Drivers of Food Waste Reduction Intention Among Indonesian Young Generation

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Abstract

Solid waste management presents a significant challenge in Indonesia, with food waste accounting for 40.8% of all solid waste generated. The young generation is the largest producer of food waste compared to adults. The Food and Agriculture Organization (FAO) reports that consumer behavior is the main factor causing food waste in middle-income countries. Considering that the younger generation occupies 24.34% of Indonesia's population, this study aimed to analyze the determinants of food waste reduction intention among the young generation in Indonesia. The Extended Theory of Planned Behavior (TPB) with four new introductory variables was used as a theoretical framework to understand the intentions of the young generation in Indonesia regarding food waste reduction. Data was collected from the young generation spread across Indonesia through an online survey using questionnaires, which resulted in 340 respondents. Data were then analyzed using descriptive analysis and partial least squares-structural equation modeling (PLS-SEM) to test the conceptual model and hypotheses proposed. The results showed that perceived behavioral control (PBC), food consumption, level of religious knowledge, and level of knowledge significantly influence food waste reduction intention. Religious knowledge was the most influential predictor. This is in line with the nature of the Indonesian community, which is highly religious, and religion profoundly guides daily lives. Based on the results, this study recommended three practical implications for reducing food waste and is expected to contribute to ensuring food security and achieving the Sustainable Development Goals.

Keywords

Extended TPB; food waste; PLS-SEM; SDGs; young generation

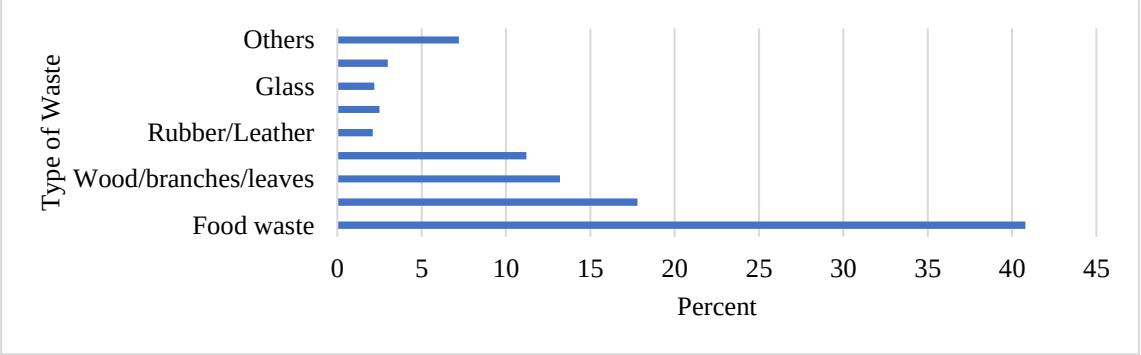
Introduction

Solid waste management is a global concern, focusing on its impact in developing countries (Ferronato et al., 2019; Ferronato & Torretta, 2019; Hoornweg et al., 2013). This emphasis is amplified in urban areas, where there is a higher production of waste, compared to rural areas, where the use of packaging products is less prevalent and the generation of food waste and manufactured goods is lower (Hoornweg et al., 2013). The average waste generation in large cities worldwide is roughly 1.3 million tons annually and is expected to rise to 2.2 million tons annually by 2025 (Kusumaningtiar et al., 2022).

As a developing country, Indonesia also faces solid waste management issues. Indonesia, with a population of 270 million people, is experiencing significant expansion accompanied by economic growth, business activity, and high consumption levels, all of which contribute to an increase in waste volume. Meanwhile, 27.5% of Indonesians can access waste transportation (Statistics Indonesia [BPS], 2022a). Other facts show that only 74.5% (14.5 million tons/year) of waste in Indonesia is adequately managed by being landfilled, while the remaining 25.5% (4.9 million tons/year) is still unmanaged (Ministry of Environment and Forestry [MoEF], 2022; National Waste Management Information System, 2023). Even though the total landfilled waste in Indonesia is expected to decrease from 31 million tons to 19.5 million tons in 2022 (National Waste Management Information System, 2023), the waste problem must still be appropriately addressed because it can cause environmental pollution, endanger health, and disrupt economic activities (Ferronato et al., 2019; Ferronato & Torretta, 2019; Heidari et al., 2019; Stancu et al., 2015; Tsai et al., 2020).

Food waste dominates the type of waste produced in Indonesia, with an average contribution of 40.8% to national waste (Figure 1). Furthermore, it is the disposal of edible food damaged and expired from the supply chain caused by economic behavior, inadequate stock management, or negligence (Bravi et al., 2019, 2020; Food and Agriculture Organization [FAO], 2014). Food waste comprises items initially designed for human consumption, except for feed and non-edible components (FAO, 2011). Food waste has substantially influenced the three fundamental pillars of Sustainable Development Goals (SDGs): environment, economy, and society, rendering the concept a multifaceted and global issue (FAO, 2013b, 2013a; Martin-Rios et al., 2018). An estimated one-third of the total food produced for human consumption is lost or squandered annually, amounting to approximately USD 1 trillion in waste. Furthermore, food waste exacerbates the scarcity of natural resources, contributes to environmental degradation, and emits methane gas, the greenhouse gas (GHG) with the most significant potential to induce global warming (Aktas et al., 2018).

Figure 1: Types of Indonesian Waste in 2022



Note: (MoEF, 2023; National Waste Management Information System, 2023)

Indonesia is the leading producer of food waste in Southeast Asia, with an estimated annual food waste of 20.9 million tons (United Nations Environment Programme [UNEP], 2021), holds the second position on a global scale at roughly 300 kg per capita per year (Ministry of National Development Planning [BAPPENAS], 2021). Meanwhile, edible food accounts for around 40% of food waste (BAPPENAS, 2021), and the hunger problem is severe, as evidenced by the country's ranking of 73rd in the Global Hunger Index (Delgado & Smith, 2021).

Food security is intricately connected to food waste since reducing food waste can nourish more individuals, alleviate strain on finite natural resources, and mitigate adverse environmental effects (Aktas et al., 2018). Furthermore, the 12th SDGs report the importance of managing food loss and waste to ensure sustainable consumption and production patterns. By setting these goals, world food waste per capita can be reduced by up to 50% at the retail, consumer, and food supply chain levels by 2030 (FAO, 2011, 2013a). The reduction also contributes to achieving SDGs Point 2: "Ending hunger and ensuring access to good quality food." Efforts in food waste reduction are also essential and urgent to be carried out due to the negative environmental impact of GHG emissions from supply chain activities (Aktas et al., 2018; Heidari et al., 2019; Martin-Rios et al., 2018; Russell et al., 2017).

The preponderance of food waste suggests that consumer behavior or society lacks concern for or appreciation for food. In addition, food loss and waste in medium-income countries are predominantly attributed to consumer behavior and inadequate coordination among supply chain participants (FAO, 2011). From a moral perspective, this situation is disheartening, as a significant amount of food goes to waste while many individuals are enduring hunger and malnutrition (Heidari et al., 2019; Martin-Rios et al., 2018; Tsai et al., 2020). In this context, the global population is inversely proportional to the food supply (Stancu et al., 2015).

