Assessing the Determinants of Food Waste Behavior: Evidence from Consumers of "Waroeng Special Sambal," Malang, East Java, Indonesia

Nur Anniyyah[1], Widayat[2], Sri Nastiti Andharini[3]

widayat@umm.ac.id[2]

[1,2,3]Universitas Muhammadiyah Malang, Malang City, East Java, Indonesia

Corresponding Author: Widayat

Abstract. A fascinating issue in the perspective of sustainability is food loss and waste. Therefore, there is a pressing need for research on behavior related to food loss and waste. This study aims to identify the determinants of food waste behaviors and investigate how attitude, subjective norms, routines, and price awareness influence food waste behavior. From the "Waroeng Special Sambal" sample, 135 respondents were selected for this study. The sample was collected using an incidental sampling technique. Data were obtained through questionnaires, which were then tested for validity and reliability. Data was analyzed using the range scale and SEM-PLS. Subjective norms and habits do not have a statistically significant effect on food waste behavior, whereas attitude and price awareness do.

Keywords: Attitude, Subjective Norms, Habits, Price Awareness, Food Waste Behavior.

1. Introduction

The Food and Agriculture Organization (FAO) reports that about one-third of all food produced (1.3 billion tonnes of food) for human consumption is lost and wasted annually across the supply chain. Food loss and waste's significant impact has increased interest in prevention programs worldwide [1]. Food waste has long been a global issue and is increasingly becoming a serious concern[2]. Food waste is becoming an epidemic all over the world. So, in recent years, food waste has received more and more attention from local, national, and European policymakers [3]. This challenge has become a significant global concern. Food waste affects food availability and poses environmental risks, such as unpleasant odors and disease transmission [4].

Indonesia ranks second in the world in the amount of food waste in the large category, reaching 300 kg per person yearly [5]. These results are supported by data from the National Waste Management Information System (SIPSN) of the Ministry of Environment and Forestry [6]. The most extensive waste composition in Indonesia in 2022 is food waste, which reaches 40.64%. Data from FAOSTAT shows that 40% of the total food waste is generated at the consumption level [7]. This situation is concerning because it reflects inefficiency—while food is abundant, many people still experience food insecurity, indicating wasteful consumption

behavior [8]. Thus, some researchers contend that in order to reduce food waste at the consumer level, it is crucial to comprehend consumer food waste behavior [9]. and [10].

According to FAO [11], food is wasted because it cannot be consumed or because of negligence in the production, processing, and distribution processes. Food waste refers to any food thrown away, even though it is still fit for human consumption, whether stored beyond the expiration date or spoiled [12]. In addition, according to BFCN, several factors cause food waste, including excessive buying, preparing excessive portions, difficulties in understanding labels, and errors that occur during storage. [13] mentioned that poor food storage facilities also trigger food waste.

Irresponsible consumer behavior is one of the main drivers of food waste in a restaurant [14]. Consumers are considered the largest contributors to food waste (Aktas et. al, 2018 [9]. Food waste formed at the consumption stage significantly impacts the economy, society, and environment. This is due to the loss of added value from the food itself, the opportunity cost of not feeding people who are hungry, and the wasteful loss of natural resources, biodiversity, labor, and energy [9]. This often occurs when consumers lose interest in certain products, leading to an accumulation of unused ingredients [15]. Efforts to manage the accumulation of goods are significant in maintaining a balance between supply and demand and ensuring consumer satisfaction.

Whether intentional or unintentional, food disposal occurs from the production stage to consumption, resulting in never-wholly lost waste. The low public understanding of food waste exacerbates the significant environmental impact of this problem. Even though people know the effect, they still throw away food, especially vegetables and rice [16]. Using restaurant food waste as animal feed can divert it from landfills while providing nutrients for livestock. Composting can also enrich the soil and help maintain groundwater levels. [17]. Despite these efforts, food waste persists at the final stage of the food chain [18].

Understanding consumer behavior that throws away food waste is becoming increasingly important, given its adverse impact on the sustainability of life [19]. Foodservice places such as cafes, hotels, or private companies that offer buffet-style food result in the most food waste [20]. Most restaurant food waste comes from customers' plates, which highlights changes in consumer behavior as an essential mitigation opportunity [21]. Understanding the motives of food selection that affect food consumption habits is very important because habits are integral in explaining food disposal behavior [22]. Taste preferences, the tendency to choose excessive foods, and the perception of portion sizes can influence consumers' food decisions.

