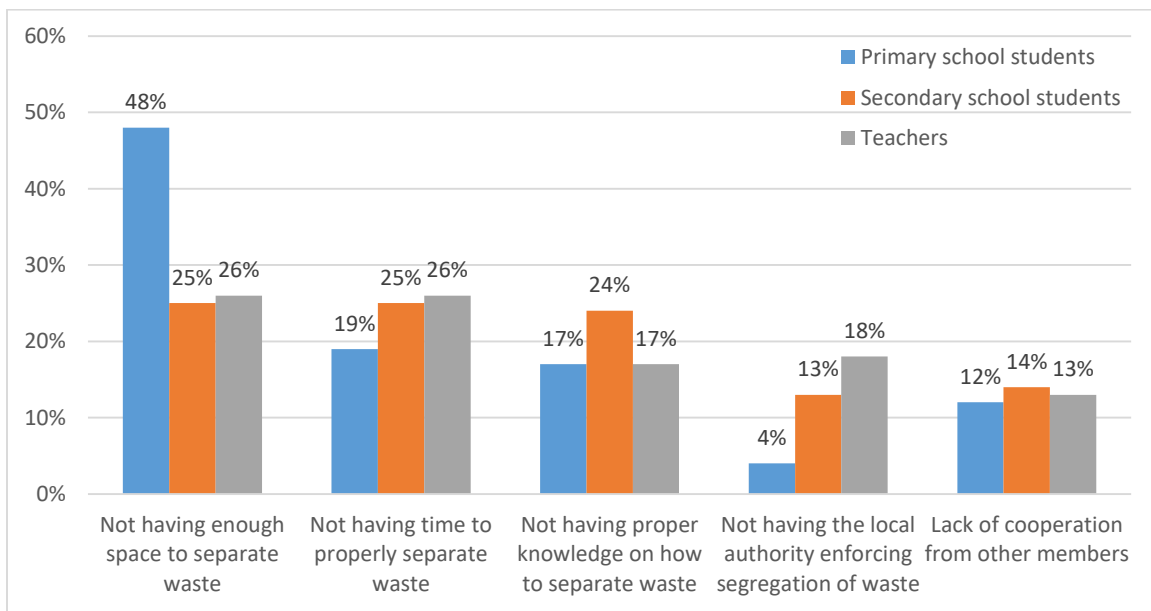
As indicated in Figure 2, a few respondents (primary school students [33%], secondary school students [40%], and teachers [41%]) agreed that they generate food waste as a result of buying too much food. Usually, pocket money value can also encourage the students' behaviour to buy more food. Secondary school students usually carry more pocket money than primary school students, and the former are more likely to buy more food in the school canteen. Some of the respondents (27% of primary school students, 25% of secondary school students, and 18% of teachers) stated that the canteen staff would usually prepare a large quantity of food, hence the consequent generation of avoidable food waste. Although the school canteen staff knows the accurate number of students in the school, their preparing food still generates excess food waste due to some uncertainties, such as illnesses, examination dates, and students being away due to school excursions. For safety and hygienic reasons, the excess of untouched food is discarded and not reused for other dishes. These findings are similar to Ponis et al. (2017), Silvennoinen et al. (2015), and Gaiani et al. (2018), who found that the food waste generated due to overcooking could not be stored or reused for other menus.

More than 30% of the canteen managers (key informants) interviewed stated that the canteen staff would take home the excess food (good conditional food). The teachers were also seen to create higher food waste due to consuming various food types and leaving those that do not satisfy their appetite. The lack of delicious food or food that does not meet their expectations also creates a higher plate waste in the school canteen. Most of the students appear to dislike eating vegetables, which continues to generate food waste. However, almost all secondary students, especially male students, do not care whether the food is delicious or not; they will eat anything bought in the school canteen. They feel too hungry during recess because they usually do not have time to eat breakfast before going to school. Besides that, the price of food and the quantity of food served to primary school students and secondary school students are almost the same. Secondary school students usually consume all their food compared to primary school students. It was also observed that secondary school students have no appetite or replete problems compared to primary school students.



**Figure 2.** Factors that cause food waste generation.

Figure 3 shows that the lack of bins available for waste disposal and inadequate space for waste storage has become a significant factor contributing to improper food waste segregation among students and teachers. The sufficient number of bins offered by the canteen managers is vital to meeting the needs of the school community; such availability would also influence their behaviour and involvement towards food waste segregation. The researchers also observed that the canteen staff had to store large amounts of waste into a limited waste storage space, especially in the kitchen. The canteen staff have also requested their contractor (who collects waste) to dispose mixed waste to the landfill immediately to prevent unpleasant visual, odour, or noise from the waste and maintain the comfort of the school environment. However, such practice has prevented the separation of waste among the school community before disposal to the landfills. The researchers also observed the lack of bins for recycling, specifically for food waste. In addition, 19% of primary school students, 25% of secondary students, and 26% of teachers stated that time constraints had caused them not to implement food waste segregation. Often they are given only twenty minutes for recess, during which all students the students have to leave classes simultaneously and queue to buy food. Usually, the canteen staff would pack the food first either in plastic or paper containers so they can handle more students queuing at the counter within the recess time. It was also observed that most of the students did not have enough time for food waste segregation, and they placed their plates (with food waste) in the containers provided by the canteen staff. Also, most of the teachers leave their plates on the table, and then the canteen staff will handle the leftovers food. The canteen managers interviewed said that there was not enough time for waste segregation as they had to prepare and pack food in a limited time.