The occurrence of food waste can be attributed to various factors, including inadequate planning, consumer preferences regarding where to buy food, purchasing too many food ingredients or cooking too much, and leaving food in the refrigerator in the hope that it can be consumed again, but ultimately being thrown away (Bravi et al., 2019; Brodersen et al., 2019). Indirectly, consumer behavior plays a significant role in increasing the issue of food waste, and a key aspect is the attitude toward the practice (Chaerul & Zatadini, 2020). Food waste can also increase because of consumers' inadequate comprehension and capacity to effectively manage food (Graham-Rowe et al., 2015; Werf et al., 2020).

Previous studies report that the young generation throws away food more than adults and parents (Bravi et al., 2019, 2020; Ellison et al., 2019; Yagoub et al., 2022). Shifts in urban lifestyles to become more urban encourage the young generation not to cook food for themselves but not to be able to utilize leftover food, which can increase food waste (Zhang et al., 2020). Understanding the behavior of the young generation in Indonesia is of utmost importance, given that the young generation has a large percentage of the total population of Indonesia (24.34 %) (Statistics Indonesia [BPS], 2022b) and generates more waste than adults (Ellison et al., 2019; Yagoub et al., 2022). Therefore, engagement and awareness in the reduction can have a significant impact on reducing food waste. Tsai et al. (2020) also stated the importance of analyzing the behavior of the young generation regarding food waste due to its significant impact on society. Therefore, the behavior has become the focus of extensive study to formulate strategies for food waste reduction.

Efforts in food waste reduction are closely related to behavior and have been the focus of previous studies because they can offer critical insights to formulate strategies to reduce food waste (T'ing et al., 2021). Traditionally, the theory of planned behavior (TPB) model, which is

empirically built from three predictors that influence individual behavior towards food waste, namely attitude towards the behavior, subjective norms, and perceived behavioral control (Graham-Rowe et al., 2015; van der Werf et al., 2019) can capture phenomena related to food waste behavior. Several previous studies have shown that food waste behavior is influenced by intention, a component within the individual that refers to the desire to carry out certain behaviors. Intention is the primary key to predicting human behavior and a psychological construct that shows the strength of an individual motivation in the future.

Previous studies regarding food waste intentions have been carried out from various perspectives (see Aktas et al., 2018; Heidari et al., 2019; T'ing et al., 2021; Teoh et al., 2021). Studies regarding food waste intentions among the younger generation in developing countries are minimal. Studying food waste reduction intentions among the younger generation in Indonesia is vital because the younger generation makes up a large percentage of the total population of Indonesia (24.34%), and consumer behavior is considered the leading cause of food waste in middle-income countries. As a country with the largest Muslim population in the world, this study also analyzes the influence of religious knowledge on food waste reduction intentions, which has rarely been done in previous studies. Significantly, religion influences people's food consumption behavior through religious codes and traditions (Long et al., 2024) and positively reduces food waste (Qian et al., 2022). Even religiosity (religious values) has a more substantial predictive power of consumer attitudes and behaviors than religious affiliation in the last two decades (Agarwala et al., 2019). Therefore, the level of religious knowledge that reflects a person's commitment to comply with religious teachings and practices is expected to affect reducing food waste.

The variables of financial attitude, knowledge level, and consumption pattern were chosen with consideration because they influence food waste behavior in young people in several countries (Fox et al., 2018; Kymäläinen et al., 2021; Radzymińska et al., 2016). Financial attitudes can influence the intention to reduce food waste through a person's purchasing power so that they can change the food they eat (van der Werf et al., 2019). Differences in consumption patterns between age groups will also produce different attitudes and intentions related to food waste. The level of knowledge about food waste will encourage the young generation to reduce food waste because they know the negative impacts of food waste. Therefore, this study aims to analyze the factors determining the intention to reduce food waste and formulate recommendations for the reduction among the younger generation in Indonesia. Understanding food waste reduction intention and influencing factors among young people in Indonesia is essential to achieving the SDGs by ending hunger, ensuring access to good quality food (SDG 2), and ensuring sustainable consumption and production patterns (SDG 12).

Literature review and hypothesis development

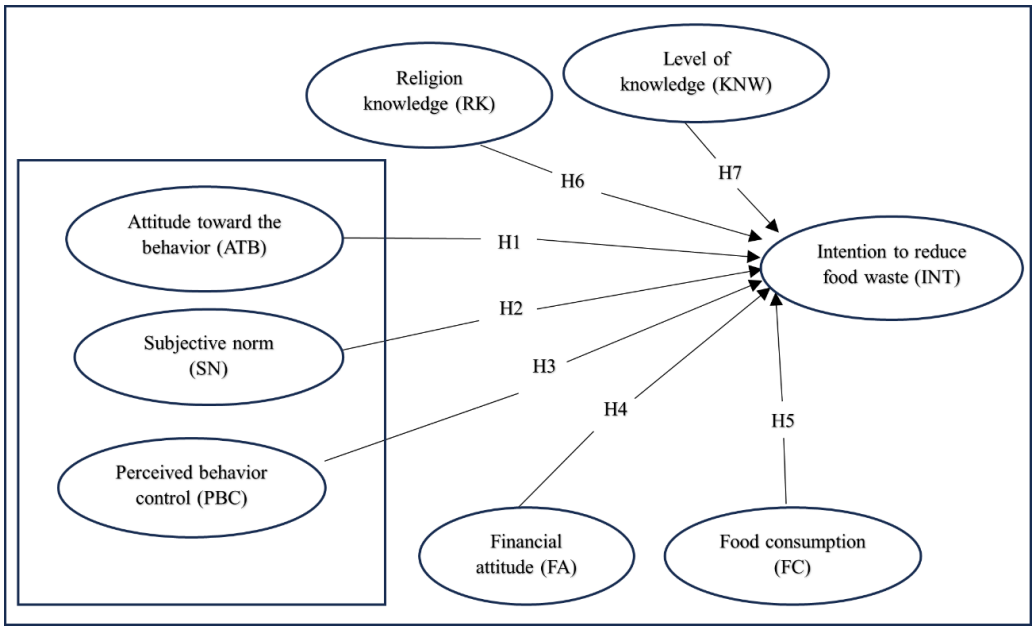
Modifying individual consumption patterns is the most effective approach to mitigating the environmental consequences of household food waste (Quested et al., 2013). Consumer behavior that induces discomfort and remorse when edible food is discarded serves as a motivation to avoid waste in the future (Mulyo et al., 2021). The government increases awareness about food waste through educational practices (Pinto et al., 2018) because food waste increases due to consumers' low knowledge and ability to manage food (Graham-Rowe et al., 2015; Werf et al., 2020). Meanwhile, food businesses can significantly reduce food waste

by offering products with various portion options, accompanied by date labels and retail marketing (Tarczyńska et al., 2023).