Restaurants have different types of service (e.g., fine dining, casual, quick service, takeout, buffet, and all-you-can-eat), and the amount of leftovers generated from each activity is often considered disposable [23]. Consumer behavior is identified as an essential determinant of restaurant food waste [24]. For example, customers ordering more food than they can eat [25]

and leaving food on their plates [26] are food sources that affect waste. Studies have also found that food waste can be influenced by emotional and affective factors [22]. In addition, there are also external factors that affect food waste behavior, such as culture and social norms [27]. However, external and internal factors will be dynamically interrelated with a person's food waste behavior. To reduce food waste, we need to understand the aspects related to the behavior of food waste itself [9].

Given the high levels of food waste in Indonesia and limited related research, public awareness of food waste and its impacts remains low. Previous studies have focused more on consumer eating behavior as a contributor to food waste in the restaurant sector. Therefore, the researcher wants to research the factors that affect food waste behavior in Waroeng Special Sambal Consumers.

2. Literature Review

Food waste involves food that is wasted before reaching the end of its life cycle, either because it is not consumed or discarded. Individual attitudes have been shown to influence their intentions regarding specific behaviors, including in the context of food waste [28]. Subjective norms, which are individuals' perceptions of the extent to which others approve or disagree with certain behaviors, also play an essential role in individual decision-making regarding *food waste*. This can be influenced by people who consider it necessary in an individual's life. Habits also influence food waste behavior, as discarding food often occurs automatically and repeatedly without conscious awareness. In addition, economic factors can also affect behavior related to *food waste*. Price-conscious consumers tend to avoid wasting food because they recognize that doing so leads to unnecessary financial loss [29].

Hypothesis

Base on figure 1. the hypothesis of this research determine as follow

H1: Attitude has a significant effect on food waste behavior
H2: Subjective norms do not have a substantial impact on food waste behavior
H3: Habits do not have a significant effect on food waste behavior
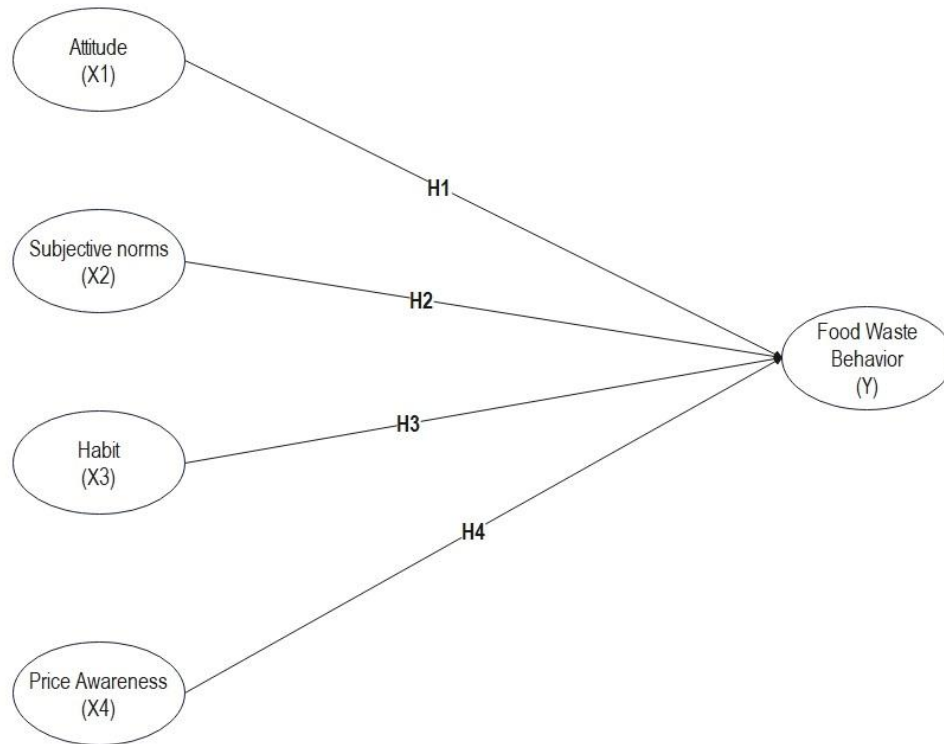H4: Price awareness has a significant effect on food waste behavior

