Quantifying and analysing food waste generated by Indonesian undergraduate students

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Abstract. Despite the fact that environmental consequences derived from food waste have been widely known, studies on the amount of food waste and its influencing factors have relatively been paid little attention. Addressing this shortage, this paper aimed to quantify monthly avoidable food waste generated by Indonesian undergraduate students and analyse factors influencing the occurrence of avoidable food waste. Based on data from 106 undergraduate students, descriptive statistics and logistic regression were applied in this study. The results indicated that 4,987.5 g of food waste was generated in a month (equal to 59,850 g yearly); or 47.05 g per person monthly (equal to 564.62 g per person per a year). Meanwhile, eating out frequency and gender were found to be significant predictors of food waste occurrence.

1. Introduction

Studies on food waste amount and its influencing factors have relatively been received little attention compared to environmental consequences derived from food waste. Some researchers, such as Morgan [1] and Young et al. [2], examined how a firm influences its consumer to reduce environmental impacts of the product usage in their household. More specifically, Young et al. [2] applied the behavioral change approaches on environmental issue in hoped that the change in attitude and behaviour would be able to shift consumers’ lifestyle into more environmental friendly. On the other hand, some previous studies by Koivupuro et al. [3], Bortoleto et al. [4], and Cox et al. [5] have been focused on calculating the amount of wasted food, finding the influence of behavioral factors towards food waste, and analyzing waste prevention behavior in household scope.

Schneider and Obersteiner [6] and European Commission [7] stated that food waste was categorized into avoidable and unavoidable based on its edibility. In this study, only the avoidable food is referred to as food waste, which defined by Koivupuro [3] as any kinds of food that could have been consumed prior to disposal.

As the number of avoidable food waste tends to escalate each year all over the world, conducting research in this area is emerged. United States, one of the biggest food wasters, disposing nearly 277 kg of food per person each year [8]. Meanwhile, United Kingdom threw away edible food equal to £13bn per year [9]. Surprisingly, not only the developed countries but also developing country have to deal with this issue. Indonesia, for example, has becoming the world's second largest food waster,
disposing almost 300 kg of food per person each year [8]. This is an ironic fact since millions in the country suffer from malnutrition [8], while at the same time, the amount of avoidable food waste is huge.

Addressing those gaps, this research purposed to quantify monthly avoidable food waste generated by Indonesian undergraduate students and analyse factors influencing the occurrence of avoidable food waste. This study focused on specific group (youngsters), as Wassermann and Schneidar [6] mentioned that young people waste more food than the elders.

2. Materials and Methods

2.1. Sample
Undergraduate students from four faculties (Faculty of Agriculture, Faculty of Economic and Business, Faculty of Teacher Training and Education Science, and Faculty of Engineering) in Sebelas Maret University (Surakarta City) were conveniently chosen as respondents. A total of 110 questionnaires were distributed to respondents for each faculty sequentially started from September 1st up to 9th 2017. Among those number, 106 (96.36%) questionnaires were used due to its completeness.

The selected respondents consisted of 90 females (84.91%) and 16 males (15.09%); both groups came from various semesters (1st, 3rd, 5th, and 9th) with age category ranged from 17 to 24 years old. The majority of respondents originated from the 5th semesters (60%), and most of them were 20 years old (52%).

2.2. Instruments measurement

2.2.1. Food waste
Different from household unit analysis used by Koivupuro et al. [3], this study applied an individual unit as quantification basis. More specifically, the quantification of avoidable food waste was based on each meal taken by respondents. Meanwhile in household unit, food waste was measured not only from individual meal but also from all kinds of food sourced from household. As a consequence, it is estimated that the amount of food waste measured in individual unit is fewer than the household unit.

Some questions were depicted in the questionnaires in order to measure the amount of avoidable food waste. Since the questionnaires was only once given, the respondents were expected to remember their previous eating habits, specifically on the intensity of wasting the edible food in each meal they consumed (breakfast, lunch, dinner, or any meals taken in between). This intensity was measured in a day and in a week. In addition, respondents were also expected to measure how many spoons they used to waste the edible food in each of their meal.

