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Food Waste Behavior Of Muslim Households In Bandung City

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Abstract
Indonesia, home to the largest Muslim population globally, ranks as the second-largest contributor to food loss and waste worldwide. Within this context, household consumption emerges as the predominant source of food waste in the country. For Muslims, Islamic teachings offer a philosophical framework in which consumption transcends the mere fulfillment of needs and the pursuit of satisfaction; it is regarded as a function of utility and benefit. Consequently, Islamic doctrines strictly prohibit wastefulness (isrāf) and extravagant behavior (tabdhīr) in consumption. This study seeks to examine the determinants of food waste behavior among Muslim households in Bandung City, with an emphasis on the environmental, health, social, and eco-nomic repercussions of such waste. The relevance of this research lies in its potential to inform and contribute to the formulation of policies aimed at mitigating and managing food waste in the future. Additionally, this study serves as a foundational analysis for initiatives designed to curtail food waste behavior, aligning with the objectives outlined in the Sustainable Development Goals (SDGs). The research adopts a quantitative methodology to investigate factors such as income, generosity, routine shopping habits, consumer awareness, consumption patterns, religious norms, and religiosity, which may influence household food waste behavior. The analysis is conducted using the structural equation modelling (SEM) approach. Data were collected from a sample of 348 Muslim households in Bandung mm. Conversely, variables such as demographics, religiosity, generosity, and religious norms were found to have no statistically significant effect on food waste.
Keywords: *Food Waste; Awareness; Shopping Routine; Religiousity; Religious Norm; Demographics, Knowledge.*

INTRODUCTION

The ongoing climate crisis has led to unprecedented global temperature records, exacerbating extreme environmental challenges and various other consequences of climate change (IPCC, 2012). This crisis is further compounded by the unsustainable exploitation of natural resources. According to the International Resource Panel (International Resource Panel, 2019), over half pertaining to global ecological assets are being utilized at unsustainable rates, with approximately 90 million tons of primary natural resources extracted annually. This unsustainable resource exploitation damages the ecological order and countless species. Among the adverse impacts of resource extraction and disposal is the rapidly growing pollution and waste problem. Food waste accounts for the largest amount of waste in Indonesia. Research shows that Indonesia is experiencing an increase in the reduction of edible product losses and discards by 54% between 2019 and 2030. A review of discarded and lost food materials in Indonesia from 2000-2019 found that Indonesia generated an average of 115-184 Kg/capita/year of food waste. The waste was then estimated to contribute 1,702.9 Mt CO2, with average Greenhouse Gas emissions and Indonesia experiencing economic losses of an average of RP213-551 trillion/year (BAPPENAS, 2021). Given the economic, social and environmental impacts, the potential increase in food waste and litter in Indonesia is a major concern. At present, the Indonesian government allocates approximately USD 1.5 billion each year to support food subsidies targeting low-income populations, alongside more than USD 2.3 billion dedicated to fertilizer subsidy programs (OECD, 2020). By prioritizing efforts to minimize inefficiencies in food utilization, the government could fulfill national food requirements with a reduced budget. These financial savings could then be reallocated to address other critical areas, including the advancement of infrastructure and efforts to alleviate poverty.

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Figure 1. The rate of non-recyclable waste in Indonesia, (SIPSN, 2021)

The issue of food waste is intrinsically linked to the Sustainable Development Goals (SDGs), especially Goals 1 and 12. Goal 1 emphasizes the eradication of poverty and the narrowing of social disparities, meanwhile, Goal 12 focuses on encouraging sustainable patterns of consumption and production. Food waste intensifies poverty by depleting critical resources that could otherwise support food production, thus exacerbating food insecurity (Waluyo & Kharisma, 2023). Furthermore, food waste significantly contributes toward consumption and production behaviors that are environmentally unsustainable, resulting in ecological harm and negative impacts on biodiversity. Addressing food waste has the potential to promote sustainable consumption and production, reduce poverty, strengthen food security, and safeguard environmental sustainability—fundamental components of sustainable development (Lubis, 2022). Moreover, minimizing food waste and total waste output can contribute to lowering food prices, offering advantages to consumers. For example, rice prices in Indonesia are nearly double those paid by consumers in other ASEAN nations (Arifin et al., 2019).

Food waste is defined as food that is discarded despite remaining suitable for human consumption (Tobergte & Curtis, 2013). This challenge spans every phase of the food supply chain; nevertheless, in industrialized nations, food losses are most prevalent at the final stage due to factors such as overproduction and consumer behaviors (Jeswani et al., 2021). The phenomenon of consumer food waste has been examined through multiple lenses. Existing studies have investigated aspects such as demographic factors (e.g., household structure and income level, consumers' awareness of the impacts of food waste, their perceptions and attitudes toward discarding food, normative influences on behavioral intent, the function of packaging, and various other influencing factors (Jeswani et al., 2021), (Kritikou et al., 2021), (Brennan et al., 2021), (Di Talia et al., 2019).