**Figure 3.** The reasons people do not segregate solid waste.

Some of the students (17% of primary school students, 24% of secondary students, and 17% of teachers) do not have adequate knowledge of food waste segregation. Most of the canteen and school managements do not know the best action to manage waste, including food waste in schools. More than 90% of the canteen managers interviewed said that all the leftover food waste is dumped into the bins. At times, the canteen staff would take home leftover food to feed animals (for ducks, chickens, geese, turkeys), with their canteen manager's permission. However, such a

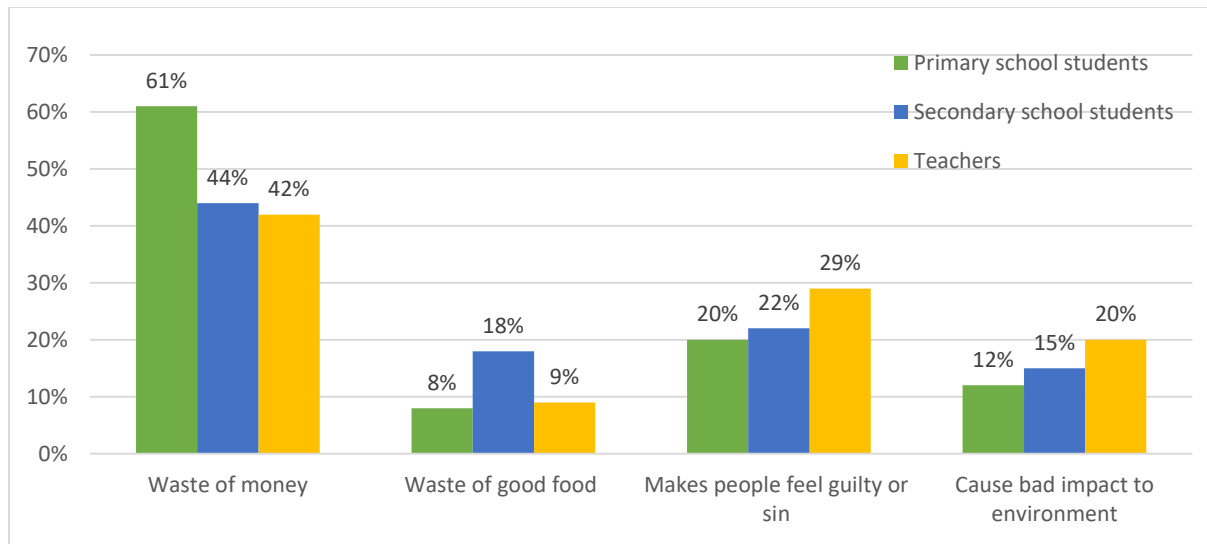
practice takes place only in two schools. As shown in Figure 3, a few of the respondents (12% of primary school students, 14% of secondary school students, and 13% of teachers) did not segregate food waste because of the lack of cooperation from other school communities. It was also observed that the lack of waste segregation takes place at their school because they feel that such action is not beneficial, or they might be influenced by friends who throw all kinds of waste into the bin directly. A few of the respondents (4% of primary school students, 13% of secondary school students and 18% of teachers) do not segregate waste due to the lack of enforcement by the local authorities. Most of the canteen managers (key informants) agreed to the lack of practising food waste segregation at the school level. One of the canteen managers noted the absence of school rules that can encourage the school community to segregate school waste.

Disposing food waste involves not only the cost of disposal, but also the costs of purchasing food raw materials, food storage costs, food transport costs, preparation and cooking costs (labour costs), and food waste disposal costs (Kasavan et al., 2020). A considerable number of the respondents (primary school students [61%], secondary school students [44%], as well as teachers [42%]) do not want to waste food, believing that it can lead to wasting money. The results of this study are consistent with the findings by Qusted et al. (2013) and Schanes et al. (2018), who found that cost saving is one of the factors influencing food waste management towards sustainable manner. However, the canteen managers in this study appear to lack still an awareness of the potential of saving operational costs. The most significant resource efficiency opportunities lie with sustainable food waste management.

Some of the respondents (8% of primary school students, 18% of secondary school students, and 9% of teachers) do not want to waste good conditional food because it creates a wasting of valuable resources used throughout the food process (Figure 4). Energy resources, time, labour, water, fuel, fertiliser, and money, have been wasted for every quantity of food waste generation from the early stages of agriculture production until disposal at the landfill. A few of the respondents (20% of primary school students, 22% of secondary school students, and 29% of teachers) do not want to waste food because they felt that the act is sinful, thus making them feel guilty. Most of the students' parents always advise against wasting food and remind them of those with the hardship of getting food. This finding is similar to Basri et al. (2016) and Zain et al. (2016), who found that education from home (parents) regarding the environment is the factor that can influence individual behaviour concerning the environment.