In regards to measure the amount of avoidable food waste, data generated by 106 respondents were processed by multiplying the intensity of weekly avoidable food waste and the amount of food being wasted in terms of tablespoons. Then, the result was converted into gram and month. A tablespoon of food waste was equivalent to 15 g.

2.2.2. Factors influencing the avoidable food waste occurrence
In this research, variables of individual characteristic (gender), financial profile (monthly living cost), and behavior (food shopping frequency and eating out frequency) were selectively chosen from Kuivopuro et al. [3]. Then, those factors were modified into more suitable context for undergraduate students.

Gender was considered as one of the most common category or predicted factor used in a scientific study. In this research, male and female were predicted to produce different amount of food waste since both groups tended to have different role and eating habits. Most woman, for example, take in charge for their family meals, for that reason, decisions regarding food menu and quantity were often lead to the level of food waste generated in her household. Additionally, some woman might consume less amount of meals than men, therefore, finishing one food portion could be a burden for them. This would lead to higher avoidable food waste. In order to measure whether gender was a predictor of food waste occurrence, the respondents were divided using nominal scale: 1 (woman) and 2 (man).
This study also measured respondent’s monthly living cost (excluding housing rent). The housing rent was not included due to the variety of student’s accommodation. Many of them stayed in boarding houses, while some of them lived with their parents or other family members. Therefore, in order to eliminate bias, monthly payment on housing was excluded in measuring living cost.

It is expected that the different amount of living cost would affect one’s buying power for monthly needs, including for food. Higher living cost could lead into higher chance of uncontrolled grocery (or meal) buying that eventually triggers more avoidable food waste. The monthly living cost was measured by 7 scale: 1 (< IDR 500,000); 2 (IDR 501,000 - IDR 1,000,000); 3 (IDR 1,001,000 - IDR 1,500,000); 4 (IDR 1,501,000 - IDR 2,000,000); 5 (IDR 2,001,000 - IDR 2,500,000); 6 (IDR 2,501,000 - IDR 3,000,000); 7 (> IDR 3,000,000).

Furthermore, the food shopping frequency was predicted as factors influencing food waste occurrence. The higher frequency of food shopping was expected to lead into higher food being wasted due to its durability limit and too much cook servings [3]. The expired date might be forgotten as many foods were stacked even before consumed. Therefore, this research measured the food shopping frequency by asking the respondents on how often they buy “raw” food.

Additionally, the eating out frequency was also expected to be a predictor of food waste occurrence. As someone has less control over the amount and taste from the food they bought, the higher eating out frequency was expected to trigger more waste from edible food. This factor was measured by asking the respondents on how often they buy meal outside, such as in food stalls or restaurants. Then, those numbers were estimated into monthly frequencies.

H1: Gender is predictor of the avoidable food waste occurrence.
H2: Monthly living cost is predictor of the avoidable food waste occurrence.
H3: Food shopping frequency is predictor of the avoidable food waste occurrence.
H4: Eating out frequency is predictor of the avoidable food waste occurrence.

2.3. Statistical analysis
The data collected through questionnaire were analysed using Microsoft excel and SPSS software. Firstly, the food waste was quantified with Excel. Subsequently, using SPSS, logistic regression model was applied to determine factors influencing the avoidable food waste occurrence. Finally, descriptive statistics from SPSS was used to classify the food wasters.

3. Results and Discussion
3.1. Food waste quantification
The descriptive statistics show that the range of wasted food resulted from the respondents was 0 up to 420 g monthly, or 47.05 g per person on average. In other words, the sample provided evidence that the average of avoidable food waste resulted by Indonesian youngsters was 564.62 g per person yearly.

| Table 1. Quantification of avoidable food waste per month.  |
|-----------------------------|-----------------|-------|
| Food Waste Quantity per Month | Number of persons | %    |
| 0 g                         | 49              | 46.20 |
| 1 – 100 g                   | 34              | 32.00 |
| 101 – 200 g                 | 18              | 17.00 |
| 201 – 300 g                 | 3               | 2.80  |
| 301 – 400 g                 | 2               | 1.89  |

The data depicts that among 106 respondents, the number of non food waster and food waster was almost equal. In particular, almost a half of Indonesian undergraduate students did not waste the edible food since they fully consumed their meals. Perhaps this was caused by the cost living limitation and the need to fulfil higher energy from the food. For instance, the university students usually have certain amount of cost living, especially if they live separately from their family. In this case, they
would use the money allowance wisely for monthly living cost, including when spending it for food. Having this limitation, they tend to have more intention to finish their meals. Moreover, the youngsters are considered to be more active than the older ages, therefore, they have a higher need to fulfill energy required to do those activities.

