The university students' knowledge and behavior towards food loss and waste in Sleman, Yogyakarta

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Abstract. This study aims to learn about students' knowledge, behavior, and food habits regarding domestic waste production. In late October 2023, a cross-sectional study using a purposive sampling was conducted among university students (n=85) in Sleman. An online questionnaire assessed their knowledge and behavior regarding domestic waste. Analysis data was using Stata/MP 17.0. The findings revealed that 30.6% of students potentially increased the domestic waste from leftover food. Among 51.8% of the students who cooked their dishes, 83.3% tended to produce vegetable waste, mainly from seeds, rind, and roots. Most students (87.1%) store their groceries at home/flat, and 56.8% often throw away the groceries if it has spoiled or reached their expiry date. Creating a shopping list was a viable solution in reducing domestic waste, as those who never (15.4%) and seldom (61.5%) made a shopping list are more likely to throw away their groceries if they exceed the expiry date. Although the students consistently finish their food, their knowledge, behavior, and food habits depict that they still could produce vast amounts of food waste. To effectively tackle and reduce the increasing domestic waste problem in Sleman, it is crucial to implement targeted food waste reduction initiatives.

1 Introduction

Globally, we pose a significant challenge in managing waste, especially in low-middle-income countries (LMIC) such as Indonesia. Waste issues are undoubtedly intertwined with human existence, as individuals consistently generate waste daily. A significant amount of waste and its traditional disposal practices are two primary contributors to adverse environmental effects [1]. Recent data by the District Environmental and Waste Management Office displays the total volume from 202 districts all over Indonesia has reached 21.1 million tonnes/year, including 13.9 million tonnes properly managed and 7.2 million tonnes improperly managed [2]. These

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circumstances threaten Indonesia tremendously, particularly in high-density population areas such as Yogyakarta.

The total waste volume in Yogyakarta throughout 2021 is nearly 413,151 tonnes/year and increased to 449,818 tonnes/year in 2022 [3]. Piyungan Landfill is the largest landfill in Yogyakarta that accommodates waste from Yogyakarta City, Bantul Regency, and Sleman Regency; amongst all the areas, Sleman Regency is marked as the biggest waste contributor in Piyungan Landfill, followed by 53,096 tonnes of unmanaged waste around January-June 2023. Moreover, based on the data launched by the National Waste Management System in 2021, the waste volume in Sleman Regency has increased through the years: 255,000 tonnes in 2019, 256,000 in 2020, and 268,000 in 2021. The government assumed this amount would reach 738.71 tonnes/day by the end of 2023, and every person would produce nearly 0.5kg of waste daily [4].

Several underlying factors might contribute to these circumstances in Yogyakarta, primarily driven by the rising population that directly impacts societal demands through purchasing clothes, books, food, and engaging in various activities, especially among university students [5]. Yogyakarta is one of the biggest education cities in Indonesia with more than 400.000 students living in this city [6]. Sleman Regency stands out as the highest number of university students in Yogyakarta, amounting to 270,110 students in 2022. These students primarily generate food waste, packaging from food and beverages, paper, and plastics associated with online shopping [7].

The Sleman Government has made several policies to reduce the amount of waste, namely by signing the "Sleman Regent Circular Letter No. 32/2022 on Waste Sorting from Household Level" to dwindle the tertiary waste sent to Piyungan Landfill from 304 tonnes/day to 260 tonnes/day, establish the Waste Bank Program, and promote the 3R dumpsite (Reduce, Reuse, Recycle). The 3R dumpsite program involves sorting the collected waste before it is sent to the Piyungan Landfill by the waste disposal personnel. Moreover, the waste bank program demonstrates a great move to decrease the amount of household waste among students, as students tend to produce more waste than others [8]. In addition, the local government is currently proposing Refused Derived Fuel (RDF) as a new program to manage plastic-based waste.

Nevertheless, the urgency of the waste issues is consequential in public health and community well-being. Inadequate waste management and handling processes escalate the significance of its impacts, especially at the household level. In addition, socioeconomic and socio-demographic factors play a crucial role in waste management [9, 10]. Improper waste management could increase the risk of infectious disease transmission due to some environmental vectors such as rodents, flies, and mosquitoes that inhabit there. These vectors are responsible for dengue fever, malaria, diarrhea, leptospirosis, and so on, which greatly burdens public health [11, 12]. A waste-polluted environment contributes to the community's well-being status. Unpleasant odors have the potential to induce mental disturbances such as stress, depression, and anxiety. On the other hand, recent studies have demonstrated that families living in well-managed environments, including proper waste disposal practices, tend to experience a higher quality of life and be protected from diseases [13].