Ineffective food waste management not only increases the operating costs of waste management for canteens but also harms the environment, such as by causing greenhouse gas emissions and loss of ecosystem diversity. In addition, total waste generation, including food waste from schools, would also contribute to the increase in waste at landfills. Food waste also releases twenty-one times methane more than carbon dioxide (CO<sub>2</sub>) does when food waste is decomposed at landfills (Noor et al., 2013). As shown in Figure 4, a few of the respondents (12% of primary school students, 15% of secondary school students, and 20% of teachers) do not want to waste food, realising that it can have harmful effects on the environment. This finding is in line with the findings study of Diaz-ruiz (2017) and Abdelradi (2018), who found that consideration of environment conservation influences behaviour towards sustainable food waste management.





**Figure 4.** The reason people do not want to waste food.

## Conclusion

The obligation to protect the environment is not only the responsibility of the local authorities but also of every citizen. Schools are a great place to raise awareness intensively towards reducing food waste. Students and teachers would spend most of their time every day at school and use various resources, and therefore, they would tend to generate a variety of food waste. The sustainability of food waste management at the school level cannot be achieved holistically without knowing the behaviour of food waste management among the school community. The overall results of this study found that the management system of the canteen and the school has had a significant impact on the control of food waste generation and strategy plans towards sustainable food waste management. An effective management system can help to reduce the generation of food waste as much as possible and reduce the cost of operating the canteen. Appropriate menu planning, preparation of accurate food quantities, effective food process management, and attractive food serving are some of the strategies that can be considered for sustainably managing food waste.

The current study also found that most of the students and teachers know about food waste but lack the knowledge on how to manage food waste. Therefore, schools should take the necessary actions to improve food waste management by educating the school community about food waste issues and by creating awareness of the impact on the environment, society, and economy. Some recommendations based on the findings are put forward for sustainable food waste management to be practised at the school level:

- The implementation of waste audits is a vital aspect to maintain statistical records on the composition of waste and the total quantity of waste generated, disposed of, and composted at the school level. Waste audits should be implemented by setting up a special internal audit team or school association to identify the leading causes of the highest food waste generation in their schools. The information can be useful for the school community to implement effective strategies towards reducing food waste.

- Canteen and school management should provide efficient facilities and infrastructure, such as attractive and suitable waste bins for waste storage. By this way, the community can implement waste segregation effectively and promote positive attitudes towards sustainable waste management.
- Cooperation with waste management contractors is equally important to the cooperation between the school community to encourage receptivity towards sustainable food waste management at the school level. Although the school management has taken all efforts to reduce the food waste sent to landfills, their initiatives cannot be optimally achieved if there is no cooperation from contractors taking waste. Hence, the school community needs to separate their solid waste based on category (such as paper, plastic, glass, rubber, metal, and food waste) using different colour bins or plastics. These practices will make it easier for contractors and the canteen management to ensure that food waste is not mixed with other solid waste when managing waste from the school.
- The school community may demonstrate commitment by participating in programmes and campaigns on green practices, such as by reducing, reusing, recycling, and composting. Such programmes are often organised by nongovernmental and government. Hence, the school community can increase their more practical or hands-on knowledge of the proper way of waste management. It is also crucial to educate the public on the responsibility of environmental protection and conservation.
- School management should establish recycling and compost of food waste programmes as a form of school rules. With this, the school community can monitor more efficiently the segregation of waste (mainly food waste). Recycling programmes can be implemented through co-curricular activities or subjects, in which students can be encouraged to develop their creativity by creating various innovations based on recycled materials. Good quality composting methods could decompose organic waste (including food waste) and can be turned into valuable organic fertilisers, which can then be used for beautifying the school landscape. Such an effort would trigger initiatives from the school communities to gain extra income from selling their recycling food waste products, e.g., organic fertilisers, as opposed to chemical fertilisers for growing healthy vegetables and fruits. This kind of green practice can lead to food waste business opportunities of converting waste to money while harnessing positive food waste-reduction behaviours.
- Canteen managers should provide staff training on sustainable food waste management from purchasing to disposal, the purpose being to educate their staff on the culture of food waste reduction. Besides that, engaging them food waste business such as food waste processed into animal feed, mainly poultry feed and aqua feed, is as useful as the more economical conventional feed.
- The school foodservice providers need to donate the leftover over food (edible food) to students from low-income families and their families to avoid wastage of food at the school canteen. This initiative can be implemented successfully by collaborating with school management.
- The management system of schools and canteens also needs to set strict rules and make extra charging (pay as you throw) to school communities who leave edible food on their plates. These practices would help to create self-awareness towards preventing over-ordering, reduce plate waste, and simultaneously reduce the canteen's operating costs.

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