Figure 1. Research Framework

3. Research Methods

In this study, a quantitative survey approach was used to collect data from adolescent customers with an age range of 15 to 25 years. Primary data were collected using a closed-ended questionnaire with a five-point Likert scale (Strongly Agree to Strongly Disagree). Respondents were selected through purposive sampling. The sample size was determined using Ferdinand's formula, based on the number of indicators in the study. The measurement uses Partial Least Squares - Structural Equation Modeling (PLS - SEM) using Smart - PLS 4.0 software. The significance of the correlation between the variables in the structural model (inner model) was tested by comparing the T-statistical values. If the T-statistical value is greater than or equal to 1.96 (>1.96), the relationship of the variable is declared significant.

4. Model Evaluation and Discussion

Based on the data collected, the respondents' characteristics include gender, age, occupation, and monthly income from the gender aspect. Most respondents were female (50.4%), while males accounted for 49.6%. This shows that compared to men, more women visit the special

chili sauce Waroeng more often. The restaurant is popular because it offers a wide variety of chili sauces and practical dining options compared to other restaurants. Meanwhile, in terms of age, most of the respondents (as many as 59.3%) are in the age group of 15-25 years. Only a tiny percentage are outside of that age group. Psychologically, it is suitable for the tastes of young consumers because consumers in this age range are more likely to like food with spicy categories and menu choices that vary in taste.

Furthermore, 64 respondents (47.4%) were students, representing the largest occupational group among participants. This data is supported by the number of students in the city of Malang who are pursuing education; they are more likely to visit food stalls compared to cooking or eating at their respective boarding houses. Finally, from respondents with an income of Rp 1,000,000 - < 2,000,000, there were 43 people with a percentage of 31.9%. The data shows that this special chili sauce waroeng has very affordable food prices and can be enjoyed by all groups.

Model Evaluation

This study tests the latent variable relationship model (attitude, subjective norms, habits, and price awareness). Measurement models need to be assessed for the reliability and validity of each latent variable. Validity can be evaluated using convergent validity, which describes the confidence level in each indicator's measurement goodness. In addition, the model needs to be assessed using discriminatory validity, which describes differences or discrepancies between indicators in latent variables. The convergence validity was evaluated by Average Variance Extracted (AVE) and Composite Reliability (CR). AVE measures the degree of variation in construction compared to the rate of measurement errors. An AVE value above 0.70 indicates an excellent measurement, and an acceptable AVE value is at least 0.50. CR is a measure of reliability lower than the Cronbach's alpha, which is an acceptable CR value of at least 0.70.

Table 1 shows the AVE, CR, Rho-A, and Cronbach's alpha for the latent variables (attitude, subjective norms, price habits, and awareness). All latent variables were found to be constructively valid according to Cronbach's alpha, Rho-A, and composite reliability showed values, with values above the critical value (0.70), even though Cronbach's alpha and composite reliability that there were four variables below 0.70, namely attitude with Cronbach's alpha (0.608) and composite reliability (Rho-A) (0.632) and subjective norm with Cronbach's alpha (0.652) and composite reliability (0.657). Likewise, all latent variables are greater than 0.50 with the AVE value.

In addition, the validity of discrimination was also measured using Fornell - Larcker. Many authors have suggested that the construction of latent variables is valid if the Fornell Larcker value is above 0.70. Fornell-Larcker's value indicates that the variable is valid. Table 3 shows that the Fornell-Larcker value of (attitude, subjective norms, price awareness, and food waste behavior) is above 0.70, while the other is the highest habit with a value of 0.904.

