

Determinants of Food Waste Behavior in Muslim Household Food Consumption in Indonesia

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Abstract. Islam forbids wasteful behavior in all activities, yet Indonesia, with the world's largest Muslim population, is the second largest contributor to food loss and waste, with household consumption being the largest contributor. This study examines the factors influencing *tabzir* (food waste) behavior in Indonesian Muslim households and their relationship with religiosity in reducing *tabzir* behavior. The method used was a survey of 529 Muslim household respondents, and data analysis was performed using the structural equation modeling–partial least squares (SEM-PLS) approach. The results showed that routine shopping and eating habits had a positive impact on food waste; the worse the shopping behavior and eating habits, the more food wasted. On the other hand, awareness, religiosity, religious norms, and knowledge negatively influence food waste. Thus, the better the level of awareness, knowledge, religiosity, and religious norms, the less food is wasted. While awareness, knowledge, religiosity, and religious norms can help lessen food waste, they are insufficient without regulations on unethical consumption.

Key words: Household food consumption, sustainability, *tabzir* behavior.

Abstrak. Islam melarang perilaku boros dalam segala aktivitas, namun Indonesia, dengan populasi Muslim terbesar di dunia, merupakan penyumbang terbesar kedua dalam hal kehilangan dan pemborosan makanan, dengan konsumsi rumah tangga sebagai penyumbang terbesar. Penelitian ini mengkaji faktor-faktor yang mempengaruhi perilaku *tabzir* (pemborosan makanan) pada konsumsi makanan rumah tangga Muslim Indonesia dan hubungannya dengan religiositas dalam mengurangi perilaku *tabzir*. Metode yang digunakan adalah survei terhadap 529 responden rumah tangga Muslim, dan analisis data dilakukan dengan menggunakan pendekatan Structural Equation Modeling-Partial Least Square (SEM-PLS). Hasil penelitian menunjukkan bahwa rutinitas belanja dan kebiasaan makan berdampak positif terhadap pemborosan makanan; semakin buruk perilaku belanja dan kebiasaan makan, semakin banyak makanan yang terbuang. Di sisi lain, kesadaran, religiositas, norma agama, dan pengetahuan berpengaruh negatif terhadap pemborosan makanan. Dengan demikian, semakin baik tingkat kesadaran, pengetahuan, religiositas, dan norma agama, maka semakin sedikit makanan yang terbuang. Meskipun kesadaran, pengetahuan, religiositas, dan norma agama dapat membantu mengurangi pemborosan makanan, hal tersebut tidak cukup tanpa adanya peraturan tentang konsumsi yang tidak etis.

Kata Kunci: Keberlanjutan, konsumsi rumah tangga, perilaku *tabzir*.

INTRODUCTION

As the world's population increases, the demand for food continues to increase, whereas resources such as the availability of land and clean water decrease. According to the World Bank, the world's population was approximately 7.594 billion in 2018 (The World Bank, 2019a). The world's poor are estimated at 10% or nearly 800 million of the world's total population, assuming a daily income per person of less than USD 1.9 (The World Bank, 2019b). However, approximately one-third of food is

wasted worldwide (Food and Agricultural Organization, 2019b). Consumers in developed countries waste approximately 222 million tons of food annually, which is almost the same as the total production in sub-Saharan Africa (approximately 230 million tons) (Food and Agricultural Organization, 2019a).

The type of food wasted every year worldwide is estimated to be 30% cereals, and 40-50% tubers, fruits, and vegetables. Approximately 20% is wasted from oil seeds, meat and milk, plus 35% from fish (Food and Agricultural Organization, 2019a). Households were the largest contributors to food waste (USD 144B), followed by supermarkets (USD 18.24B), full-service restaurants (USD 15.98B), farmers (USD 15 B), food institutions and services (USD 11.4B), limited-service restaurants (USD 9.12B), factories (USD 2B), and the government (USD 1.14B). The Barilla Center of Food and Nutrition issued a list of the four largest contributors to food loss and food waste per capita per year in the world, namely Saudi Arabia (427 kg) and Indonesia (300 kg), followed by the United States (227 kg) and the United Arab Emirates (196 kg) (Barilla Center of Food and Nutrition, 2019).

Large quantities of food waste have a negative impact not only on the environment (Lahiri et al., 2023) but also on food security and the global, regional, national, and monetary economies (Parizeau et al., 2015). Household food waste contributes greatly to environmental problems, such as climate change and the extensive use of limited natural resources, such as water and land (Schmidt, 2016). The negative impact of food waste on society is a lack of food for the world's population (Stancu et al., 2016). The total avoidable food waste is estimated to cost UK households up to £480 per year, representing approximately 15% of the total household expenditure on food and drink (WRAP, 2009), while in the United States, it is estimated to be around \$936 per household per year (Buzby and Hyman, 2012). In developed countries, consumers are among the largest sources of food waste. Consumer motivation to avoid food waste, management skills in food supply and handling, and food priority selection influence food waste behavior (Aschemann-Witzel et al., 2015).

Food waste (*tabzir*) behavior is related to the ethics and norms adopted by adherents (Asyari et al., 2024). Religion is an aspect of culture that can influence a person's values, behavior, and habits (Delener, 1994). An act is judged to be good or bad depending on the beliefs or levels of religiosity and religious norms adopted and carried out by these individuals (Pastwa-Wojciechowska et al., 2021). Religiosity includes personal beliefs, such as belief in God or a higher power, and organizational or institutional beliefs and practices, such as church membership, attendance at places of worship, and commitment to the religious belief system they adhere to, including the norms of good and bad that an act is believed to originate from the religion he professes (Zinnbauer et al., 1997). Islam forbids wasteful behavior in all activities (Shompa et al., 2024). However, Indonesia, with the world's largest Muslim population, is the second largest contributor to food loss and waste, with household consumption being the largest contributor, while food waste harms sustainability.