In this context, individual behavior toward food waste has been extensively studied using the TPB model (Graham-Rowe et al., 2015; Mondéjar-Jiménez et al., 2016; Stefan et al., 2013; Visschers et al., 2016). The TPB model is an empirically constructed model comprising three variables influencing individual behavior toward food waste: attitudes, subjective norms, and behavioral control (Graham-Rowe et al., 2015; Werf et al., 2020). Developing the model by introducing additional variables is very important (Visschers et al., 2016) because adding other relevant and empirically tested constructs can improve the predictive power of the basic TPB model of food waste reduction intention.

Several essential variables in the literature were considered in building and testing the extended TPB model according to the conditions of the young generation in Indonesia. Financial attitude was chosen as a predictor because it correlates with a person's purchasing power to switch food types (van der Werf et al., 2019) and can trigger over-purchasing (Siaputra et al., 2022). Food consumption is expected to affect the intention of food waste reduction because the consumption patterns of each generation are different, and the young generation is considered to have a stronger intention to reduce food waste (Wajon & Richter, 2019). Solving food waste problems is also closely related to the level of knowledge, as knowledge of environmental issues and the negative impact of food waste encourages consumers to reduce food waste (Abu Hatab et al., 2022; Fox et al., 2018) and increasingly plan food consumption properly (Richter, 2017). Indonesia's demographic conditions, which Muslims dominate, make the level of religious knowledge an interesting predictor to be tested in reducing food waste because Islam has several rules in food and beverage consumption, such as halal and haram (Li et al., 2020; Özbük et al., 2022), good for the body (Niri, 2021), and prohibited from overeating (Özbük et al., 2022). Therefore, the extended TPB in this study was developed as follows:

Figure 2: Study Model



Studies related to food waste with an Indonesian scope have been the subject of investigation in several previous reports, with various perspectives such as food waste management

regulations (Cahyani et al., 2022), food consumption management (Mulyo et al., 2022), perceptions of food waste processing (Susilo et al., 2021), determinants of consumption behavior towards food waste (Sia Niha et al., 2022) to the circular economy to handle food waste (Waluyo & Kharisma, 2023). Even though the young generation's behavior toward food waste will significantly impact society (Tsai et al., 2020), studies on intentions to reduce food waste, especially among Indonesia's young generation, are still limited. The urgency of analysis on food waste reduction intentions among the young generation in Indonesia is due to the relatively large percentage of the generation (24.34%) (Statistics Indonesia [BPS], 2022b) and also producing more significant food waste than adults (Ellison et al., 2019; Werf et al., 2020). This study also offers novelty with an area covering Indonesia to better describe food waste reduction intention. Furthermore, it contributes to filling the gap in the literature regarding food waste reduction intention among the young generation in developing countries, particularly in Indonesia.

Hypothesis development

The literature review synthesis shows that apart from the three main predictors of the TPB model, food waste reduction intention can be explained by several additional predictors, as presented in Figure 2. This section describes the development of hypotheses for each variable used in this study. According to Selahudin et al. (2020), the young generation has a negative attitude toward food waste, as shown by the tendency to prevent and reduce food waste. In this context, individual attitude is necessary and influences daily consumption behavior and food waste reduction intention. This research hopes that attitude toward the behavior significantly affects food waste reduction intentions. Therefore, the first hypothesis is as follows:

H1. Attitude toward the behavior (ATB) has a significant effect on food waste reduction intention

According to several studies, consumer behavior regarding food waste is not apparent to others (Graham-Rowe et al., 2015; Stefan et al., 2013; Visschers et al., 2016). Subjective norms about food waste refer to the social pressure experienced when food is wasted. Intention increases when an individual experiences pressure in food waste reduction (Siaputra et al., 2022); hence, the subsequent hypothesis is delineated as follows:

H2. Subjective norm (SN) has a significant effect on food waste reduction intention

Perceived behavioral control as an antecedent influencing food waste reduction intention and behavior has been proven significant in many studies (Graham-Rowe et al., 2015; Mondéjar-Jiménez et al., 2016; Stefan et al., 2013; Visschers et al., 2016). In food waste, perceived behavioral control refers to an individual's subjective assessment of the ease of exercising control and avoiding engaging in the behavior. Food waste reduction intention increases with the belief that the factors causing the formation are under control; hence, the third hypothesis is as follows:

H3. Perceived behavioral control (PBC) has a significant effect on food waste reduction intention

To improve the model explanatory power, this study attempts to broaden the TPB by identifying other factors influencing food waste reduction behavior in the young generation, such as food consumption (FC), financial attitude (FA), religious knowledge (RK), and level of knowledge (LK). Financial attitude is a predictor that dramatically affects food-wasting behavior and greatly influences purchasing power. In this context, an individual's income level is proportional to the ability to change menus and throw away food (van der Werf et al., 2019). Food waste reduction intention is in line with the problem of over-purchasing and price awareness (Siaputra et al., 2022); hence the fourth hypothesis is as follows:

H4. Financial attitude has a significant effect on food waste reduction intention

Different generations have variations in attitudes towards food consumption. There is a negative correlation between the young generation and food waste reduction (Wajon & Richter, 2019). A study showed that students in Poland (Radzymińska et al., 2016) and Generation Z in Finland (Kymäläinen et al., 2021) tended to make price a critical aspect when purchasing or consuming food. This is consistent with Wajon and Richter (2019), where economic factors are directly related to consumption and spending patterns, making Generation Z have a stronger intention for food waste reduction. Therefore, the fifth hypothesis is formulated as follows:

H5. Food consumption has a significant effect on food waste reduction intention

Conversely, Indonesia is a nation that consistently observes religious principles in its daily existence. Therefore, religious determinants of individual consumption patterns constitute an intriguing field of study. Food consumption is a significant religious indicator (Tuhin et al., 2022). Religion such as Islam mandates halal compliance, Hindu advocates for a particular and stringent diet, and Buddha abstains from animal consumption (Li et al., 2020). In this context, religion has the potential to mitigate food waste through its prohibition of excess, known as “haram” or “sin” in Islam (Özbük et al., 2022). This shows that religious beliefs may influence food waste reduction intention (Mumuni et al., 2018); hence, the sixth hypothesis is stated as follows:

H6. The level of knowledge about religion has a significant effect on food waste reduction intention

The study by Selahudin et al. (2020) showed that increasing teenagers' knowledge about the causes and problems of food waste has improved behavior in managing food waste. Participants from Denmark, Greece, Indonesia, and Taiwan expressed a comparatively limited understanding of the subject matter, even though food waste constitutes an ethical and environmental dilemma precipitating the depletion of natural and economic resources (Fox et al., 2018). Richter (2017) found that consumers who possessed a wealth of information were progressively more preoccupied with the food to consume; hence, the seventh hypothesis is stated as follows:

H7. The level of knowledge has a significant effect on food waste reduction intention

Materials and methods

Sample and data collection

The target respondents were the young generation across various regions in Indonesia. The definition of young generation referred to the Regulation of Minister of Youth and Sports of the Republic of Indonesia No. 11 of 2017, namely Indonesian citizens entering a critical growth and development period aged 16–30 (Ministry of Youth and Sports Republic of Indonesia, 2017). The demographic profile of the respondents was not restricted as long as they were still in the territory of the Republic of Indonesia and met the criteria of being the younger generation. Respondents were men and women with various professional backgrounds, religions, and inherent socioeconomic status.