Table 1 Composite Reliability

Variable	*Cronbach's Alpha*	*(Rho_A)*	*Composite Reliability (Rho_C)*	*Bird*
Attitude	0.608	0.631	0.782	0.545
Food waste behavior	0.854	0.856	0.895	0.631
Habit	0.889	0.906	0.931	0.818
Price awareness	0.840	0.850	0.887	0.610
Subjective norms	0.652	0.657	0.811	0.589

Table 2 Discriminant Validity (Fornell - Larcker)

Variable	Attitude	Food waste behavior	Habit	Price Awareness	Subjective Norm
Attitude (X1)	**0.738**				
Food Waste Behavior (Y)	0.579	**0.795**			
Habit (X3)	0.398	0.408	**0.904**		
Price Awareness (X4)	0.578	0.670	0.691	**0.781**	
Subjective Norm (X2)	0.548	0.526	0.497	0.639	**0.767**

Cross-loading is used to detect the validity of discrimination. Based on the testing and data processing results, both indicators have a higher correlation with themselves than other with variables. Table 3 shows the cross-loading values. All of the indicators used latent variable indicators in the cross-loading model; the value of each indicator was more significant than the latent variable itself (the number in bold) compared to the other variable (smaller and not in bold). For example, in the first row, A1 is an indicator that measures the attitude variable, and the one written in the second column is 0.709, which is greater than the values in the other columns (0.499, 0.333, 0.423, and 0.410). This shows that A1 is a valid indicator of attitude variables compared to its effectiveness as a measure of other variables. For indicators of other variables, the value is greater than the variable itself compared to other variables. It also shows that the indicator that measures the latent variable is valid.

Table 3. Cross - Loading Test Results

Variable	AT	FWB	K	KH	NS
A1	**0.709**	0.338	0.355	0.451	0.463
A2	**0.709**	0.335	0.261	0.351	0.345
A3	**0.794**	0.551	0.284	0.470	0.416
FWB1	0.499	**0.780**	0.346	0.495	0.485
FWB2	0.462	**0.807**	0.266	0.430	0.421

Variable	AT	FWB	K	KH	NS
FWB3	0.490	**0.841**	0.320	0.555	0.362
FWB4	0.438	**0.801**	0.343	0.617	0.433
FWB5	0.413	**0.740**	0.339	0.544	0.389
K1	0.333	0.382	**0.888**	0.601	0.522
K2	0.403	0.407	**0.950**	0.680	0.443
K3	0.339	0.308	**0.873**	0.587	0.372
KH1	0.423	0.461	0.750	**0.745**	0.427
KH2	0.406	0.493	0.582	**0.790**	0.479
KH4	0.454	0.582	0.393	**0.804**	0.553
KH5	0.542	0.599	0.558	**0.826**	0.520
KH8	0.419	0.457	0.457	**0.737**	0.509
NS1	0.410	0.356	0.291	0.457	**0.737**
NS4	0.443	0.439	0.433	0.483	**0.793**
NS5	0.408	0.409	0.407	0.531	**0.770**

The R-Square table is used to determine the structural model's predictions. R-squared describes the influence of certain exogenous latent variables on endogenous latent variables. The R-square can be strong with a value of 0.67, moderate with a value of 0.33, and weak with a value of 0.19. It shows that the independent variable affecting the bound variable (food waste behavior) interprets the R-Square value in the moderate category (0.515).