Food waste behavior is included in satanic behavior in Islam and is strictly prohibited in the Qur'an "*And give to close families their rights (zakat, infak, sadaqah), to the poor and people who are on the way and do not waste (your wealth) extravagantly. Verily, the spenders (mubazirin) are the brothers of Satan, and the devil is a complete disbeliever in his Lord*" (Quran, 17: 26-27). The Prophet Muhammad (PBUH) advised humans to finish food and not leave it when eating, if a bite of food among your falls, then let him clean his dirt and (after that) let him eat it and not leave it to the devil. Anas said: "*And he ordered us to finish the food from the plate.*" He also said, '*Indeed, you do not know in which food there is a blessing*' (Sahih Muslim No. 2034).

But on the other hand, Muslim countries such as Saudi Arabia and Indonesia are among the countries that waste the most food. This contradicts the religious teachings adopted by the majority of the population in the country. According to Choudhury, the concerns of Islam in consumption and criticism of the capitalist economy are: (1) Muslims should prioritize their consumption of basic needs and be able to live properly, while the consumption of luxury goods that cause excessive consumption

is prohibited; and (2) excessive production and consumption in various ways is highly discouraged, especially as it causes wasted resources, both in production and consumption (Choudhury, 1986).

Meanwhile, there are five principles of consumption in Islam, namely; principles of justice, cleanliness, modesty, generosity, and morality (Mannan, 1997; Afif, 2017). *Israf* or excessive consumption can be reduced by the obligation of zakat and alms to the rich. The allocation of consumption by the rich moves to the poor so that they can meet their consumption (Choudhury and Khan, 1986).

Indonesia has the largest Muslim population in the world. Indonesia's population in 2020 was around 270.20 million people (Badan Pusat Statistik, 2020). There are approximately 1.9 billion Muslims worldwide, making Islam the second-largest religion in the world after Christianity. The total population of Muslims is 87.20%, or 229 million people, accounting for 12.7% of the world's Muslim population (World Population Review, 2021). Meanwhile, the poor population in Indonesia in urban areas in September 2020 was 12.04 million people, and the poor in rural areas were 15.51 million people (Badan Pusat Statistik, 2020). The high level of poverty in Indonesia shows that there are still many Indonesian people who need food and drink for consumption, while on the other hand, many people throw away their food when consuming it. Indonesia has one of the fifth largest populations in the world, with a fairly high level of hunger (approximately 22 million) from 2016 to 2018 (Asian Development Bank, 2018).

The Indonesian Ministry of National Development Planning/National Development Planning Agency (PPN/Bappenas) stated that food loss and waste in Indonesia reached 23–48 million tons/year from 2000 to 2019, equivalent to 115–184 kg/capita/year. Food loss occurs in the first three stages: production, postharvest and storage, and processing and packaging. Meanwhile, food waste occurs in the last two stages, namely, the distribution and marketing stages, and the consumption stage. Over the last 20 years, the percentage of food loss in Indonesia has declined from 61% in 2000 to 45% in 2019, with an average of 56%. Meanwhile, the percentage of food waste increased from 39% in 2000 to 55% in 2019, with an average of 44%. The largest amount of food loss occurs during the consumption stage, with a total of 5–19 million tons per year. Food that is mostly discarded from the food crop sector in the form of grains, is 12-21 million tons/per year. Meanwhile, the type of food that is wasted a lot in the horticultural sector is vegetables, with losses reaching 62.8% of the entire domestic supply of vegetables in Indonesia (Bappenas, 2021).

Indonesia, with a Muslim-majority population, is one of the largest contributors to food waste worldwide. Households contribute the most to food waste, whereas Islam strictly prohibits food waste behavior. Food waste has adverse environmental, economic, and social impacts, as well as adverse impacts on the country's food security. Therefore, it is necessary to study the factors that influence food waste behavior in Muslim households in Indonesia. The purpose of this study was to examine both positive and negative factors that influence behavior of food waste in Muslim households. In this study, the variables of religiosity, religious norms, knowledge, awareness, and philanthropy were used to examine their negative relationship with food waste behavior. Meanwhile, demographics, income, routine spending, and eating habits were used to determine a positive relationship with food waste behavior.

LITERATURE REVIEW

Consumption in Islam has a good purpose in meeting human needs so that people can perform their duties as caliphs on Earth (Sadali et al., 2024). The goal of consumption in Islam is to achieve individual and social welfare (*maṣlahah*), and the higher goal is to achieve the pleasure of God (Furqani, 2017). Islamic economics exists to criticize the capitalist economy and straighten consumption in a capitalist economy by (1) a Muslim's consumption priority is the fulfillment of basic needs to be able to live properly, so it should not be excessive; and 2) there should be no waste of

resources in all aspects of the economy, especially in production and consumption activities (Choudhury, 1986).

The consumption of a Muslim should be less than that of others because Muslims do not drink alcohol, gamble, or buy forbidden food (Metwally 1997). The consumption of luxury goods that cause waste is prohibited in Islam; therefore, the amount of food waste in Muslim countries should be less than that in countries with non-Muslim populations. In addition, there is an obligation to share items such as zakat, infaq, and alms, which can also reduce Muslims' food consumption (Iqbal, 1985), so that little food is wasted.

Khan argued that consumption has four dimensions: moderation, excess (*israf*), extravagance (*tabzir/waste*), and stinginess (*bakhil*). Every society consists of various social strata; therefore, the consumption dimensions mentioned above have different meanings in each stratum. The level of consumption that is considered extravagant in one social stratum can be considered a necessity in another. Therefore, these four dimensions do not have a single definition for the entire economy. Instead, the definition differs according to the social stratum. There are several aspects of consumption factors. Among these, three are significant: personal consumption, social consumption, and public spending. Greed and covetousness can lead to high levels of material well-being but lower levels of happiness, whereas the highest levels of happiness occur because of the moderation of income and expenditure. While excessive behavior and extravagance reduce the level of happiness, the level of material well-being is higher (Khan, 2020).

