



Factor Affecting the Behaviour of the Households of Food Waste of Vegetables and Fruits in Sleman District, Yogyakarta, Indonesia

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Abstract. Food waste is bad behaviour that is throwing away food that is still fit for consumption. While the world is facing the problem of food safety and malnutrition, on the other hand, the food waste produced is increasing. Does this also happen with vegetables and fruit commodities in Indonesia? This study has two objectives: (1) To know the number of vegetables and fruits waste produced by households, (2) The effect of food waste management and other factors on vegetables and fruit waste behaviour by households. One hundred and fifty respondents who live in the Sleman district, Yogyakarta have been interviewed. The amount of food waste produced by a household is measured by estimating the amount of vegetable and fruit leftovers produced. The statistical method uses Structural Equation Modeling (SEM) to analyse the factors that influenced household behaviour towards fruit and vegetable food waste. The results of the study showed the quantity of vegetables is 4,9 kg per household/week and fruits food waste is 10,7 kg per household/week. Food management factors such as planning habits and storage management have a 49,5% correlation to increased perceived behavioural control. Perceived behavioural control, intention, and religious knowledge are factors that could reduce food waste behaviour.

Keywords: Vegetable waste · Fruits waste · Food waste quantity · Food management

1 Introduction

Food waste is one of the important problems considering the problem of malnutrition that affects about one billion people worldwide, while there is an increasing amount of food waste [1]. Hunger and malnutrition are some of the food problems that can be related to food waste. Hunger and malnutrition are caused by poverty and difficult access to food. While many of the world's people are starving due to difficulty in accessing food, on the other hand, a lot of food has been wasted. The wasted food occurred, among others, because the purchased food did not have time to be consumed or passed the expired limit. Food that should be consumed eventually becomes piled up and becomes unfit for consumption. If proper food is not purchased excessively, food waste behaviour can be

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A. G. Abdullah et al. (Eds.): SEAVEG 2021, ABSR 23, pp. 247–257, 2023.

https://doi.org/10.2991/978-94-6463-028-2_27

reduced so that it can reduce the amount of food waste produced. The amount of food that does not become food waste when it is still fit for consumption can overcome the problems of hunger and malnutrition that occur in the world.

Food waste is one of the most important problems today. Every year the need for food increases along with the increase in the human population. Meanwhile, when food demand increases, the behaviour of food waste reduces the availability of food needed by the community [2]. The behaviour of food waste indirectly affects the supply chain. Food waste can affect the supply chain because the behaviour of food waste can reduce the availability of food in the market. The reduced availability of food in the market can cause food prices to increase. If food prices increase, it will cause low-income consumers to find it difficult to obtain food. Reducing food waste behaviour is an opportunity to reduce hunger, optimize the use of natural resources, and indirectly affect finances by saving household expenses [3].

Food waste is food residue that occurs at the end of the food chain related to retail and consumer behaviour [4]. Based on this definition, FAO concludes that food waste is the behaviour of food waste that occurs at the final stage of the supply chain, namely at the distribution and consumption stages [5]. To reduce the amount of food waste produced by the community, to reduce bad behaviour, it should start from reducing food waste in the household. Why is reducing food waste in the household so important? This is because as much as 61% of the food waste produced comes from the final consumption stage, namely consumers and households [6].

Food waste index report 2021 concludes that food waste generated in households produces a higher quantity when compared to food service and retail. Indonesia produces food waste of 77 kg/capita/year. When compared to several countries in Southeast Asia, Indonesia is in the category of Medium confidence along with Malaysia and Vietnam. Even though it is a country with Medium confidence in reducing food waste, in terms of the total amount of food waste produced, Indonesia is the largest producer of food waste in Southeast Asia with a total of 20 million tons/year [6].

This study aims to measure the amount of vegetable and fruit food waste produced by households in the Sleman district and to find out what factors influence food waste behaviour that occurs in households. Factors thought to be influential include Food management which consists of shopping planning, Storage Management, Consumption management, and consumption behaviour. This research is expected to provide an overview of food waste produced by households and find out what factors correlate to reducing food waste behaviour in households.