Several studies in various countries showed that raising awareness of food waste is correlated with reducing food waste action at the household level [14-16]. The significant factors influencing food waste were too much purchasing food, a lack of expiry-date control, a lack of purchase and menu planning, and a lack of waste management knowledge [14, 15, 17, 18]. A study at the university level in Indonesia revealed that students' motivation to reduce food waste was their awareness of the environmental, social, and economic consequences of food waste and perceived behavior control [19]. Half of the youth in Tangerang, known as

Generation Z or Gen Z, had shown awareness of food waste. However, the study focused on respondents' perceptions and attitudes about food leftovers [20]. Through this study, we try to fill the gap by assessing students' knowledge and behavior towards expiry date, food storage, shopping list, and the campaign of Food Loss and Waste. Assessing students' knowledge and behavior regarding food loss and waste is vital to acquiring sustainable habits and reducing waste [21]. By compiling all the crucial programs to dwindle food waste, we aim to anticipate emerging environmental issues shortly, mitigate the risk, and enhance the community's welfare. Therefore, this study was undertaken to evaluate and further explore university students' knowledge, behaviors, and dietary practices concerning domestic waste production.

2 Materials and Methods

2.1 Participants

We utilized a purposive sampling method to select participants based on inclusion criteria, specifically targeting undergraduate and graduate students residing in Sleman. Roscoe's (1975) theory suggests that a sample size between 30 and 500 is generally adequate for behavioral research [22], as it ensures enough data to make reliable conclusions while being feasible for most study designs. In our research, we chose a minimum of 85 respondents to align with this recommendation and to ensure sufficient statistical power. This decision was based on the need to gather a robust amount of data for reliable analysis, given the diversity and potential variability among the student population in Sleman Regency. Additionally, we applied a 20% cut-off to the sample size as a precaution to account for potential non-responses or exclusions, ensuring that we would still have an adequate number of respondents even after excluding those not meeting the inclusion criteria, such as those not residing in Sleman Regency or not providing informed consent. While the initial calculation with the cut-off suggested a minimum of 43 respondents, we opted to increase this number to 85 to further strengthen the reliability of our findings. The inclusion criteria were carefully chosen to ensure that the sample accurately represented the target population and that participants fully understood and consented to their involvement in the study. By clarifying these points, we aimed to provide a clear and thoughtful rationale for our sample size determination, balancing both theoretical guidance and practical considerations.

2.2 Data collection tools

The questionnaire used in this study was previously validated on a different population with similar characteristics. Ethical clearance for this research was obtained from the Ethics Committee of the Faculty of Medicine, Public Health, and Nursing at Universitas Gadjah Mada

2.3 Data evaluation and statistical analysis

This study assesses three main aspects: food behavior and domestic waste, food storing behavior and domestic waste, and knowledge about food storage and organic waste education for university students in Sleman. The first aspect, we assess food consumption and domestic waste, includes how to get daily meals, behavior in consuming cooked or purchased food, the actions when having a large portion, and menu variations toward food waste. In the second aspect, we assess food storing behavior, which includes stored food, awareness about expiry dates, action on damaged or expired food, and the habit of creating a shopping list. Lastly, food storage and organic waste education include reading expiry dates, knowledge about food

storage, and students' interest in food loss and waste campaigns. We developed the questionnaire both in an open and closed form of question. This research was conducted online through Google Forms from October 20 to 23, 2023. All the data obtained were analyzed using STATA/MP 17.0 software.

3 Results and Discussion

We provide principal findings on food waste issues among university students. As shown in Table 1, most students (65.9%) are between 19 and 27 years old. More than 50% of the students reside in boarding houses/flats, and 51.8% are self-cooked for daily meals. Furthermore, only 30.6% of 85 respondents tend to increase the domestic waste volume from leftover food; moreover, most students (65.9%) chose to save their excessed cooked or purchased food, while others (12.9%) decided to throw it away that potential to be domestic waste. The ones commonly classified as domestic waste are vegetable cuts (83.3%), and only 1.2% of the students process their waste as compost. Based on the data, either those who cooked or purchased their meal have the potential to increase domestic waste from leftover or unprocessed groceries.

Moving on to the aspect of knowledge and behavior on expiry dates, nearly 92.9% of students admitted that they understood how to read various kinds of expiry dates on the packaging. Most students (87.1%) stored some food at their homes/boarding houses; moreover, 58% of the respondents already knew about the food loss and waste campaigns, and they wanted to discover more about these campaigns. This result highlights that growing awareness about decreasing food waste through FLW campaigns is urgently needed for university students.