Wasteful behavior is a major factor in wasting edible foods. Food waste prevention and management are effective policies for preventing food waste at the household level (Abiad and Meho, 2018). Tackling food waste can save more than 20% of the overall food production and feed millions of people (Dou et al., 2016). In addition, education level, sorting rules, attitudes, and concern for food waste are related to individual behavior toward food waste (Secondi et al., 2015). This can strengthen a country's food security and reduce its negative impacts on resources and the environment. Technological innovations and policy interventions to reduce food waste (Casonato et al., 2023; Oroski and da Silva, 2023) are among the main strategies for fighting hunger and feeding the poor.

In European Union countries, fresh fruits and vegetables contribute almost 50% of household food waste that is disposed of; the waste of fruits and vegetables that are disposed of per person is 21.1 kg per person per year, but if implementing a prevention strategy, food waste can be minimized by around 14.2 kg per person per year (De Laurentiis et al., 2018). Food waste is influenced by consumptive behavior (Diana et al., 2024; Vittuari et al., 2023), and consumptive behavior is influenced by many factors, including lifestyle and financial literacy affecting consumptive behavior (Pulungan and Febriaty, 2018). Consistent behavior is also influenced by the level of economic literacy (Solihat and Amasik, 2018). Social media, such as Instagram, also have an influence (Miranda and Lubis, 2017). In addition, eating frequency and sex have a significant effect on food waste (Mandasari, 2018).

This study uses the theory of planned behavior (TPB) (Ajzen, 1991). This theory can predict behavioral intentions that are environmentally conscientious, particularly those connected to food. Behavioral intention might be viewed as a motivator since it is thought that customers detest waste (Connor and Armitage, 2002). Three factors are used by TPB to forecast a person's likelihood of engaging in an activity: (1) beliefs about what constitutes appropriate action form the basis of attitudes, which are then reinforced by the advantages of the behavior; (2) the influence of those around you to engage in this conduct or not is known as the subjective norm; and (3) an actor's sentiments of how simple or difficult behavior is to do are referred to as behavioral control (Bhatti et al., 2023).

Variables and Hypothesis

Income affects the purchase of goods and services (Hernández et al., 2011). The number of items purchased depends on household income (Picchioni et al., 2022; Unnikrishnan and Figliozzi, 2020). Therefore, household income is positively related to consumption; the higher the household income, the more goods and services that can be purchased. High-income households can buy things they like, including food, even if they do not need them. Due to excessive food purchases, food is finally wasted (Thi et al., 2015).

Food waste behavior in lower-middle-class families is caused by buying in bulk, lack of planning, and preference for large packages, such as buying groceries in bulk, monthly shopping, preference for supermarkets, and cooking from scratch, resulting in more food waste (Porpino et al., 2015). The practice of providing daily food to households also affects food waste, such as shopping, cooking, and eating. Policymakers and the food industry can implement effective strategies to influence food waste through training, education, socialization, educational interventions, and improving food preparation skills. Food shopping planning has a positive effect on reducing food waste (Romani et al., 2018). In Islam, there is an obligation to tithe, and it is recommended to infaq and alms; people who have a high income will donate more than those with a low income.

H1: Income has a positive effect on food waste

H2: Income has a positive effect on philanthropy

Household eating habits can affect the amount of food waste. The better the consumption behavior of a household, the less food is wasted (Aschemann-Witzel et al., 2015). Good consumption behavior, such as family members often eating at home, bringing lunch to school and work, finishing the food served, storing unfinished food for reconsumption, cooking, and preparing food as needed. Non-cognitive behaviors, namely emotions and habits, can reduce food waste (Russell et al., 2017). Food waste behavior is also influenced by intentions, planning, and shopping routines as well as moral attitudes and subjective norms that affect food waste (Stefan et al., 2013). Variances in intentions, attitudes, subjective norms, perceived behavioral control, self-identity, and anticipated regret have emerged as significant predictors of reducing food waste (Graham-Rowe et al., 2015). Potential factors of consumer food waste are categorized into behavioral, personal, product, and community factors and sub-groups (Qian et al., 2021; Roodhuyzen et al., 2017).

H3: Eating habits and consumption patterns have a positive effect on food waste

The shopping routine is affected by the distance from home to supermarkets (Read and Muth, 2021; Stancu et al., 2016). Residences in urban and rural areas also affect household consumption patterns (Monge-Rojas et al., 2013). Households living in rural areas have different consumption patterns than those living in urban areas. Access to goods and services is easier in urban areas than in rural areas; therefore, people in urban areas buy more food than those in rural areas because of the ease of access to shopping. In urban areas, the food supply is greater than that in rural areas. The greater the supply of food, the more income allocation is spent on food consumption (Witt, 2001), therefore, food waste in urban areas is much higher than that in rural areas (Secondi et al., 2015; Vargas-Lopez et al., 2021).

In addition, the number of household members determines the amount of food consumed (Abdullah et al. 2015). The greater the number of household members, the more food that will be bought and wasted. Countries with dense populations contribute more food waste than countries with small populations (Thi et al., 2015). This indicates that the number of people in a family affects food waste. Many households do not plan the food and drinks to be purchased, therefore, they buy foods and drinks that are not needed and do not suit their tastes. Ultimately, they are neither eaten nor wasted. Routine shopping is influenced by moral norms, attitudes, commitments, and planning, which can reduce the amount of food waste (Stancu et al., 2016; Stancu and Lähteenmäki, 2022); the worse the routine household shopping, the more food that is discarded.