Data were collected through an online survey using the Google Forms platform to identify the factors determining food waste reduction intention. The online survey was used to obtain data and information through Internet channels, and the method was selected with three considerations. First, it could reach a relatively wide range of respondents quickly and cheaply and collect large amounts of empirical data (Woods et al., 2015). Second, an online survey was widely used in previous research on human intention and behavior (Habib et al., 2023; T'ing et al., 2021). Third, there were limited resources for conducting face-to-face surveys because the coverage of Indonesia's territory was extensive. Biased online survey results in this study were minimized with eight steps: providing screening questions for respondents who fit the criteria, using neutral and closed questions, avoiding leading statements and answers, respondent's name disguised (anonymous), removing the researcher's identity so that answers are not influenced, conducting repeated checks, conducting trials for validity adjustment and reliability testing, and conducting ethical clearance.

Data were collected in July 2023 using a convenience sampling method by distributing questionnaire links through social media (WhatsApp, Instagram, and Facebook) personally and in groups. Furthermore, respondents were asked to voluntarily distribute the questionnaire link to their networks. Convenience sampling is used considering limited resources and was widely used to develop an intention model through TPB (Aydin & Aydin, 2022; Teoh et al., 2021), and the purpose of the study is to test conceptual models and theory-based hypotheses. However, under more ideal conditions, probability sampling is recommended to increase the generalizability of findings, especially when the population can be identified (Hair et al., 2019).

Respondents were asked to complete the questionnaire voluntarily, resulting in 348 responses. Eight responses were deleted because the criteria for the young generation (16–30 years) were unmet and unwilling to be used as respondents, resulting in 340 samples for further analysis. This number was also considered adequate according to the needs of the statistical technique used, multivariate analysis, which required a sample size of at least five times the indicators (Hair et al., 2012). In addition, this sample size met the minimum numbers necessary to reduce bias in all types of SEM estimates (Loehlin & Beaujean, 2017).

Variable and measure

This study combines the fundamental variables of the TPB (attitude towards the behavior, subjective norm, perceived behavioral control, intention) (Ajzen, 1991) and four other variables (financial attitude, food consumption, level of religious knowledge, and level of knowledge). The identification was conducted through an intensive literature review and modified accordingly with the study context. Each variable was measured using at least three indicators adopted from previous research, as shown in Table 1. The Likert scale was used in the questionnaire, with one and five indicating "strongly disagree" and "strongly agree" for strong negative and positive views.

The questionnaire was used as a data collection instrument and was approved by the Ethics Commission for Social Humanities, National Research and Innovation Agency (BRIN) based on Decree No. 496/KE.01/SK/07/2023. Furthermore, it was prepared based on an in-depth literature review and presented in Indonesian to equalize respondents' perceptions. In the first section, participants were asked about their willingness to be respondents and their age, which was the basis for determining whether the participant could be used. A brief explanation was provided at the beginning of the questionnaire to equalize perceptions regarding food waste. The questions were grouped into seven sections consisting of respondents' characteristics (A), frequency of food waste (B), amount of food waste (C), main reason for not finishing food (D), main reason for spending food (E), knowledge about food waste (F), and behavior towards food waste (G).

Table 1: Relationship Between Latent Variables and Indicators

Latent variable		Indicator	Relevant literature
Attitude Towards the Behavior (ATB)	ATB_1	Finding alternative	(Graham-Rowe et al., 2015; Selahudin et al., 2020; van der Werf et al., 2019)
	ATB_2	Compared with other life	
	ATB_3	Principle of life	
Subjective Norm (SN)	SN_1	Personal value expectations	(Siaputra et al., 2022; Stefan et al., 2013; Visschers et al., 2016)
	SN_2	Family value expectations	
	SN_3	Coworker value expectations	
	SN_4	Expectations value of an immediate social environment	
Perceived Behavioral Control (PBC)	PBC_1	Irregular eating at home	(Graham-Rowe et al., 2015; Mondéjar-Jiménez et al., 2016; Stefan et al., 2013; Thompson et al., 2020; Visschers et al., 2016)
	PBC_2	Difficulty in preparing food and leftovers	
	PBC_3	Time limitations	
	PBC_4	Large number of family members	
	PBC_5	Food storage knowledge	
Financial Attitude (FA)	FA_1	Purchasing power	(Siaputra et al., 2022; van der Werf et al., 2019; Wajon & Richter, 2019)
	FA_2	Wasteful	
	FA_3	Saving	
Food Consumption (FC)	FC_1	Food portions	(Kymäläinen et al., 2021; Radzymińska et al., 2016; Wajon & Richter, 2019)
	FC_2	Ability to buy food	
	FC_3	Family members consumption	
Level of Religious Knowledge (RK)	RK_1	Halal compliance	(Li et al., 2020; Mumuni et al., 2018; Özbük et al., 2022; Tuhin et al., 2022)
	RK_2	Dietary compliance	
	RK_3	Food portions compliance	
	RK_4	Celebrations of religious holidays	
	KNW_1	Biological knowledge	

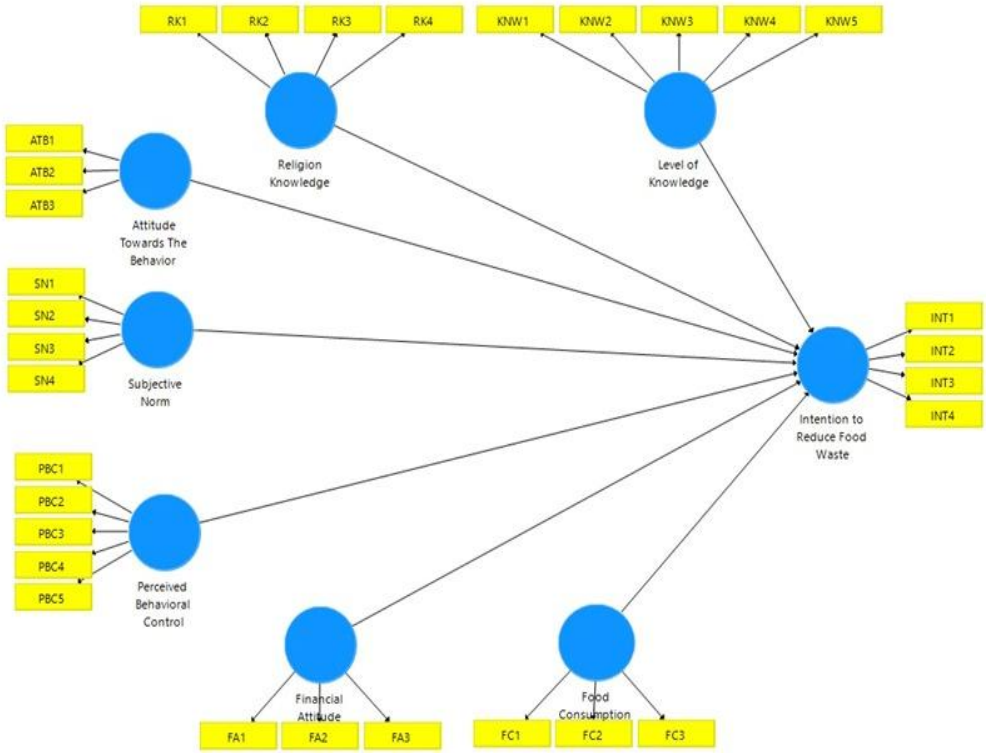
Latent variable		Indicator	Relevant literature
Level of Knowledge (KNW)	KNW_2	Knowledge of cooking planning	(Fox et al., 2018; Selahudin et al., 2020; Wajon & Richter, 2019)
	KNW_3	Knowledge of food purchase planning	
	KNW_4	Knowledge of product expiration dates	
	KNW_5	Waste management knowledge	
Food Waste Reduction Intention (INT)	INT_1	Trying not to waste food	(Aktas et al., 2018; Gokarn et al., 2023; T'ing et al., 2021)
	INT_2	Trying to eat purchased food	
	INT3	Trying to produce enough food	
	INT_4	Trying to use all the leftovers	