2 Methods

The research location was chosen purposively with housewives as respondents who live in Sleman, Regency, Yogyakarta. Considerations in the selection of research sites are based on the amount of waste generated in the Special Region of Yogyakarta. Where based on data from information on regional environmental management performance in 2019, Sleman Regency is the area with the largest waste generation in the province of the Special Region of Yogyakarta.

The sampling technique used to determine the respondents in this study is a purposive sampling technique. Purposive sampling is the selection of respondents intentionally to

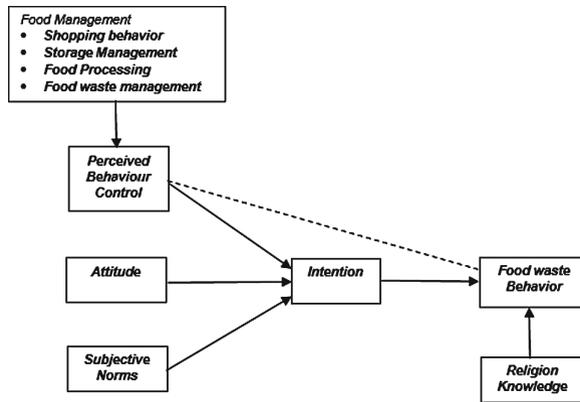


Fig. 1. Framework of factors that influence food waste behaviour.

obtain the information needed based on the experience and knowledge of the respondents [7]. The criteria for selecting respondents in this study were respondents who worked as housewives who were responsible for food management in the household. In this study, the respondents will be asked questions about the number of vegetables and fruits that have been consumed in the last week. The number of vegetables and fruits that have been consumed will be calculated as the average amount of vegetables and fruit consumed, then the average number of household consumption in one year will be calculated.

The quantity of food waste produced by households in this study was measured using an estimation method [8]. The respondents estimate the number of vegetables and fruits consumed in the last week, then estimate the amount of food waste produced by calculating the percentage of vegetables and fruits consumed.

The model used in this study is based on the Theory of Planned Behaviour [9]. Factors that correlate with food waste behaviour include perceived behaviour control, subjective norms, and attitude. These three factors are related to the intention to reduce food waste. From this intention factor, we can see how it relates to the behaviour of food waste of vegetables and fruits in the household (Fig. 1).

In this study, to measure food waste behaviour, the theory of planned behaviour and food management components will be combined. Food management variables used in this research include planning behaviour, storage management, food processing, and food waste management [10, 11]. These four variables will affect the perceived behavioural control, so the better food management is carried out, the stronger the perceived behavioural control to reduce food waste behaviour.

This study uses the PLS-SEM method to analyse the factors that are thought to be related to food waste behaviour as shown in Table 1. The reason for using PLS-SEM in this study is because using this method can form a model based on the researchers' comprehensive reasoning. The most frequently cited reason for using PLS-SEM is that the model form can be measured with a small number of samples [12].

3 Results and Discussion

3.1 The Quantity of Food Waste in the Household

In this study, the amount of vegetable and fruit food waste produced by households in Sleman district, Yogyakarta has been calculated. Data were obtained based on interviews with 150 housewives in the Sleman district. To measure the amount of vegetable and fruit food waste produced by households, the method used is to estimate the number of vegetables and fruit consumed in one week. The amount of consumption that has been calculated will be divided based on the types of vegetables and fruit consumed, then the resulting food waste is calculated by percentage to make it easier for respondents to answer questions in the questionnaire. In this case, if there is food waste that is processed and used as animal feed, it will not be counted because the food is not wasted. The calculation of the amount of food waste produced by households in the Sleman district in one year can be seen in Tables 1 and 2.

Based on the results of data collection on the consumption of vegetables and fruits in households in Sleman Regency, Yogyakarta, there are some vegetables and fruits that are wasted during the consumption process. Vegetables that are produced by households in Sleman district, Yogyakarta include spinach, mustard greens, kale, beans, cabbage, broccoli, and carrots. According to the respondents, two main factors cause the vegetables consumed to be wasted.

The first cause is unplanned shopping habits. Shopping habits such as making shopping records are very rarely done, causing the number of vegetables spent to exceed the number of vegetables consumed. The excessive number of vegetables makes the stock of vegetables at home abundant but in the end, if the vegetables purchased do not have a long shelf life, the vegetables become rotten so they cannot be consumed.