H4: Demographics have a positive effect on food waste

H5: Routine shopping has a positive effect on food waste

H6: Routine shopping has a positive effect on eating habits

Household awareness of the dangers of food waste harms consumptive behavior (Priefer et al., 2016). The more aware a household is that throwing food away is unacceptable, the less food that will be discarded. Awareness increases motivation or the intention to not waste food. Intentions play a role in consumption behavior (Lim et al., 2016), people consume what and how they behave in consumption, and food waste is influenced by intentions. The higher the level of awareness, the less food that will be discarded (Secondi et al., 2015; Vargas-Lopez et al., 2021). Consumer motivation to avoid food wastage, management skills in food supply and handling, and choosing priority foods to buy have a positive influence on the least amount of food waste (Aschemann-Witzel et al., 2015).

H7: Awareness hurts food waste

Knowledge of and attitudes toward the environment contribute to perceptions, awareness, and participation in community-based recycling projects (Singhirunnusorn et al. 2012). A person's knowledge of the negative effects of wasting food has a positive impact on their attitude and influence in choosing healthy foods (McDonnell et al., 1998). Knowledge also has a significant impact on waste reduction (Akhtar and Soetjpto, 2014). Knowledge and behavior are positively related to environmental preservation (Fox et al., 2018; Tilikidou, 2007). Knowledge about the negative effects of food waste will prevent households from being frugal and wise in consumption because knowledge will affect a person's perception and behavior. Thus, the better a person's knowledge of the negative effects of food waste, the more they will avoid food waste behavior (Kasavan et al., 2018).

H8: Knowledge has a positive effect on awareness

H9: Knowledge hurts food waste

Philanthropy arises from a person's high sense of empathy (Sidiq et al., 2021; Savitri and Purwaningtyastuti, 2020). Philanthropy arises due to spiritual intelligence (Diyai et al., 2019); the better the level of spiritual intelligence, the higher the generosity. One of the signs of pious people is those who are generous, both in the field and in difficult conditions (Quran, 3:133-134). The more empathetic someone is, the more caring for others (Ni'mah, 2017). Households that are accustomed to giving part of their wealth to the poor and needy will slightly reduce their income allocation for consumption because part of their wealth is given to those in need. The higher a person's generosity, the more he shares will reduce the allocation of consumption so that it will reduce food waste consumption (Quran,17: 26-27).

H10: Philanthropy hurts food waste

Religiosity is related to consumptive attitudes, which harm consumptive behavior (Purwadi, 2007). Religiosity also affects economic behavior (production, distribution, and consumers) (Ma'zumi et al., 2017). Religiosity has a positive effect on self-enhancement (Sedikides and Gebauer, 2010). Religion influences adherence to economic choices (Benjamin et al., 2016). Beliefs, morals, expectations, social identities, political ideologies, and religious beliefs influence a person's behavior, leading to sustainable "social awareness" (Bénabou and Tirole, 2016). More religious consumers are more likely to participate in sustainable behavior. In contrast to Christians and atheists, deeply religious Buddhists are more likely to participate in sustainable behavior (Minton et al., 2015; Minton et al., 2019).

H11: Religiosity hurts food waste

H12: Religiosity has a positive effect on awareness

H13: Religiosity has a positive effect on philanthropy

Religion has an important influence on the lives of the majority of the world's population, 80% of the world's population is religiously affiliated (Hackett et al., 2012). For example, more than 70% of Americans state that religious beliefs influence their daily behavior. Religion influences consumer behavior, such as information seeking and product innovation (Hirschman, 1981). Studying the effect of religion on consumer behavior is important, among other things, because consumers communicate their religious identity to others and express the intensity of their beliefs through consumption choices (Mathras et al., 2016; Singh et al., 2021; Coşgel and Minkler, 2004).

Al-Quran mentions that worship practices, beliefs, and religious communities can influence a person's behavior “*worship activities will prevent someone from doing bad things*” (Quran, 29: 45), so that pious people will obey the orders of their religion and people who are diligent in worship will obey the prohibition of wasteful behavior in consumption. Religion affects morality (Bloom, 2012) and norms (Willard et al., 2020). Moral aspects are important in explaining consumer food choice behavior (Raats et al., 1995). Moral aspects seem relevant to food waste behavior, and consumers feel guilty or annoyed to some extent if they waste food (Burlea-Schiopoiu et al., 2021; Le Borgne et al., 2021; Lyndhurst et al., 2007). There is an important difference between social and descriptive norms. Social norms are generally agreed upon or rejected in culture by society, such as shared beliefs about how to behave, called norms (normative). Descriptive norms refer to what exists and is usually done in society, but what is usually done is not necessarily true (Reno et al., 1993).

H14: Religious norms hurt the behavior of food waste

H15: Religious norms have a positive effect on awareness

METHOD

This study uses a survey of Muslim households in Indonesia in collaboration with zakat institutions, small and medium business communities, housewives' communities, and others, which were spread across several major islands in Indonesia (Java, Sumatra, Kalimantan, Sulawesi, Irian Jaya, Bali, and Nusa Tenggara). The sampling of respondents was conducted from March to September 2021. The questionnaires were distributed online using Google Forms via social media or email.

The population of households in Indonesia is approximately 68,700,700 (Badan Pusat Statistik, 2020), and the population of Muslims in Indonesia is 87%. Thus, the total population of Muslim households was 59,769,609. Sampling was determined using the table approach of Isaac and Michael (1995), where when the population is more than 1,000,000 or infinity, then the minimum sample taken with alpha (α) of 1% is 664 samples, alpha (α) of 5% is 349 samples, and alpha (α) level 10% is 272 samples. This study used an alpha (α) of 5%; therefore, the minimum number of samples or respondents was 349. However, the authors sampled as many as 529 participants. All questions on behavior used a Likert scale ranging from 1 to 5, with 1 = strongly disagree and 5 = strongly agree.