Table 1. Frequency Distribution of Variables

Variables	n	(%)
Respondent Characteristics		
Age		
19-27	56	65.9
28-35	16	18.8
36-43	11	12.9
44-51	2	2.3
Residence		
Boarding House/apartment	54	63.5
House/rented house	31	36.5
Daily food		
Catering	1	1.2
Delivery order	9	10.6
Cooking	44	51.8
Buy food at the stall	31	36.5
Knowledge		
Knowledge about food storage		
Yes	61	71.8
Uncertain	21	24.7
No	3	3.5
Knowledge about reading expiry date		
Yes	79	92.9
Uncertain	6	7.1

Behavior		
Behavior of consuming food		
Always finish the food	59	69.4
Sometime finish the food	26	30.6
Variety of cooking menu		
1 menu	19	33.9
2-3 menus	36	64.3
>3 menus	1	1.8
Discarded food waste		
Yes	31	55.4
No	25	44.6
Food Waste		
Spice	1	3.3
Eggshell	1	3.3
Plastic	1	3.3
Vegetable	25	83.3
Chicken/fish bone	2	6.7
Throwing away where portions are excessive		
Shared	15	17.6
Give to animal	2	2.3
Throw away	11	12.9
Processed into compost	1	1.2
Saved	56	65.9
Behavior of food storage		
Yes	74	87.1
No	11	12.9
Behavior of making a shopping list		
Always	30	35.3
Often	15	17.6
Sometime	27	31.8
Never	13	15.3
Behavior of paying attention to expiry dates		
Always	58	68.2
Often	14	16.5
Sometime	13	15.3
Behavior towards damaged or expired food		
Often	16	18.8
Sometime	48	56.5
Never	21	24.7
Food Loss and Waste		
Knowledge about Food Loss and Waste		
Yes	49	57.6
No	36	42.4
Interest in Food Loss and Waste:		
No	9	10.6
Yes	76	89.4

Table 2 illustrates that domestic waste could also come from students who cooked their daily meals, as 55.4% of them often throw away grocery leftovers during cooking. The finding is highly linked to the 63.9% of students who cooked 2-3 menus at a time.

Table 2. Frequency of leftover food ingredients based on variations in the cooking menu

Variety of cooking menu	Leftover food ingredients		
	No n(%)	Yes n(%)	Total n(%)
1 menu	12 (63.2)	7 (36.8)	19 (100)
2-3 menus	13 (36.1)	23 (63.9)	36 (100)
>3 menus	0 (0)	1 (100)	1 (100)
Total	25 (44.6)	31 (55.4)	56 (100)

Based on Table 3, it is evident that students who know how to read the expiry date tend to throw their food away, with 55.7% indicating they would do it sometimes and 17.7% often, particularly if the food is damaged or has exceeded its expiry date. Apart from that, 17.2% of students who always pay attention to the expiry date admitted that they also often throw away their food if it is damaged or exceeds the expiry date. Moreover, nearly 27.6% of respondents who always pay attention to the expiry date while shopping did not throw away their food, mainly because it has a longer expiry date. The research also revealed that students who never created a shopping list admitted that they often and sometimes throw away their food due to it exceeding the expiry date or being damaged, 15.4% and 61.5%, respectively. Then, among students who stored food, they admitted that they often (20.2%) and sometimes (56.8%) throw away food because it has been damaged or passed the expiry date and had the potential to become domestic waste.

Table 3. The frequency of behavior of throwing away food/food ingredients because of expired or damaged

Variables	Behavior towards damaged or expired food			
Knowledge about reading expiry date	Sometime n (%)	Often n (%)	Never n (%)	Total n (%)
Yes	44 (55.7)	14 (17.7)	21 (26.6)	79 (100)
Uncertain	4 (66.7)	2 (33.3)	0 (0)	6 (100)
Behavior of paying attention to expiry dates				
Always	32 (55.2)	10 (17.2)	16 (27.6)	58 (100)
Often	9 (64.3)	2 (14.3)	3 (21.4)	14 (100)
Sometime	7 (53.8)	4 (30.8)	2 (15.4)	13 (100)
Behavior of making a shopping list				
Always	14 (46.7)	6 (20)	10 (33.3)	30 (100)
Often	10 (66.7)	3 (20)	2 (13.3)	15 (100)
Sometime	16 (59.3)	5 (18.5)	6 (22.2)	27 (100)
Never	8 (61.5)	2 (15.4)	3 (23.1)	13 (100)
Behavior of food storage				
Yes	42 (56.8)	15 (20.2)	17 (23)	74 (100)
No	6 (54.5)	1 (9.1)	4 (36.3)	11 (100)

Accomplishing mindful eating is one of the ways to reduce food leftovers waste, by a conscious attitude towards the food by savoring each bite and paying attention to the taste, texture, and aroma of the food, individuals become more aware of their actual hunger levels rather than impulsive emotional eating [23]. As a result, individuals are less likely to overeat, which directly contributes to the reduction of food waste [24]. Mindful eating is a path to

change eating behavior so it can increase healthy food intake without increasing food waste and it has a relationship to improved eating behavior and diet quality [25]. It helps prevent individuals from buying and eating excessive amounts of food, thus reducing the amount of food waste. Sharing food can also be applied to further encourage efficient use of resources by distributing excess food to others. Experimental research conducted in Italy states that the habit of sharing food allows individuals to optimize the use of food ingredients collectively, reducing the likelihood of perishable food waste being wasted. This research can minimize domestic waste production by 45% for two weeks [26].