The second reason is that vegetables that become leftovers occur due to cooking too many vegetables so that the remaining vegetables become stale, but this only happened to a small number of respondents. Most of the other respondents based on interviews were able to reprocess vegetables that were overcooked by reheating or being used as ingredients for other recipes, and if the household had livestock, the remaining vegetables would be used as livestock feed.

Table 1. Quantity of vegetable food waste produced by households

Vegetables	Quantity Household/year (Kg)
Spinach	1.02
Mustard greens	1.04
Water Spinach	0.54
Green Bean	0.64
Cabbage	0.65
Broccoli	0.50
Carrot	0.59
Total	4.98

Table 2. Quantity of fruits food waste produced by households

Fruits	Quantity Household/Year (Kg)
Banana	3.59
Apple	1.80
Orange	1.92
Mango	0.91
Papaya	1.94
Watermelon	0.62
Total	10.77

Based on Table 2, it can be seen that the most wasted vegetable when consumed is Mustard greens with a quantity of 1,040.5 g per Household/year. Based on the data in Table 2, the average amount of vegetables wasted is 4.98 kg per household/year. If we compare it with the quantity of fruit wasted, it can be seen that the number of vegetables wasted is much less than the amount of fruit that was wasted.

Based on Table 3, it can be seen that bananas and oranges are the most wasted types of fruits in the household. Based on the data collected, the results show that the average amount of food waste produced by each household in the Sleman Regency is 10.77 kg/year.

Wasted fruits produced by households in Sleman district, Yogyakarta based on interviews with respondents include bananas, apples, oranges, mangoes, papayas, and watermelons. The main reason why these fruits become food waste, in general, is similar to the cause of vegetables being wasted in the previous discussion, namely the shopping for fruits that exceeds household needs. This happens due to bad shopping habits and not under what was planned. There are often discounts in several shopping places that provide fruit, often giving discounts to spend their stock of fruit, and based on interviews with respondents this also triggers them to shop for fruits more than what is needed. Indirectly shopping outside the plan or need results in excess stock of fruits at home, which results if not stored properly then the fruits will become rotten and unfit for consumption.

3.2 Factors Affecting the Household Food Waste of Vegetables and Fruits

This research aims to find out what factors correlate with an effort to reduce food behaviour in households in Sleman district, Yogyakarta, Indonesia. Respondents in this study amounted to 150 people who work as housewives. The method of data collection is by conducting interviews with housewives in the Sleman district related to daily habits related to consumer behaviour.

The variable model is based on several previous studies by modifying the basic model of the theory of planned behaviour [9]. The difference in this study is the inclusion of food management elements contained in the guidelines for measuring food waste in the household [10] and related research on how to avoid wasting food [11]. Food management variables are arranged based on daily consumption behaviour in the household

which is then adjusted to several household consumption behaviours in Indonesia. The variables used in this study include food management which consists of shopping habits, storage management, food processing, and food waste management. The variables from food management will affect the perceived behavioural control. Other variables that are thought to have an effect include attitude, subjective norms, religious knowledge, and intention.

Attitude is a variable that will represent how a person's attitude towards food waste behaviour is. An example of an attitude that will be assessed is guilt if the respondent throws away leftover food that is still fit for consumption or is stored for later consumption. The purpose of using this variable is to see the attitude of the respondents in responding to food waste behaviour that occurs in the household. The better the family in responding to food waste problems, the stronger the intention to reduce food waste behaviour in the household.

Subjective Norms will describe how the prevailing values in society are related to food waste behaviour. Subjective Norms will be assessed on how food waste behaves when viewed from the point of view of family, friends, and the prevailing culture in the respondent's environment. If the respondents hold fast to the values that apply in society that food waste behaviour is bad behaviour and try to reduce food waste behaviour then this will increase the intention to reduce food waste behaviour.

Perceived Behavioural control is a variable that will indicate a person's level of difficulty in controlling behaviour. The easier it is perceived behavioural control for a person, eating will increase a person's intention to reduce food waste behaviour. Besides being able to influence intentions, perceived behavioural control is also able to influence food waste behaviour directly. If perceived behavioural control can make it easier for someone to control food waste behaviour, then food waste behaviour will tend to decrease.