The data analyzed in this study used the Structural Equation Model (SEM) using SmartPLS 3.0 software. SEM Partial least squares (PLS) is a powerful analytical method that is often referred to as soft modeling because it eliminates the assumptions of ordinary least squares (OLS) regression. For example, the data must be normally distributed in a multivariate manner, and there is no multicollinearity problem between exogenous variables (Wold, 1982). Wold developed PLS, which tested weak theory and weak data, such as small sample size or data normality problems (Wold, 1983). Although PLS is used to explain whether there is a relationship between latent variables (prediction), it can also be used to confirm this theory.

PLS-SEM has five stages: (1) conceptualizing the model, (2) determining the logarithm analysis method, (3) determining the sampling method, (4) drawing a path diagram, and (5) evaluating the model (Hair et al., 2017). Validity and reliability tests were conducted to assess the measurement model. The reliability test used Composite Reliability; if the value was greater than 0.70, it met the reliability test (Hair et al., 2017). A validity test was conducted using discriminant and convergent validity. Items from the variables related to the variable were evaluated for convergent validity. Convergent validity is met if the average variance extracted (AVE) is greater than 0.50 (Hair et al., 2017). After completing the validity and reliability tests and looking at the R-square, the next step was to test the significance of the structural model coefficients using bootstrapping.

Table 1 Variables measurement for the determinants of food waste behavior in Muslim household food consumption in Indonesia

Variables	Indicators
Food waste behavior	The intensity of wasting food and drink on average every day
Income	Income of all household members and income allocation for one month's consumption
Eating Habit	Daily eating habits of family members, preparing meals, treating daily meals
Routine shopping	Behavior of family members in shopping for food and beverages
Demography	Number of family members, education of head of family, location, distance from house to market or supermarket
Awareness	Awareness of family members not to waste food and drink in a day
Knowledge	Knowledge of the adverse effects of food waste behavior
Philanthropy	The willingness of the family to pay zakat, infaq, alms, Islamic endowments (ZISWAF) and as well as help others when in financial difficulties
Religiosity	Obedience in carrying out worship, both obligatory worship and sunnah worship
Religious norms	Norms that are believed to be based on Islamic religious beliefs related to food waste

Source: Authors, 2021.

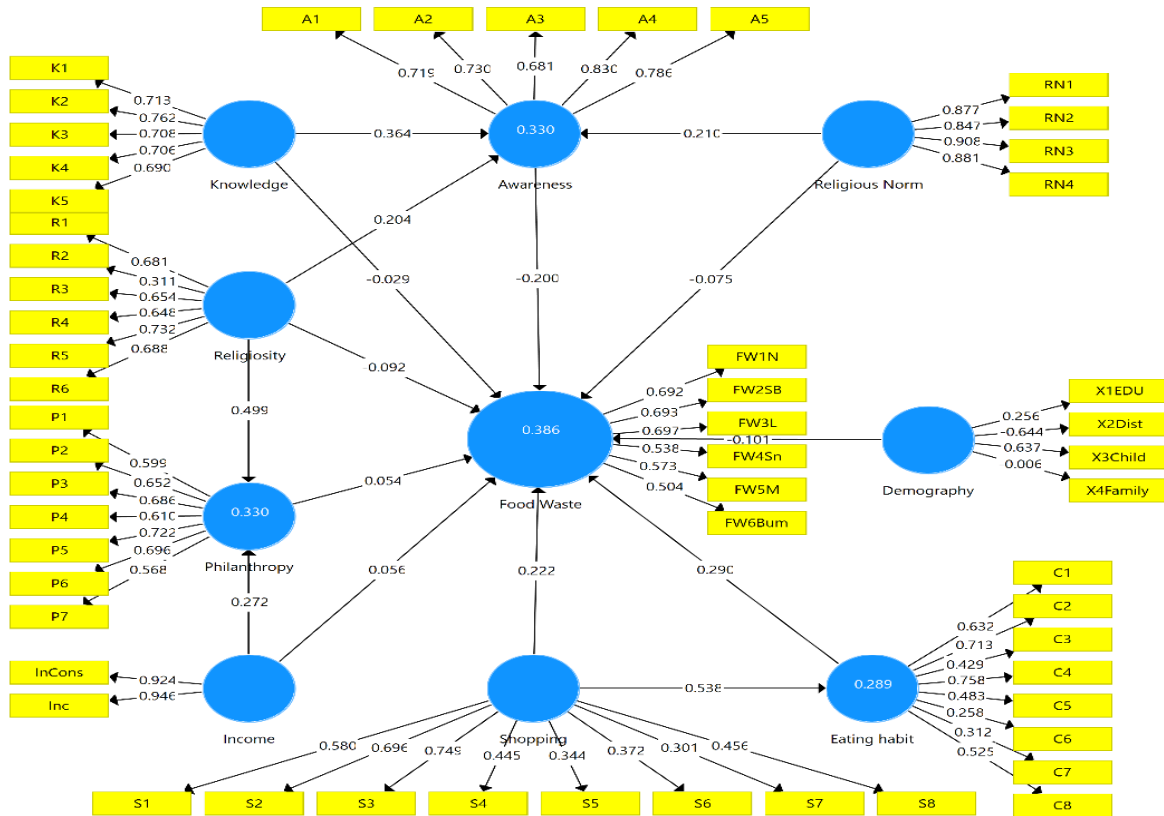
RESULT AND DISCUSSION

Result

The respondents included 349 women (66%) and 180 men (34%). The education level of the head of household consisted of 227 diploma/bachelor's graduates (43%), 176 High School graduates (33%), 60 postgraduates (11%), 25 Junior High School graduates (5%), and School Basic 8 people (8%). The type of work of the household heads of respondents was dominated by private employees as many as 145 people (27%), followed by entrepreneurs/SMEs 99 people (19%), public servants, police, and the army as many as 85 (16%), other types of work, such as photographers, online drivers, etc., as many as 75 people (14%), 41 teachers and lecturers (8%), 38 farmers/fishers (4%), 18 entrepreneurs (3%), and 8 professionals (2%).