Data analysis

The factors determining food waste reduction intention were analyzed using Partial Least Square-Structural Equation Modeling (PLS-SEM). The function of PLS-SEM was similar to multiple regression analysis (Cahyasita et al., 2021). The concept allows analysis with data that are not normally distributed, small sample sizes, exploratory studies, and formative measurements (Zeng et al., 2021). This analysis method is also considered flexible enough to predict relationships from the model construction (Gokarn et al., 2023). Therefore, PLS-SEM is considered suitable for estimating the influence of the seven exogenous latent variables observed on the endogenous latent variable (Table 1). The data analysis process is carried out in two stages; namely, the first stage is measuring the model (outer model) to measure the relationship between latent variables and the indicators, and the second stage is analyzing the model structure (inner model) to test the hypothesis of the relationship between the observed endogenous and exogenous latent variables (Gokarn et al., 2023). The model framework was built based on a literature review and was adapted to the study objectives, as in Figure 3.

The outer model was evaluated using several tests, including convergent validity, discriminant validity, and composite reliability (Ghozali & Latan, 2015). The convergent validity test used reflective indicators, which were assessed based on loading factors and must be greater than 0.6 (Pantouvakis & Psomas, 2016). The discriminant validity was tested concerning the average variance extracted (AVE) value, which was recommended to be greater than 0.5 for each variable (Monecke & Leisch, 2012). Meanwhile, the consistency of the measuring instrument was validated by the composite reliability value, which was more significant than 0.7 (Hair et al., 2012). Testing was carried out on the inner model, including the coefficient of determination (R^2), goodness-of-fit (GoF), and significance testing of t-values through a bootstrapping procedure when the outer model is considered valid (Cahyasita et al., 2021).

Figure 3: Model Measurement



Results

Socio-demographic characteristics

Table 2 shows the socio-demographic information of mostly women respondents, namely 215 people (63.24%). Meanwhile, regarding age distribution, the 21–25-year category dominates (49.75%), indicating that respondents are the young generation in early adulthood. A total of 253 people (74.41%) were Muslim, the mainstream religion in Indonesia. Meanwhile, Hindu and Buddha respondents were only 0.29% and 0.59% respectively. The monthly income varied widely, with most respondents having an average income of < USD 62.19 (71.47). The income was in line with the work of most respondents, who are dominated by students (80%). This income generally comes from their parents or is still relatively limited. This was primarily used to meet consumption needs, as shown by the majority spending on consumption that was dominated by < USD 31.09 (32.94%) and USD 31.09 to 62.19 (43.24%). Most respondents cook to reduce expenses in providing the dominant food (61.47%).

Table 2: The Demographic Profile

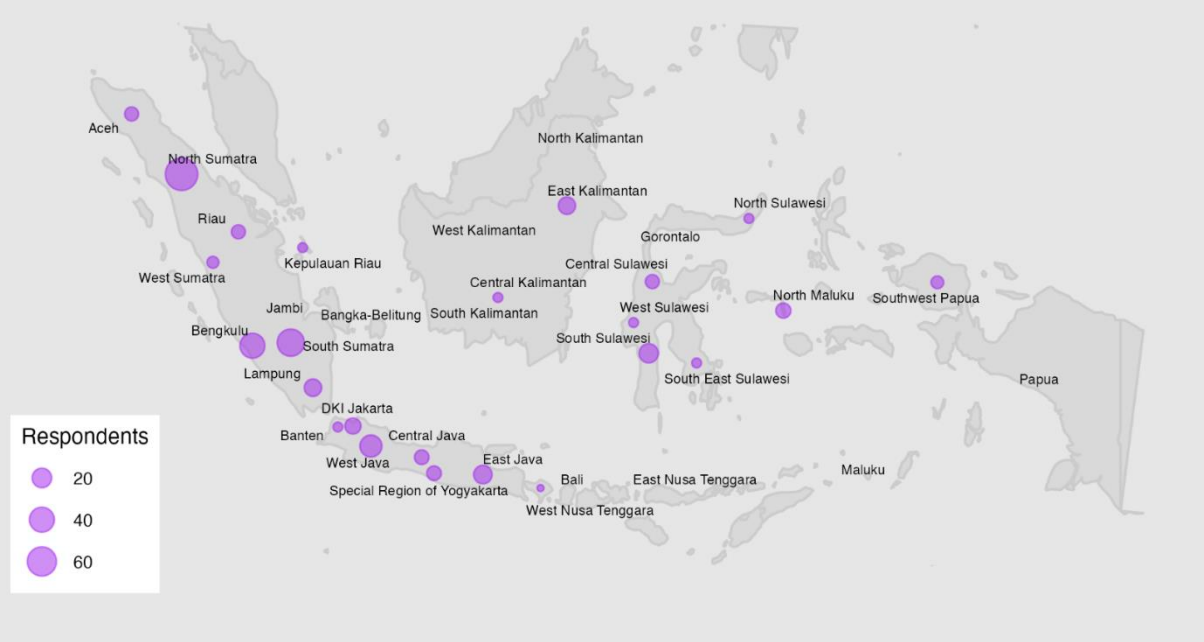
Category	Classification	Frequency (*n*)	Percentage (%)
Gender	Male	125	36.76
	Female	215	63.24
Age	16–20	124	36.47
	21–25	169	49.71