Table 4. R-Square Value

Variable	R-Square	R-Square Adjusted
FWB (Y)	0.515	0.500

Table 4 shows that all latent variable constructs are valid, as their T-statistic values exceed the critical threshold of 1.96. In the structural model (Table 5) describing the relationship pathways between latent variables, the T-statistical values of 3.677 and 4.692 were more significant than the T-critical (1.96) at a significance of 5%, except for the subjective norms and habits of the pathway to food waste behavior, whose T-statistics were only 1.459 and 1.161, significant at the 10% level. The coefficients of all paths in the inner model (original sample) range from 0.262 to 0.096. Standard deviation from 0.071 to 0.083. This coefficient shows the magnitude of the influence of the latent variable on other latent variables. All coefficients are marked positively, meaning the variables' relationship is unidirectional. If the independent latent variable changes, then the dependent latent variable also changes to increase. For example, the coefficient of attitude pathways to food waste behavior is 0.262, reflecting the magnitude of change that will occur if the attitude changes. The interpretation of the meaning of variable change depends on the measurement and scale used. Not all changes can be interpreted quantitatively.
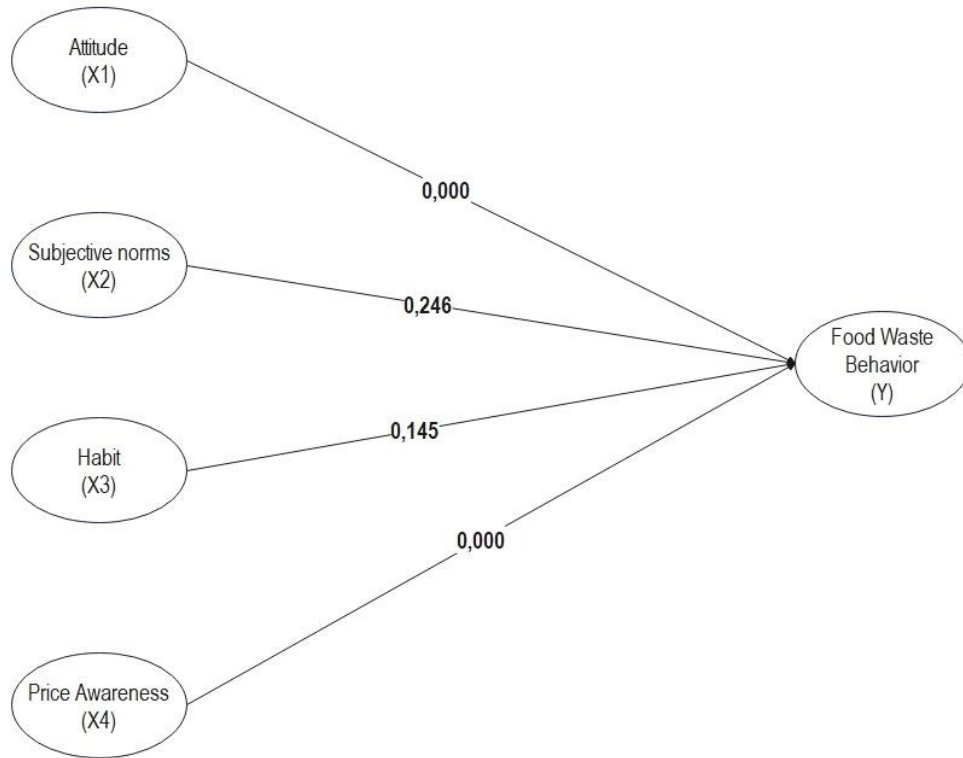
Figure 2. Results of Bootstrapping Hypothesis Testing

Table 5. Path Coefficient Hypothesis Testing

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P-Values
Attitude → Food Waste Behavior	0.262	0.268	0.071	3.677	0.000
Habit → Food Waste Behavior	-0.114	-0.110	0.078	1.459	0.072
Price Awareness → Food Waste Behavior	0.536	0.536	0.114	4.692	0.000
Subjective Norms → Food Waste Behavior	0.096	0.099	0.083	1.161	0.123

This study aimed to test the relationship model among the latent variables (attitude, subjective norms, habits, and price awareness) influencing food waste behavior. These variables were derived from the SDG framework, with each factor measured by valid indicators. The results of data analysis show that the behavior of food waste carried out by consumers is significantly predicted by attitudes towards food waste. These results support previous research applied in a variety of contexts. For example, in the case of a food stall, it was stated that food waste behavior

is influenced by a person's attitude towards the food they choose in the context of consumers who often value food, tend to have an attitude of not doing food waste.

More specifically, price awareness, subjective norms, and habits can also play a role in influencing consumer food waste behavior. The results of the analysis show that consumers who have a high price awareness tend to pay more attention to the value of the food they buy, so they are more careful in avoiding waste. In addition, subjective norms, namely individuals' views on food waste behavior that are influenced by social influences from the group or the surrounding environment, are also important factors. Likewise, habits where consumers who are used to minimizing food waste tend to have wiser behavior in managing food waste. Through this study, it can be strengthened that factors play an essential role in shaping consumer behavior related to food waste, and the use of the TPB model provides a better understanding of these behavioral dynamics.

The analysis based on the available data showed statistically significant results, showing that consumers positively influenced their behavior toward food waste. The significance of these findings supports previous research that applies the overall SDGs in the context of food waste behavior. Price awareness is an additional variable consider to determine whether these factors can affect food waste behavior. Attitudes, subjective norms, and habits are taken from the SDGs' framework to explain behavior. As an explanation, the formation of attitudes is influenced by external factors, namely, external factors towards the perpetrator. In this study, the attitude being optimized is influenced by attitude. The SDG framework is more geared towards behavior control. The analysis shows that the TPB framework dominantly assists food waste behavior in a special chili sauce waroeng.