In this study, to measure food waste behaviour, the theory of planned behaviour and food management components will be combined. Food management variables used in this research include planning behaviour, storage management, food processing, and food waste management [10, 11]. These four variables will affect the perceived behavioural control, so the better food management is carried out, the stronger the perceived behavioural control to reduce food waste behaviour.

Shopping behaviour will show how respondents plan on supplies and behaviour when shopping for food. One example of the application of planning behaviour is making shopping records to avoid impulsive buying behaviour or buying food more than what is needed in the household [10–12].

Storage management is an effort made by respondents to manage food supplies and maintain food conditions so that they last longer. The importance of storage management is to prevent food supplies from becoming rotten or expired which causes food to become unfit for consumption and eventually wasted [10, 11].

Food Processing is an effort made by the respondents how to process vegetables and fruit so that they are processed according to family needs. Taking into account the amount of food that will be served will reduce the risk of throwing away food that is still fit for consumption [10, 11].

Food waste management is a variable that will describe how the respondents will treat the vegetables and fruit left in the family. The behaviour that will be carried out

Table 3. Internal consistency reliability evaluation results

Variables	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
Attitude	0.945	0.965	0.902
Food Processing	0.765	0.894	0.808
Food Waste Behaviour	0.926	0.944	0.770
Intention	0.920	0.949	0.862
Food waste management	0.868	0.919	0.791
Storage Management	0.912	0.945	0.851
Perceived Behavioural Control	0.889	0.931	0.818
Shopping Behaviour	0.909	0.936	0.785
Religion Knowledge	0.976	0.985	0.955
Subjective Norm	0.874	0.922	0.797

is if there are vegetables and fruit left, then the vegetables and fruit will be stored to be processed again for later consumption or will throw the food away. If someone often throws away food that is still fit for consumption, it will reduce the effect of perceived behavioural control to reduce food waste behaviour in the household.

Religious Knowledge is a variable that is used to determine the extent to which beliefs and values in religious teachings influence a person's food waste behaviour. Various religious teachings certainly teach how valuable the food that a person gets, or it can be said that food is a blessing given by God to humans in life. Several previous studies have proven that religious knowledge is a powerful campaign in reducing food waste behaviour [13, 14].

In determining whether the model is valid or not, the model is tested using the internal consistency reliability evaluation method which is known based on the composite reliability value, and the evaluation of convergent validity is known by looking at the average variance extract (AVE) value. To meet the requirements as a good construct model, the composite reliability value according to the rule of thumb is >0.70 . The evaluation of convergent validity meets the requirements if the average variance extract (AVE) value is >0.50 . The results of the analysis of the variables in this study can be seen in Table 3.

Based on the results of the evaluation using the internal consistency reliability method, from Table 4 that the variables used in this study meet the criteria where the composite reliability value is >0.7 [15, 16]. The next model evaluation is to measure convergent validity based on average variance extracted (AVE).

The next model evaluation is to measure convergent validity based on average variance extracted (AVE). Based on the results of calculations with Smart-PLS, it can be seen in Table 5 the variables contained in the model meet the requirements to be said to be valid, namely, AVE must have a value >0.50 [16].

Table 4. Convergent validity evaluation results

	Average Variance Extracted (AVE)
Attitude	0,738
Consumption Behaviour	0,651
Consumption Management	0,652
Food waste behaviour	0,745
Intention	0,869
Perceived behaviour control	0,822
Shopping behaviour	0,883
Religion Knowledge	0,817
Storage Management	0,790
Subjective Norms	0,767

Table 5. Food waste variable model with PLS-SEM

	Real Samples (O)	T Statistics	P Values
Attitude - > Intention	0.368	2.888	0.004 ^{***}
Food Processing - > Perceived Behavioural Control	0.053	0.648	0.517 ^{ns}
Intention - > Food Waste Behaviour	-0.249	2.870	0.004 ^{***}
Food waste management - > Perceived Behavioural Control	0.015	0.156	0.876 ^{ns}
Storage management - > Perceived Behavioural Control	0.507	7.574	0.000 ^{***}
Perceived Behavioural Control - > Food Waste Behaviour	-0.250	2.768	0.006 ^{***}
Perceived Behavioural Control - > Intention	0.315	2.989	0.003 ^{***}
Shopping behaviour- > Perceived Behavioural Control	0.221	2.633	0.009 ^{***}
Religious Knowledge - > Food Waste Behaviour	-0.250	3.120	0.002 ^{***}
Subjective Norm - > Intention	0.140	1.146	0.252 ^{ns}