Category	Classification	Frequency (*n*)	Percentage (%)
	26–30	47	13.82
Religion	Buddha	2	0.59
	Hindu	1	0.29
	Islam	253	74.41
	Catholic	11	3.24
	Christian	73	21.47
Profession	State Civil Service (ASN)	20	5.88
	Housewife	2	0.59
	Private sector employee	28	8.24
	Student	272	80.00
	Trader/Entrepreneur	2	0.59
	Other	16	4.71
Income	< USD 62.19	243	71.47
	USD 62.1–185.57	45	13.24
	USD 185.57–310.94	29	8.53
	USD 310.94–435.32	12	3.53
	USD 435.32–559.70	7	2.06
	> USD 559.70	4	1.18
Expenditures on food	< USD 31,09	112	32.94
	USD 31.09–62.19	147	43.24
	USD 62.19–124.38	60	17.65
	USD 124.38–185.57	15	4.41
	USD 185.57–248.76	5	1.47
	> USD 248.76	1	0.29
Dominant food preparation	Self–cooking	209	61.47
	Buy at a shop/similar	122	35.88
	Catering	9	2.65

Note: The currency was calculated based on the exchange rate of 1 USD = IDR 16,080 on May 13, 2024

As presented in Figure 4, 340 respondents represent the provinces in Indonesia. The respondents were spread across every island region, including Java, Sumatra, Kalimantan, Sulawesi, Maluku, and Papua. Most respondents' domiciles are in Java and Sumatra, with the most significant number of respondents in North Sumatra Province. Java and Sumatra are the islands with the largest populations in Indonesia.

Figure 4: Map of Respondent Location Distribution



Respondents were also asked about their general knowledge of food waste (Table 3) regarding its behavior and impacts. The results show that respondents have a high level of general and practical knowledge of food waste management. The types of food most often thrown away were fruit and vegetables (83.82%). Most respondents (94.71) also realized that food waste had an environmental, social, and economic impact. In line with this, most respondents also realized that food waste would harm the environment (74.12%), contributes to increasing global warming (80.88%), and is the third largest producer of GHG emissions in the world (77.94%).

Regarding practical knowledge, food waste reduction contributes to overcoming the issue of hunger (85.88%) and is an environmentally friendly action (94.82). Regarding respondents' knowledge regarding the relationship between food waste and SDGs, most respondents realized that reducing food waste would support the achievement of SDGs Point 2, "End hunger and ensure access to good quality food" (88.24), and Point 12, "Consume and responsible production" (94.12%).

Table 3: General Knowledge of the Young Generation in Indonesia regarding Food Waste

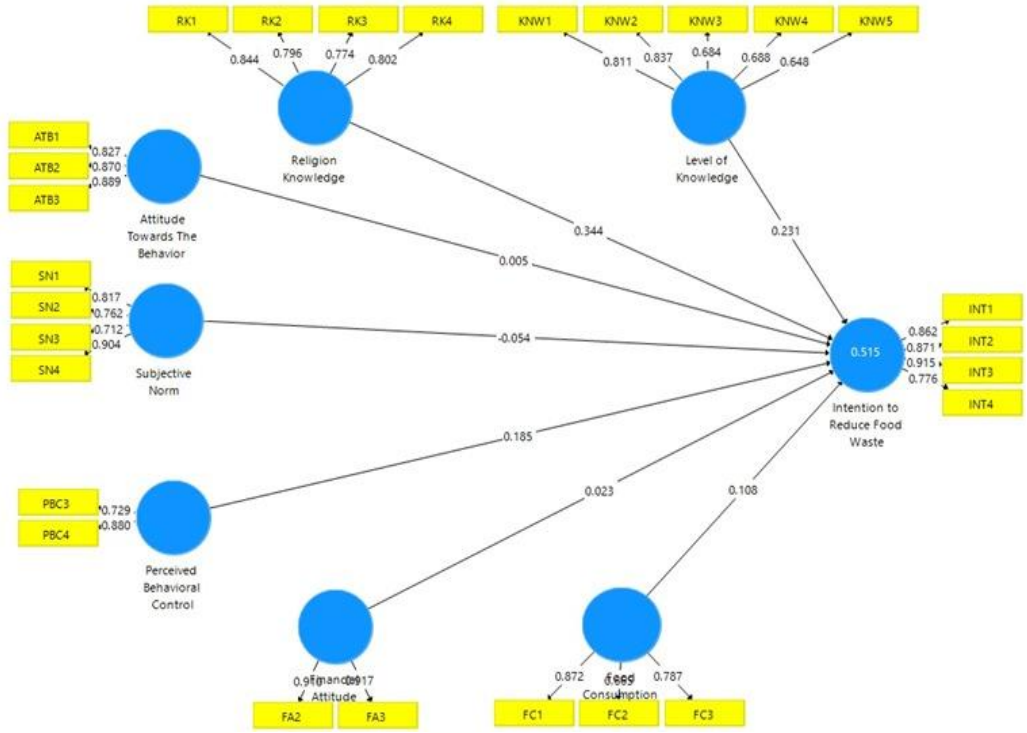
Category	Description	Percentage (%)	
		True	False
General knowledge about food waste	Fruit and vegetables are the types of food that are most often thrown away	83.82	16.18
	Food waste has an impact on the environment (ecology)/social/economic	94.71	5.29
	Throwing away food waste will harm the environment	74.12	25.88
	Food waste contributes to increasing global warming	80.88	19.12
	Food waste is the third largest producer of GHG emissions in the world	77.94	22.06
	Food waste reduction contributes to overcoming the issue of hunger	85.88	14.12

Category	Description	Percentage (%)	
		True	False
Practical knowledge of food waste management	Food waste reduction is an environmentally friendly action	93.82	6.18
	Food waste reduction contributes to supporting the achievement of SDGs Point 2, namely "ending hunger and ensuring access to good quality food	88.24	11.76
	Food waste reduction contributes to supporting the achievement of SDGs Point 12, "responsible consumption and production."	94.12	5.88

Model measurement

Model measurements were carried out by analyzing the feasibility of the outer and inner models. The first stage in measuring the outer model used convergent validity by considering the loading factor value. Several indicators were removed to make the model fit, namely PBC_1, PBC_2, PBC_5, and FA_1, with a loading factor value < 0.6 (Pantouvakis & Psomas, 2016). This process was repeated several times until no loading factor was below 0.6. After removing indicators that did not meet the standards, the model met the first requirement. Therefore, the path diagram of the final precipitation model can be seen in Figure 5.

Figure 5: Final Loading Path



The outer model shown in Table 4 is feasible, and construct validity is evaluated by calculating the Average Variance Extracted (AVE). Each construct AVE value in this study exceeded 0.5. As a result, both the tested model and the model were deemed valid (Fornell & Lacker, 1981; Hair et al., 2012). The following criterion was model reliability, which showed the level of trust. Construct reliability was calculated using composite reliability to evaluate internal consistency, and the resulting value was greater than 0.7. The aggregate composite reliability

measurement results were reliable after exceeding 0.7 (Hair et al., 2012). Therefore, the data were reliable, consistent, and capable of elucidating the model.