5. Conclusions

A study on food waste behavior in Waroeng Special Sambal revealed essential findings related to the Theory of Planned Behavior (TPB). The study results show that consumer attitudes toward food waste reduction play a crucial role in shaping behavior. Positive attitudes toward environmental awareness and concern for food waste significantly influence the likelihood of responsible consumption behavior. However, the findings suggest that factors such as subjective norms and habits do not significantly impact food waste behavior in the stalls, highlighting the role of attitude as a substantial factor in the SDGs.

In addition, price awareness was also identified as an essential factor in reducing food waste behavior in Waroeng Special Sambal. More price-conscious consumers tend to be more cautious in purchasing and consuming food, reducing waste. In the framework of the SDGs, price awareness shows that economic factors can be a vital consideration in forming consumer attitudes and intentions towards food waste. Thus, understanding these variables can help Waroeng owners and related parties to design more effective strategies for reducing food waste,

in line with the principles of SDGs that emphasize the critical role of attitudes, subjective norms, and behavioral control in shaping individual intentions and behaviors.

References

[1]   R. Ishangulyyev, S. Kim, and S. H. Lee, "Understanding food loss and waste-why are we losing and wasting food?" *Foods*, vol. 8, no. 8, 2019, doi: 10.3390/foods8080297.

[2]   A. Maria and S. Asih, "Perilaku Individu terhadap Food Waste di Indonesia," vol. 151, pp. 1–10, 2020.

[3]   K. Schanes, K. Dobernig, and B. Gözet, "Food waste matters - A systematic review of household food waste practices and their policy implications," *J. Clean. Prod.*, vol. 182, pp. 978–991, 2018, doi: 10.1016/j.jclepro.2018.02.030.

[4]   S. Muhammad, F. Levi, and A. Suharyani, "Analisis Pangan Terbuang (Food Waste) Di Pasar Modern Kota Pontianak (Studi Kasus : Hypermart Ayani Megamall Pontianak) Analysis," vol. 25, no. 1, pp. 50–58, 2023.

[5]   H. Siaputra, N. Christianti, and G. Amanda, "Analisa Implementasi Food Waste Management Di Restoran 'X' Surabaya," *J. Manaj. Perhotelan*, vol. 5, no. 1, pp. 1–8, 2019, doi: 10.9744/jmp . 5.1.1-8.

[6]   SIPSN, "Capaian Kinerja Pengelolaan Sampah," 2022. [Online]. Available: https://sipsn.menlhk.go.id/sipsn/.

[7]   M. Seyffert *et al.*, "Internet-delivered cognitive behavioral therapy to treat insomnia: A systematic review and meta-analysis," *PLoS One*, vol. 11, no. 2, pp. 1–21, 2016, doi: 10.1371/journal.pone.0149139.

[8]   B. Hermanu, "Pengelolaan Limbah Makanan (Food Waste) Berwawasan Lingkungan Environmentally Friendly Food Waste Management," vol. 1, no. 1, pp. 1–11, 2022.

[9]   E. Aktas *et al.*, "A consumer behavioural approach to food waste," *J. Enterp. Inf. Manag.*, vol. 31, no. 5, pp. 658–673, 2018, doi: 10.1108/JEIM-03-2018-0051.

[10]   E. Toti, C. Di Mattia, and M. Serafini, "Metabolic Food Waste and Ecological Impact of Obesity in the FAO World's Region," *Front. Nutr.*, vol. 6, no. August, pp. 1–6, 2019, doi: 10.3389/fnut.2019.00126.

[11]   FAO, *Global Initiative on Food Loss and Waste Reduction What IS food?*. 2015.

[12]   V. Filimonau, H. Algboory, N. K. Mohammed, H. Kadum, J. M. Qasem, and B. J. Muhialdin, "Food waste and its management in the foodservice sector of a developing economy: An exploratory and preliminary study of a sample of restaurants in Iraq," *Tour. Manag. Perspect.*, vol. 45, no. January 2022, p. 101048, 2023, doi: 10.1016/j.tmp.2022.101048.

[13]   Tristram Stuart, *Waste: Uncovering the Global Food Scandal*. New York City: W. W. Norton & Company, 2009.