There were 186 respondents (35%) in rural areas, 168 (24%) in urban areas, and 175 (25%) in suburban areas. The total income of the respondent households per month with the exchange rate of the rupiah against the US dollar is IDR 14,000/\$1, with an income of USD 35 to USD 143 for as many as 84 households' incomes of USD 143 to USD 357 for as many as 190 households, an income of USD 358 to USD 571 for as many as 97 households, an income of USD 571 to USD 857 for as many as 75 households, and an income above USD 857 for as many as 83 households.

After several tests, the data were deemed to be reliable and valid. This can be observed in the outer loading of each indicator. The high outer loading on the constructs shows that the related indicators have many in common, which is captured by the constructs. This characteristic is also commonly referred to as indicator reliability. The minimum value and outer loading of all indicators must be statistically significant. The general rule is that the (default) outer loading should be 0.708 or higher. The established rule for outer loading is that the latent variable should account for a large part of any indicator of variance, typically at least 50%. This also implies that the variance shared between the construct and indicator is larger than the variance of the measurement error. This means that the indicator beyond loading must be above 0.708 because the squared number (0.708²) equals 0.50. In most cases, 0.70 is considered sufficiently close to 0.708 to be acceptable.



Source: Authors, 2021 (processed data).

Figure 1 Data test results with the calculated PLS algorithm using the SmartPLS3 software

The Cronbach’s alpha value for the demographic variable was 0.230 or below 0.6, whereas the values for other variables were above 0.6. Meanwhile, the Average Variance Extracted (AVE) value for variables whose value is below 0.5 is; eating habits 0.292, demographics 0.221, food waste behavior 0.386, philanthropy 0.422, religiosity 0.403, and shopping routine, 0.267. For the model to be reliable, an outer load with a small value must first be removed. Table 2 shows that all variables are reliable and valid, and all outer loadings with low values were dropped from the model so that further tests could be continued.

Table 2 Construct reliability result based on the research of determinants of food waste behavior in Muslim household food consumption in Indonesia

Variables	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Awareness	0.805	0.814	0.866	0.564
Eating habit	0.634	0.669	0.803	0.579
Food Waste	0.666	0.668	0.818	0.600
Income	0.857	0.867	0.933	0.874
Knowledge	0.763	0.763	0.840	0.513
Philanthropy	0.701	0.712	0.816	0.528
Religiosity	0.602	0.600	0.790	0.557
Religious Norm	0.901	0.902	0.931	0.772
Shopping	0.635	0.678	0.803	0.581

Source: Authors, 2021 (processed data).

From the results of the model test, we can see that all composite reliability values show values between 0.7 to 0.925 and still below 0.95, which is considered satisfactory. The Cronbach's alpha value is below 0.6, namely, demography with 0.230. Therefore, the demographic variables can be excluded. Cronbach's alpha for the demographic variable was 0.230 or below 0.6, whereas the value for the other variables was above 0.6. Meanwhile, the Average Variance Extracted (AVE) values for the values below 0.5 are; eating habits 0.292, demography 0.221, food waste behavior 0.386, philanthropy 0.422, religiosity 0.403, and shopping routine, 0.267.

For the model to be reliable, an outer load with a small value must first be removed. The high outer loading on the construction shows that the related indicators have many in common, which are captured by the construction. This characteristic is also known as indicator reliability. The minimum value and outer loading of all indicators must be statistically significant. Generally, the outer loading must be 0.708 or higher. A well-established rule for outer loading is that the latent variable should account for most indicators of variance, usually at least 50%. This also implies that the variance shared between the construct and its indicators is greater than that of the measurement error. This means that the indicator for offloading must be above 0.708 because the squared number (0.708²) equals 0.50. In most cases, 0.70 is considered sufficiently close to 0.708 to be acceptable.

Table 3 R square and R square adjusted result based on the research of determinants of food waste behavior in Muslim household food consumption in Indonesia

Latent Variable	R Square	R Square Adjusted
Awareness	0.337	0.333
Eating habit	0.201	0.199
Food Waste	0.328	0.318
Philanthropy	0.333	0.330

Source: Authors, 2021 (processed data).

The R² values of all variables were below 0.50. According to Hair et al. (2010), an R² of 0.75 indicates a strong model, 0.50 indicates a moderate model, and 0.25 indicates a weak model. Meanwhile, for research on community behavior, the value of R² at 0.2 is quite significant. Meanwhile, according to Chin (1998), R² has a value of 0.67 indicating a strong, 0.33 indicating a moderate, and 0.19 indicating a weak model. There were two variables with values above 0.33: awareness (0.337) and philanthropy (0.333).

The results of bootstrapping were significant. The critical values for the two-tailed test were 1.65 (significance level = 10%), 1.96 (significance level = 5%), and 2.57 (significance level = 1%), respectively. A significance level of 5% was considered for this test. The number of valid observations is 5,000 in the bootstrapping test. Hypothesis testing for path coefficients uses t-test statistics, where if the t-statistic is greater than 1.96 (α 5), it is said to have a significant effect. After completing the validity and reliability tests and looking at the R-value, the next step is to test the significance of the structural model coefficients using bootstrapping. From the results of this test, it can be seen which variables are significant, which are not significant, and which have positive or negative effects. The results of the coefficient significance test are as follows:

Table 4 The result of significance testing of the structural model path coefficients from the research of determinants of food waste behavior in Muslim household food consumption in Indonesia

Variables	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (O/STDEV)	P Values
Awareness -> Food Waste	-0.191	-0.193	0.057	3.338	0.001
Eating habit -> Food Waste	0.316	0.318	0.047	6.717	0.000
Income -> Food Waste	0.048	0.048	0.037	1.289	0.198

Table 4 The result of significance testing of the structural model path coefficients from the research of determinants of food waste behavior in Muslim household food consumption in Indonesia (continue)