Table 4: Construct Reliability and Validity

Predictor	Composite Reliability (CR)	Category	Average Variance Extracted (AVE)	Category
INT	0.917	Reliable	0.735	Valid
SN	0.877	Reliable	0.643	Valid
ATB	0.897	Reliable	0.744	Valid
RK	0.880	Reliable	0.647	Valid
FA	0.910	Reliable	0.834	Valid
LK	0.908	Reliable	0.831	Valid
FC	0.849	Reliable	0.737	Valid
PBC	0.788	Reliable	0.653	Valid

The inner model was validated by assessing the goodness-of-fit (GoF) value, which was 6.82. This value served as a singular metric to evaluate the overall effectiveness of the measurement and structural models. The GoF value was derived by taking the square root of the average communalities index and multiplying it by the average R^2 value of 0.5. The observed variation in the R^2 coefficient showed the impact of the exogenous latent variable on the endogenous latent variable, resulting in a significant 50% decrease in intention.

Table 5: Hypothesis Testing

Hypothesis	SD	T Statistics	*p* value	Conclusion
H1: ATB -> INT	0.043	0.725	.469	Reject (not significant)
H2: SN -> INT	0.051	0.924	.356	Reject (not significant)
H3: PBC -> INT	0.049	3.136	.002	Accept (significant)
H4: FA -> INT	0.057	0.443	.658	Reject (not significant)
H5: FC -> INT	0.072	2.686	.007	Accept (significant)
H6: RK -> INT	0.061	5.728	.000	Accept (significant)
H7: LK -> INT	0.056	2.773	.006	Accept (significant)

Hypothesis testing in Table 5 shows that perceived behavioral control, religious knowledge, level of knowledge, and food consumption significantly affect the food waste reduction intention variable. Meanwhile, the other three variables, attitude towards the behavior, subjective norm, and financial attitude, do not have a significant effect. Based on the direction of influence, perceived behavioral control, religious knowledge, level of knowledge, and food consumption have a positive influence, as shown by the parameter coefficient values of 0.185, 0.344, 0.231, and 0.108. The closer the value to +1, the stronger the relationship between the two constructs is considered.

Discussion

This study is motivated by the Indonesian position as the largest producer of food waste in Southeast Asia (UNEP, 2021) and the negative impact on socio-economics and the environment (Heidari et al., 2019; Stancu et al., 2015; Tsai et al., 2020). Furthermore, it predicts the determinants of food waste reduction intention in the young generation of Indonesia using

the extended TPB framework. The results showed that perceived behavioral control, food consumption, and level of religious knowledge positively and significantly influenced food waste reduction intention. In addition, attitude toward the behavior, subjective norm, and financial attitude failed to show a significant effect.

Perceived behavioral control significantly predicted food waste reduction intention among the young generation and was consistent with previous research (Coşkun & Özbük, 2020; Teoh et al., 2021). Therefore, a higher intention for food waste reduction is shown when the young generation has the power to control behavior to minimize the practice. The influence of the PBC variable is also considered greater than consumer attitudes toward food waste reduction and developing consumer behavior control mechanisms (Aydin & Aydin, 2022).

The results show that perceived behavioral control is related to religious values and consumption culture, which affects food waste reduction intention (Elshaer et al., 2021). Consumers who feel obliged to reduce food waste show the behavior of throwing away less food so that the amount of food wasted will decrease (Abu Hatab et al., 2022). PBC and guilt about religion also encourage better food management behaviors to prevent food waste (Attiq et al., 2021; Soorani & Ahmadvand, 2019). In online food purchases, perceived behavioral control also affects food waste reduction intention (Jia et al., 2022). Consumers who do not have strong self-control discard food waste due to information asymmetries, such as many portions and unpalatable foods.

The level of knowledge is a significant determinant of food waste reduction intention, in line with Attiq et al. (2021). With a higher level of knowledge, the young generation has a more favorable intention for reducing food waste. Knowledge and issues related to food waste have been proven to promote the reduction of food waste in the young generation. This can happen because they already have information about the negative impacts that may be caused by food waste. This shows that respondents' knowledge level realizes that food waste has an environmental, social, and economic impact, endangers the environment, contributes to increasing global warming, and emits GHG (Table 1). Higher knowledge of food waste also encourages consumers to have better food planning (Falasconi et al., 2019; Richter, 2017). Previous studies provided empirical evidence on increasing knowledge and awareness of the young generation regarding food waste, as in Malaysia (Selahudin et al., 2020) and Italy (Principato et al., 2015).

Food consumption patterns significantly and positively influence food waste reduction intention. These validate previous results from Elshaer et al. (2021) and Wajon and Richter (2019). The implications are that improvements in consumption patterns will reduce food waste. The positive influence of the young generation's food consumption patterns on food waste reduction intentions may occur for several reasons. First, most respondents are college students with no income or limited financial conditions. Hence, they are cautious when planning food purchases and consumption to avoid food waste. Second, this generation continuously checks food stock before buying other products to prevent waste (Ghinea & Ghiuta, 2019). Third, the young generation generally has a high level of awareness regarding the product expiration date and continuously checks before making a purchase (Ghinea & Ghiuta, 2019). Fourth, the young generation is more optimistic about climate-friendly behaviors, such as avoiding food waste (Kymäläinen et al., 2021). Even though most individuals may not have the cooking skills useful in overcoming the problem of food waste, there is a high interest in learning many things, including food waste management (Kymäläinen et al., 2021). In addition, most of the younger generation have a "bad feeling"

when they have to throw away food waste because they think there are still many hungry people and the food waste problem must be solved immediately (Lemy et al., 2021).

The other results show that the intention to reduce food waste is significantly influenced by religious knowledge. Religious knowledge is the most important predictor of food waste reduction intention in this context. This result is in line with previous research, which shows that knowledge and religious values affect food waste reduction in various countries, such as Saudi Arabia (Azazz & Elshaer, 2022), China (Qian et al., 2022), India (Dhar et al., 2021), and Poland (Filimonau et al., 2020). This significant effect occurs because religiosity strongly determines moral behavior, so it can prevent religious people from engaging in socially unethical practices such as throwing food away (Azazz & Elshaer, 2022). As a Muslim-majority country, Indonesian society, including the young generation, is guided by Islamic teachings in the form of halal and haram rules in the consumption of food and beverages (Tuhin et al., 2022). Criteria of Muslim food must also be good for the body (Niri, 2021), and Muslims are prohibited from overeating because it is considered a "sin" (Özbük et al., 2022). Some Islamic guidelines increase consumers' appreciation of food, prevent waste (Sobian, 2022), and reduce purchases (Azazz & Elshaer, 2022). This certainly affects the inclination of Muslim consumers to consume food and adequately mitigates the prevalence of food waste. In this context, religious knowledge influences food waste reduction intention more significantly, resulting in less food waste.

The level of religious knowledge can impact food waste reduction through three mechanisms (Qian et al., 2022). First, food has symbolic meaning in every religion, and most religions oppose food waste and teach food storage as a virtue and a measure of respect. Secondly, religious beliefs can indirectly influence adherents' attitudes toward food and raise their self-awareness to reduce food waste. Third, most religious teachings propose a moderate diet, which contributes to reducing food waste.