In addition, in-store purchasing behavior is one of the underlying aspects contributing to the increase in food waste. The product's packaging and the expiry date information are two main factors influencing customer purchasing decisions [27, 28]. This research revealed that nearly one-third of the respondents who consistently check upon expiry date are less likely to discard groceries. Moreover, an effective method to cut domestic waste is arranging a shopping list, encouraging consumers to be more responsible in managing their groceries. Shopping lists could help to reduce food waste by approximately 0.09 kg/person/week [29]. Conversely, our study indicates that individuals who seldom use a shopping list tend to discard their groceries more often than those who use a shopping list due to damage or exceeding the expiry date, contributing to food waste. Aligned with other research, those who adhere well to a shopping list exhibit more mindful behavior, purchasing items based on their needs [30]. However, occasional impulsive buying can also interfere with purchasing behavior on the product [31]. Furthermore, comprehensive and holistic interventions beyond creating shopping lists demonstrate favorable results in promoting food sustainability in the forthcoming era [32].

Addressing the waste issues in Sleman requires tackling the problem at its core; reducing the activities that lead to generating excessive domestic waste. Food Loss and Waste (FLW) is an international campaign to reduce food waste, stated in Sustainable Development Goals (SDG) point 12.3 that by 2030 “halve per capita global waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses” [33]. Indonesia was claimed to be the country with the most considerable food waste, estimated at 300 kg per capita (2018). While also producing foul odors and leachates that contaminate groundwater and surface water [34]. The risks also extend to respiratory disorders, waterborne diseases, and potential long-term chronic health effects from pollutants released by the waste [35]. Household waste containing organic materials provides ideal breeding grounds for disease vectors like rodents, flies, and mosquitoes, leading to vector-borne illnesses such as Zika virus, dengue, malaria, and leptospirosis (spread through contact with infected animals' tissue or rodent urine) [36].

In 2021, the BAPPENAS developed the national FLW strategies. Enriching knowledge and behavior change is one of the five main strategies in Indonesia [37]. Reducing FLW decreases the need for additional food production. Moreover, less food waste reduces pollution from fertilizers and pesticides used in food production, decreasing water and soil contamination linked to intensive agriculture. Furthermore, the reduction in wasted food means that the energy used for food production, processing and transportation is also minimized, resulting in a smaller carbon footprint for the food supply chain, which in turn reduces the Greenhouse Gas (GHG) [38-40].

The FLW campaign needs to be raised among students in Sleman. Involving the community, such as students, in managing waste is considered a strategic way since domestic waste is attached to their daily activities [41]. The elevated student population in Sleman poses a great opportunity as we can reach an abundance of crowds to decrease the domestic waste volume. Collaboration with existing health promotion programs on campus, such as Health-Promoting University (HPU), is an efficacious way to implement the campaign.

The FLW campaign mainly focuses on food waste reduction at the household level through numerous ways such as good shopping planning, portion control in cooking and eating, proper storage methods for food products, and others [37]. It aligns with a call to action of the international FLW campaign, which states that consumers must stock and store their food correctly, including attention to the expiry date. The consumers also, when possible, must donate food to charities. The government and decision-makers ought to educate consumers regarding FLW, including the knowledge of expiry date marks [42]. The FLW campaign should be conveyed in harmony with other related campaigns held by the District Health Office and the District Environmental and Waste Management Office in Sleman to maintain its sustainability.

The limitation of this research is that we did not collect and analyze the socio-demographic factors of respondents, such as gender, social and economic status, and level of educational background. Since we only examine the overview of knowledge and behavior-related FLW among students, further research needs to be performed to analyze the correlation between variables.

4 Conclusion

An ongoing and unresolved issue in Sleman, Yogyakarta is the overload dumpsite, despite the initiation of various waste management programs by the local government. The action to minimize waste production is crucial to start at the household level. Some domestic waste produced by students, including food and beverage leftovers and spoiled food, can be reduced by enhancing knowledge and fostering behavior change regarding FLW. While more than half of the students are already aware of FLW, there is a growing interest in expanding the FLW campaign to reach a bigger audience. The FLW campaign among students is considered a strategic and adequate way to manage the production of domestic waste in Sleman. The FLW campaign concentrated on ways to reduce food waste at the household level, such as good shopping planning, portion control in cooking and eating, proper storage methods for food products, and donated food when possible. The FLW campaign should collaborate with existing health promotion programs on campus and synergize with related programs in the District Environmental and Waste Management Office and District Health Office. Indeed, the role of government and decision-makers is needed to ensure the effectiveness and sustainability of the FLW campaign.

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