Variables	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (O/STDEV)	P Values
Income -> Philanthropy	0.333	0.337	0.034	9.666	0.000
Knowledge -> Awareness	0.363	0.364	0.056	6.526	0.000
Knowledge -> Food Waste	-0.017	-0.013	0.051	0.321	0.748
Philanthropy -> Food Waste	0.019	0.020	0.047	0.400	0.689
Religiosity -> Awareness	0.224	0.223	0.043	5.181	0.000
Religiosity -> Food Waste	-0.132	-0.134	0.043	3.106	0.002
Religiosity -> Philanthropy	0.463	0.465	0.038	12.241	0.000
Religious Norm -> Awareness	0.209	0.214	0.051	4.067	0.000
Religious Norm -> Food Waste	-0.081	-0.083	0.049	1.650	0.099
Shopping -> Eating habit	0.448	0.450	0.041	11.015	0.000
Shopping -> Food Waste	0.139	0.138	0.048	2.915	0.004

Source: Authors, 2021 (processed data).

The variables that positively and significantly influenced food waste behavior were eating habits and routine shopping. The variables that negatively and significantly affected food waste behavior were awareness, religiosity and religious norms. Knowledge, religiosity, and religious norms had a significant and positive effect on awareness. On the other hand, income and religiosity have a positive and significant effect on philanthropy. Shopping routines significantly and positively affected eating habits. From the above test, we can see that food waste behavior itself is caused more by poor eating and shopping habits. While awareness significantly reduces food waste behavior, a higher level of awareness among household members can reduce their food waste behavior. Likewise, awareness and religiosity negatively affect food waste behavior. Furthermore, to be able to see all the relationships between variables, both direct and indirect relationships can be seen in the total effects significance test.

Discussion

Food waste behavior is influenced by households' shopping routines and eating habits. Bad shopping habits, such as shopping intensity (S1), unplanned food shopping (S2), and food shopping not according to needs (S3), lead to leftover and wasted food. While household eating habits, such as cooking with large portions that do not meet their needs (C1), many family members do not finish their food (C2) and consume large portions of food that do not meet their needs (C4) can lead to food waste behavior.

The types of food that are often discarded by family members are staple food or rice, vegetables, fruits, and side dishes, such as chicken, fish, eggs, tofu, and tempeh. This type of food is commonly consumed by households in Indonesia and is on the main menu. In addition to influencing food waste behavior, shopping routines can also influence consumption patterns and household eating habits. The worse the routine shopping, the worse the consumption and behavior of food waste. In contrast, the better the household shopping habits, the better the eating behavior in the household. Shopping routines affect food waste and contribute to the amount of food being thrown away (Stancu et al., 2016). The better the eating habits in the household, the less food is wasted; in contrast, the worse the eating habits, the more food is wasted (Aschemann-Witzel et al. 2015; Tsalis et al. 2021). The number of households that do not plan to buy food and beverages and do not plan to shop for their needs

makes up a lot of food that expires or is wasted because the portions are too large. Good shopping planning and commitment can reduce the amount of food waste (Stancu et al., 2016).

The variables that had a direct negative influence on food waste behavior were awareness, religiosity, and religious norms. The manifest variable of family awareness not to throw away food consists of family awareness in the household to always spend food when eating (A1), family awareness that they have no right to throw away food even though it belongs to them (A2), household awareness that the food they consume involves many people in the process (A3), household awareness that leftover/wasted food is a concern for their families when eating (A4), and family members' awareness of always reminding and repriming other family members who throw away food (A5).

Meanwhile, the manifest variables of religiosity that can prevent food waste behavior are as follows: the family prays in congregation at least 2 times a day (R3); the family regularly attends the science conference at least once a week (R5); and the family always invites and reminds family members to worship (R6). The manifest variables of religious norms that can prevent food waste behavior are as follows: family members feel guilty when they see others running out of food while we waste food (RN1); family members feel guilty about environmental damage because of throwing away food (RN2); throwing food away makes family members feel guilty to God (RN3); and throwing away food makes family members feel ungrateful for Allah's favors (R4).

Awareness of avoiding wasting food significantly and negatively affects food waste behavior. The higher the level of awareness among household members, the more likely the household will be able to avoid wasting food. The more aware households are that food waste behavior is bad, the less food is thrown away in the household (Priefer et al., 2016). The motivation to avoid wasting food has a positive effect on the least amount of food waste (Aschemann-Witzel et al., 2015). Awareness can also lead to an individual's motivation to avoid wasting food. Intention plays an important role in consumer behavior (Lim et al., 2016). What and how a person consumes food and drinks and the behavior of food waste are influenced by intentions. The better the level of awareness of not throwing away food, the less food is discarded (Secondi et al., 2015).

Religiosity had a significant and indirect negative effect on food waste through awareness. Religiosity describes a person's obedience to worship according to his beliefs. Religiosity not only has a direct negative impact on food waste behavior but can also negatively and significantly affect food waste behavior. The better a person's religiosity, the better the level of awareness of not wasting food, and religion affects consumer behavior, such as information seeking and product innovation (Hirschman, 1981). Religion affects consumer behavior, among other things, because consumers communicate their religious identity to others and express the intensity of their beliefs through consumption choices (Mathras et al., 2016; Singh et al., 2021; Syadiyah et al., 2017; Coşgel and Minkler, 2004). Throwing food away is part of an evil act; therefore, it must be avoided. Therefore, people who devout worshippers should not throw away food, and religiosity can reduce food waste (Elhoushy and Jang, 2021; Elshaer et al., 2021). Consumers with a high level of religiosity have less food waste (Minton et al., 2015; Minton et al., 2019).