Food waste generated during social activities associated with cultural practices and religious celebrations is also becoming a serious challenge as food is generally prepared in large quantities and not entirely consumed (Phasha et al., 2020). In Arab countries, sociocultural influences in consuming food related to religious rituals contribute to food waste problems, such as the large amount of food wasted during Ramadan (Dhar et al., 2021). This is due to the misunderstanding of the Islamic advice to be generous, giving rise to buying excessive food for alms (Sobaih, 2023). In the case of Indonesia, cultural influences are also found in religious rituals such as at weddings, where guests often waste food and excess food is provided by the host. However, in the traditional view, providing excess food for guests is considered normal even if the event is organized and attended by Muslims. It relates to religious rituals but can be viewed as a socio-cultural issue (Dhar et al., 2021). Therefore, religious leaders must be more proactive in encouraging awareness to prevent food waste.

Hypothesis testing of other variables shows that the primary TPB variable, subjective norm, has no significant effect in predicting food waste reduction intention, consistent with a previous study conducted by (Coşkun & Özbük, 2020; Mondéjar-Jiménez et al., 2016; T'ing et al., 2021). This phenomenon occurred because discarding food was not observable to others, failing to exert social pressure on individuals engaged in this behavior. Moreover, there were no strict social norms to prohibit food waste disposal that could prevent the behavior of throwing food waste.

Another essential TPB variable, attitude toward the behavior, did not significantly predict food waste reduction intention, as Teoh et al. (2021) reported. Many respondents continue to

reside with or receive financial support from parents. Consequently, they may not fully appreciate the significance of minimizing food waste. Another contributing factor is the perception held by many respondents that their contributions are minimal. The extended TPB variable, specifically the financial attitude, fails to exert a discernible influence on determining food waste reduction intention. Therefore, respondents show reduced motivation to prevent food waste, primarily attributable to financial considerations. This can happen because respondents are less concerned about the financial implications that arise due to food waste. The reasons that can be the basis for this are that most respondents are college students who have not made money independently or that the purchase of food is still the responsibility of their parents.

Recommendations for food waste reduction and SDGs achievement in Indonesia

Achieving Sustainable Development Goals (SDGs) 2 and 12 in Indonesia cannot be separated from food waste reduction, specifically among the young generation, contributing to the high amount of food waste in Indonesia (Piselli et al., 2019), and the issue is considered important (Liu & Nguyen, 2020). Food waste reduction globally is a crucial challenge in developing sustainable systems (Falasconi et al., 2019). Therefore, formulating a reduction strategy based on the results of this study will contribute to achieving the SDGs. This study offers three practical implications for reducing food waste among Indonesia's young generation.

First, in line with the positive and significant influence of knowledge level on food waste reduction intention, one of the efforts made in food waste reduction is to increase the knowledge and understanding of the young generation. Previous studies conducted by Bhatti et al. (2023) discussed knowledge value as a powerful way to waste less food by creating awareness of the effects on the environment. Knowledge of food waste can be improved through education, providing incentives, and promoting role models (Gokarn et al., 2023; Pinto et al., 2018; Yagoub et al., 2022). The formulation of a curriculum based on the concept of sustainability development can be applied in formal education by introducing the issue of food waste. Increasing knowledge can also be conducted by providing education and campaigns on various social media platforms, which are popular among the young generation. Efforts to increase knowledge and awareness are the responsibility of the young generation, parents, and policymakers. Food manufacturers can also increase consumer knowledge by informing consumers about the environmental impact of the food through labeling.

Second, as the most critical predictor of determining the intention of reducing food waste among the young generation in Indonesia, it is essential to increase understanding and application of religion concerning food waste. Therefore, the leaders of religion can play a more significant role in promoting the awareness of the young generation in food waste reduction through religious activities at various levels of education. The religious figures are also expected to be role models for managing food waste daily.

Third, the food waste reduction strategy from the perspective of perceived behavioral control and consumption patterns is to manage better consumption by planning routine (Cammarelle et al., 2021). This management approach is implemented to mitigate the factors identified as contributors to food waste. The factors primarily include the constraint of limited time

available for processing food waste and challenges associated with accurately estimating consumption within the family. Effectively managing food waste commences with control of shopping, where the young generation is promoted to be mindful of the needs and the quantities purchased. This approach prevents impulsive buying, often leading to food waste (Clement et al., 2023). Other efforts can be made to promote the use of food waste for reprocessing (Kim et al., 2020). Moreover, using food waste as pet food presents an option when consumers perceive time constraints in managing food waste. From the producers' perspective, good strategies include creating food products with extended shelf lives, using more compact packaging dimensions, enhancing time-labeling to produce better information, and formulating a price promotion strategy, avoiding excessive aggressiveness.

Schanes et al. (2018) suggested that responsibility for preventing and reducing food waste should not be focused on the individual. Therefore, efforts in food waste reduction are a joint task for the young generation, practitioners, producers, and policymakers. Promoting food waste reduction must start with the young generation because changing consumption behavior requires time, awareness, and the inclusion of many parties, so it must begin with the young generation by educating them on environmental issues (Ghinea & Ghiuta, 2019). The young generation plays a vital role in overcoming the challenges of an unsustainable food system associated with creativity, enthusiasm, and advocacy (Piselli et al., 2019). The results of this study significantly contribute to SDGs, which are part of the UN agenda by 2030.

Conclusions

In conclusion, testing the extended TPB model using SEM-PLS showed that perceived behavioral control, food consumption, religious knowledge level, and level of knowledge were positively and significantly associated with food waste reduction intention. Meanwhile, attitude toward the behavior, subjective norm, and financial attitude had no significant effect. The level of religious knowledge was the most crucial predictor that determined the young generation's intention to reduce food waste. Extended SDGs increased the model's strength in determining food waste reduction intentions in the young generation in Indonesia.

Based on the test results of the model, the three practical implications offered to food waste reduction are increasing the knowledge and understanding of the young generation, increasing the interpretation and application of religion related to food waste in the young generation with the active role of religious leaders, and better consumption management by making regular food plans. The synergy between the young generation, practitioners, producers, and policymakers was needed to prevent and reduce food waste. Ultimately, this is expected to significantly reduce food waste and further contribute to achieving the SDGs in Indonesia.

This study contributes to the existing investigation on the food waste reduction objectives of the young generation, specifically in developing countries such as Indonesia, which is still limited. The introduction of extended variables, such as food consumption, level of religious knowledge, level of knowledge, and financial attitude, has increased the model’s strength in explaining food waste reduction intention. This study also included respondents with even representation from each archipelagic region. Based on extended TPB testing, three practical implications are offered in food waste reduction and further contributing to achieving SDGs in Indonesia.

Several gaps can be used as material for further development. This study is limited to predicting food waste reduction intention without measuring actual food waste behavior, even though previous studies reported that intention was positively correlated with behavior. Adding other predictors to increase the model's explanatory power was necessary for future studies, such as using more detailed religious predictors, namely religious holidays, culture, and customs.

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