*** = Significant at 1% error rate; ** = Significant at 5% error rate; * = Significant at 10% error rate; ns = Not Significant

Table 6. R square analysis of factors affecting food waste behaviour

	R Square	R Square Adjusted
Food waste behaviour	0,417	0,405
Intention	0,508	0,497
Perceived behaviour control	0,495	0,481

Table 6 shows the results of the analysis using the Partial Least Square method to test the model that has been compiled to see the factors that influence food waste behaviour. Based on the results in Table 6, it can be seen that shopping behaviour and storage management factors can increase perceived behavioural control to reduce food waste behaviour.

In the model compiled in this study, the Intention factor which aims to reduce food waste behaviour is influenced by the Attitude, Subjective norms, and perceived behavioural control variables. The results of the analysis that have been carried out show that the attitude and perceived behavioural control variables can strengthen the intention to reduce food waste behaviour.

In this research model, the factors that are thought to influence the behaviour of food waste are Intention, Religious Knowledge, and Perceive Behavioural Control. The calculation results in Table 6 show that these three factors have a negative effect on food waste behaviour. The negative coefficient value means that if these three factors continue to be improved, they will be able to reduce food waste behaviour in the community.

Based on the results of the analysis shown in Table 6, it can be seen that the factors in food management, namely Planning behaviour and Storage Management, can affect the perceived behavioural control by 48.1%. The results of the analysis of the model of the factors that influence the behaviour of wasting food in households in the Sleman Regency, Yogyakarta show the relationship between Intention, Religious knowledge, and perceived behavioural control with religious knowledge has a moderate relationship, namely 40.5%.

4 Conclusion

Overall from the results of this study, it can be concluded that the relationship between food-management variables consisting of planning behaviour and storage management can affect perceived behavioural control by 48.1%. This shows the need for behavioural improvement in terms of shopping planning and good food storage management in the household. Based on the results of interviews conducted with respondents in this study, there are still many households that do not plan when shopping for food which results in bad shopping habits. Shopping for food in excess has a risk, namely excess when buying groceries that are already available at home. The importance of changing shopping habits is one way to prevent unnecessary grocery shopping (impulsive buying) which can increase the possibility that food can be purchased in excess and wasted [10–12].

The results of interviews conducted by researchers with respondents also show the importance of recording spending. Regarding the amount of leftover food produced by households in Sleman Regency, the data shows that most households that do not keep a shopping record produce more vegetable and fruit leftovers when compared to households that have a habit of making food scraps shopping records. Excessive buying of groceries is also related to how food can be wasted. One of the foodstuffs that are prone to waste, if not stored properly is vegetables and fruit. Based on the results of interviews with respondents, it was found that there was a lot of food waste produced because the fruit was stored for too long. The fruit that is stored for too long is finally wasted because it does not have time to be consumed. From the results of data analysis, it is necessary to improve the behaviour of Planning Behaviour and Storage management to improve Perceived Behavioural Control. So that the final result is expected by planning and storing vegetables and fruits properly, it will reduce food waste generated by households.

In general, the results of this study indicate that food waste behaviour can be reduced. Factors that have a significant influence include Intention, Religious Knowledge, and Perceived behavioural control. By increasing the intention to minimize food waste, it can play an important role in reducing the resulting food waste. Religious knowledge has an important role in reducing food waste behaviour. This is supported by Abdelradi's research which states that religious knowledge is one of the best forms of campaigns in increasing environmental awareness caused by food waste behaviour [14]. Lastly, by increasing the perceived behavioural control through good food management in the household, it is expected to be able to reduce behaviour and the resulting food waste.

Acknowledgment. The researcher would like to thank the agriculture faculty of Gadjah Mada University and the Ministry of Research Technology and Higher Education for the facilities and financial assistance provided.

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