[14]   B. Artha, "Food Waste Management : Suatu Studi Literatur," vol. 6, no. 2, pp. 137–144, 2021.

[15]   J. F. Gollnhofer, "Normalising alternative practices : the recovery , distribution and consumption of food waste and consumption of food waste," *J. Mark. Manag.*, vol. 00, no. 00, pp. 1–20, 2017, doi: 10.1080/0267257X.2017.1301982.

[16]   N. S. Timoty and L. N. Yuliati, "Peningkatan Kesadaran Masyarakat Dalam Pengurangan Food Waste Untuk Membentuk Cinta Lingkungan," vol. 4, no. 2, 2022.

[17]   M. Murni, "Pengurangan Food Waste Pada Restoran Melalui Regulasi Retribusi Sampah," no. October, 2020.

[18]   C. Wharton, M. Vizcaino, A. Berardy, and A. Opejin, "Resources , Conservation & Recycling Waste watchers : A food waste reduction intervention among households in Arizona," *Resour. Conserv. Recycl.*, vol. 164, no. March 2020, p. 105109, 2021, doi: 10.1016/j.resconrec.2020.105109.

[19]   S. Pandey, M. Budhathoki, F. J. A. Perez-Cueto, and M. Thomsen, "Factors influencing consumers' food waste reduction behavior at university canteens," *Food Qual. Prefer.*, vol. 111, no. September, p. 104991, 2023, doi: 10.1016/j.foodqual.2023.104991.

[20]   D. Gunders, "Wasted : How America Is Losing Up to 40 Percent of Its Food from Farm to Fork to Landfill. August, 2012.

[21]   L. Sirieix, J. Lála, and K. Kocmanová, "crossmark," *J. Retail. Consum. Serv.*, vol. 34, no. June 2016, pp. 153–158, 2017, doi: 10.1016/j.jretconser.2016.10.004.

[22]   S. V Russell, C. W. Young, K. L. Unsworth, and C. Robinson, "Resources , Conservation & Recycling Bringing habits and emotions into food waste behavior," *Resour. Conserv. Recycl.*, vol. 125, no. March, pp. 107–114, 2017, doi: 10.1016/j.resconrec.2017.06.007.

[23]   P. Garrone, M. Melacini, and A. Perego, "Opening the black box of food waste reduction," *Food Policy*, vol. 46, pp. 129–139, 2014, doi: 10.1016/j.foodpol.2014.03.014.

[24]   C. Martin-rios, C. Demen-meier, S. Gössling, and C. Cornuz, "Food waste management innovations in the foodservice industry," *Waste Manag.*, vol. 79, pp. 196–206, 2018, doi: 10.1016/j.wasman.2018.07.033.

[25]   E. Papargyropoulou, R. Lozano, J. K. Steinberger, N. Wright, and Z. Bin Ujang, "The food waste hierarchy as a framework for the management of food surplus and food waste," *J. Clean. Prod.*, vol. 76, pp. 106–115, 2014, doi: 10.1016/j.jclepro.2014.04.020.

[26]   M. A. Memon, S. Mekhilef, M. Mubin, and M. Aamir, "Selective harmonic elimination in inverters using bio-inspired intelligent algorithms for renewable energy conversion applications: A review," *Renew. Sustain. Energy Rev.*, vol. 82, no. August, pp. 2235–2253, 2018, doi: 10.1016/j.rser.2017.08.068.

[27]   M. Bozzola, D. Dal Palù, and C. De Giorgi, "Design for Leftovers. From Food Waste to Social Responsibility," *Des. J.*, vol. 20, no. sup1, pp. S1692–S1704, 2017, doi: 10.1080/14606925.2017.1352692.

[28]   E. Wajon, J. Richter, and M. Dahl, "Students' Intention to Reduce Food Waste An approach with an extended version of the Theory of Planned Behavior," no. June, pp. 1–70, 2019, [Online]. Available: http://www.diva-portal.org/smash/record.jsf?pid=diva2%3A1335458&dswid=2909.

[29]   G. Pellegrini, S. Sillani, M. Gregori, and A. Spada, "Household food waste reduction: Italian consumers' analysis for improving food management," *Br. Food J.*, vol. 121, no. 6, pp. 1382–1397, 2019, doi: 10.1108/BFJ-07-2018-0425.