On the other hand, there were 53.80% respondents produced up to 400 grams of food waste each month. The fact that more than a half of students were food waster could be a concern since any kinds of edible food waste are dissipating the farmer’s effort in producing raw food materials. Koivupuro et al. [10] and Gustavsson et al. [11] highlighted that when edible food is wasted, not only the energy and resources to produce the food were useless, but also the environment effects from food production and transformation were neglected.

3.2. Factors influencing the occurrence of avoidable food waste

The result of Hosmer and Lameshow test indicates that the logistic regression model fits the data (sig. 0.215). In addition, the Nagelkerke R Square shows that living cost, food shopping frequency, eating out frequency, and gender contributed as many as 18.7% in influencing the occurrence of avoidable food waste among Indonesian youngsters. Table 2 depicts that, among four predicted factors influencing the avoidable food waste existence, only two were found to be statistically significant. The two factors namely eating out frequency and gender, resulting 0.006 and 0.035 significant values, respectively. Meanwhile, the two other factors (living cost and food shopping frequency) were not predictors of avoidable food waste occurrence among the youngsters.

Table 2. Factors influencing the occurrence of avoidable food waste.

| Chi-square | df | Sig.  |
|------------|----|-------|
| 10.765     | 8  | 0.215 |

Table 3. Factors influencing the occurrence of avoidable food waste.

| -2 Log likelihood | Cox and Snell R Square | Nagelkerke R Square |
|-------------------|------------------------|----------------------|
| 130.011           | 0.140                  | 0.187                |

Table 4. Factors influencing the occurrence of avoidable food waste.

|                       | B   | S.E. | Wald | df  | Sig.  | Exp(B) | Lower       | Upper       |
|-----------------------|-----|------|------|-----|-------|--------|-------------|-------------|
| LivingCost            | .396| .269 | 2.162| 1   | .141  | 1.486  | .876        | 2.521       |
| FoodShopFreq          | .061| .077 | .632 | 1   | .427  | 1.063  | .914        | 1.236       |
| EatingOutFreq         | .022| .008 | 7.425| 1   | .006* | 1.023  | 1.006       | 1.039       |
| Gender                | -1.325| .629 | 4.435| 1   | .035* | .266   | .077        | .912        |
| Constant              | -.163| .939 | .030 | 1   | .862  | .850   |             |             |

Based on the statistical result, eating out frequency was strongly significant in influencing the occurrence of edible food being wasted. The higher eating out frequency, the more edible food was wasted by the youngsters. This was probably because most of respondents (85%) eating out on a regular bases, especially when they had activities on campus. When that happened, they could not freely control the food amount and taste from the food they bought. The data from questionnaire revealed that the main reasons why the youngsters wasted edible food were 38.60% due to the dissatisfaction with the food taste (although the meal was in the right portion) and 36.84% due to the excessive food portion given by the seller (or waiter/ waitress). Accordingly, the more avoidable food being wasted occurred.

The result also mentioned that gender was moderately significant as predictor of food waste occurrence. In line with this result, Kuivupuro et al. [3] stated that single woman was the one who wasted more edible food compared to other groups (single man, young households, and adult
households). Perhaps one of the main reasons was related to the high intensity of eating out, where woman often given the excessive food portion. Since the portion was usually much more than they could consume, the woman ended up wasting the avoidable food.

4. Conclusion
To underline, this research found that Indonesian youngsters produced 47.05 g of avoidable food waste per person each month (564.62 g each year). Moreover, eating out frequency and gender were proven to be predictors of food waste occurrence.

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