Religious norms have a negative and significant effect on food waste behavior; there is a difference between social and descriptive norms (Reno et al., 1993). Social norms are generally agreed upon or rejected in culture by society, such as shared beliefs about how to behave, called norms should (normative). Religious norms are included in social norms, and norms should be (normative). Descriptive norms refer to what exists and is usually done in society; however, what is usually done is not necessarily true. It may be that in some communities, picking up food is commonplace, and people do not feel guilty when throwing food away. In addition, the moral aspect has proven important in explaining consumer behavior in choosing food (Raats et al., 1995). In food waste behavior, moral aspects seem relevant to reducing food waste, where consumers feel guilty or annoyed to some extent if they throw away food (Lyndhurst et al., 2007). Consumer activism and

personal norms are significant mediating mechanisms that convey the impact of religiosity on intentions to reduce food waste (Elhoushy and Jang, 2021).

Furthermore, knowledge does not have a direct effect on food waste but has a negative and significant effect on food waste behavior through awareness. The manifest variables of self-knowledge consist of the following: throwing away food is the same as adding to environmental pollution (K1); wasting food is the same as wasting natural resources and human resources (K2); the process of getting food is a very long process (K3); there are still many hungry people who need food (K4); and throwing away food is a bad behavior (K5). The better the knowledge about the impact of food waste, the better the behavior of food waste. The better the knowledge, the less food is wasted.

Knowledge has a positive impact on attitude and influence in choosing healthy foods (McDonnell et al., 1998). This indicates that knowledge affects a person's decision to behave accordingly. Knowledge and behavior have a positive relationship with environmental maintenance (Tilikidou, 2007). Good knowledge of the negative effects of food waste will make households always efficient and wise in consumption. Knowledge also affects a person's perception and behavior. This is in line with research showing that the better a person's knowledge of the negative effects of food waste, the more that person avoids food waste behavior (Kasavan et al., 2018). Knowledge hurts food waste; the better the knowledge of the adverse effects of food waste, the less food is discarded (Silvennoinen et al., 2014). The Qur'an emphasizes that people who know are not the same as those who do not (Quran, 39:9).

Islamic philanthropy does not affect food waste behavior, with the manifest variable as follows: the family distributes zakat maal/income through official zakat institutions (P2); the family donates money regularly at least 2 times a week (P3); the family is giving waqf at least once a year (P5); and families make regular sacrifices every year (P6). Islamic philanthropy does not have a direct relationship with reducing food waste, because people who like to share do more food shopping. Therefore, the amount of food consumed remains the same and does not decrease because of spending more on food needs (Elshaer et al., 2021; Morone et al., 2018).

However, one strategy to reduce food waste is to share food (Lazell, 2016; Pellegrini et al., 2019), and philanthropy arises partly because of spiritual intelligence (Diyai et al., 2019). One of the signs of pious people described in the Al-Quran is those who are generous, both in the field and in difficult conditions (Quran, 3: 133-134). The more often someone donates, the more income allocation for consumption decreases, and the less income allocation for consumption reduces the amount of food wasted. This is in line with religious orders, so we always continue to donate both in field conditions and in difficult circumstances (Quran, 3:134).

Meanwhile, one of the solutions to dealing with food waste through policy is the sharing economy mechanism, which suppresses consumerism, waste behavior, and community participation in regulating food waste behavior (Polackova and Poto, 2017). This is in line with Islamic teachings: the command for Muslims to share with others through zakat, infaq, alms, and waqf. Sharing the poor will obtain the food they need, and those who are rich can reduce their consumption, which results in reduced food waste. Although modern alternatives for processing food waste can avoid global warming through the restoration of nutrients and energy, the prevention of food waste is much more effective and has great benefits in reducing global warming compared to anaerobic methods in food waste management (Schott and Andersson, 2015).

Limitations and Recommendations for Future Research

Although the study included a substantial number of participants (529), its focus solely on Muslim households in Indonesia might restrict the broader applicability of the findings. The religious homogeneity of the sample could potentially reduce behavioral diversity, suggesting that the results may not accurately represent household practices in non-Muslim populations or across different countries. To address this limitation, future studies should examine populations with varied religious

backgrounds to better understand the differences in food waste behaviors. Additionally, employing qualitative methods, such as in-depth interviews or focus group discussions, could provide deeper insights into the underlying motivations for food waste behavior. These approaches could complement quantitative data and uncover aspects that the Theory of Planned Behavior (TPB) may not fully capture.

This study did not examine the impact of external influences, such as governmental regulations or social media, on food waste habits. These external factors have the potential to shape people's views and intentions regarding food disposal. Future studies should explore how social media and policy measures might act as moderating or mediating variables in food waste behavior. While external elements, such as government initiatives or social media trends, may affect food waste practices, they were not considered in this research. These factors can potentially mold perceptions and inclinations toward discarding food. Subsequent investigations should delve into the role of social media and policy interventions as possible moderating or mediating variables.

CONCLUSION

From the results, it was found that several factors have a T-statistic value of at least 1.650, indicating that they influence food waste (*tabzir*) behavior. Both factors positively influenced *tabzir* behavior: routine shopping (11.015) and eating habits (6.717). The worse the shopping behavior and eating habits, the more food is wasted. On the other hand, *tabzir* behavior is negatively influenced by awareness (3.338), religiosity (3.106) and religious norms (1.650). Thus, the better religiosity, religious norms, and awareness of the harmful effects of food waste, the less food is wasted. Awareness was positively influenced by knowledge (6.526), religiosity (5.181), and religious norms (4.067); the higher the awareness of not throwing away food, the less food was wasted. The factors that do not affect food waste behavior are income and philanthropy. Although religiosity, religious norms, knowledge, and awareness can help prevent food waste behavior, reducing food waste requires government intervention through regulations.

The results of this research can inform policymakers and community organizations in developing strategies to reduce food waste among Muslim households by emphasizing religious and social norms that discourage wastefulness. One approach could involve creating messages that resonate with Islamic teachings, such as the admonition against waste. Additionally, religious leaders who are influential within their communities could play a crucial role in food conservation initiatives. Providing these leaders with educational resources could help transform attitudes and decrease food waste, as their messages may have a more profound impact on households due to their respective status.

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