Food waste behavior is closely associated with the ethical principles and social norms embraced by individuals. As a cultural dimension, religion can shape one's values, conduct, and habitual practices (Hernández et al., 2011). The lack of literature that writes about consumer behavior in wasting food is interesting, especially in Indonesia, which has a majority Muslim population. Islam itself strictly prohibits *tabzir* and *israf* behavior. Even the behavior of *tabzir* is included in the deeds of the devil (QS.Al-Israa' 26-27 and QS. Al 'Araf: 31). However, on the other hand, it is found that Predominantly Muslim nations like Indonesia are among the highest contributors to food waste globally. This is very contradictory to the teachings of the religion adhered to by the majority of the population in the country. Indonesia is currently the most populous Muslim-majority country in the world but is the largest contributor to food waste in the world. Food Waste is mostly contributed by households because households are the biggest consumers. On the other hand, there are still many people who still need food.

The Islamic perspective conveys the teaching of how a Muslim acts in moderation in consumption behavior. A Muslim is encouraged not to be wasteful but also not stingy in using his property. From a conventional economic perspective, consumption behavior is influenced by household income and price levels. In conventional economics, consumer satisfaction is in line with the more goods and services consumed (Stancu et al., 2016). This is contrary to consumption in the Islamic perspective, which prioritizes blessings and benefits (Lim et al., 2016). To achieve benefits, consumption is not only limited

to worldly fulfillment measured by satisfaction, but also fulfillment of the hereafter, so there is what is called consumption in the way of Allah, such as *infaq*, alms, zakat, sacrifice, and others. The application of this Islamic consumption pattern should encourage Muslim individuals to avoid food waste behavior (Aschemann-Witzel et al., 2015).

Building upon the aforementioned explanation, this study aims to identify several issues concerning food consumption, specifically focusing on food waste behavior among Muslim households. The prevalence of food waste in Indonesia—despite being a country with a Muslim-majority population—reflects a misalignment with Islamic values, which emphasize moderation and the prohibition of wastefulness. Food waste generates adverse effects across social, economic, and environmental dimensions. While poverty remains widespread in Indonesia, there is a paradoxical coexistence of individuals discarding food unnecessarily. Furthermore, the absence of a coherent strategy and effective policies to mitigate food wastage within households further intensifies the problem. Food waste behavior is influenced by a multitude of factors, encompassing both internal and external determinants, and contributes significantly to environmental degradation, economic inefficiencies, health risks, and social disparities. This contradicts the aims outlined in the Sustainable Development Goals (SDGs), a globally recognized framework for sustainable progress. Despite the urgency, Indonesia currently lacks a systematic strategy to prevent and reduce food waste within households. Based on these challenges, the research problem addressed in this study is formulated as follows What are the characteristics of food waste behavior among Muslim households in Bandung City? What factors shape patterns of food wastage among Muslim families in Indonesia?

LITERATURE REVIEW

Consumption Concept and Food Waste

Consumption is the expenditure of households to obtain goods and services, either long-lasting item like vehicles and household equipment, as well as short-lived products such as food and drinks. Meanwhile, consumption of services in the form of intangible goods, such as hospital care and education costs (Mankiw, 2018). Consumption is the first activity in economic activity that cannot be avoided, so there is what is called autonomous consumption, which is a situation where a person has no income but still has to carry out consumption activities. Meanwhile, production is a response to consumption activities, the existence of consumption needs, production and distribution activities are present to meet consumption needs. When consumption increases, the demand for goods and services increases and causes production activities to increase, otherwise when consumption activities fall, production will fall. For example, when there is a corona outbreak (COVID-19) around the world, consumption of goods and services decreases which then results in decreased production activities, so that many companies reduce production and lay off some of their employees and there are even companies that close because consumption demand continues to fall. A decline in consumption activity followed by a decline in production will result in a decline in investment. Consumption is the lifeblood of economic activity, a country's economic growth is influenced by consumption, and even investment is strongly influenced by the level of consumption. When consumption increases, investment will increase, conversely when consumption falls, investment will fall. In economics there are three groups of economic actors, namely; households, companies, and governments (Lipsey, n.d.).

Food waste has become a critical concern on a global scale, prompting countries worldwide to implement measures to prevent and address because of its harmful implications for both the environment and the economy, and food security (Thyberg & Tonjes, 2016). From an Islamic perspective, food waste is in direct contradiction to religious teachings, and those who engage in such behavior are described as "brothers of shaitan" (Satan). Islam was the first to promote zero food waste and moderation in all activities. It is explicitly commanded in the Qur'an that we share with our relatives, the poor, and travelers in distress by sharing some of our sustenance. By sharing some of our sustenance, our consumption allocation will be reduced and diverted to those who need it. By redistributing income or food, it will minimize food waste behavior because the excess wealth and food we have is channelled to those who need it.

Tafsir Ibn Katsir explains that the prohibition of squandering wealth and extravagance is conveyed after the command to spend, Allah forbids excessive spending, but it must be in the middle. This is in line with Allah's words in another verse, "And those who spend, they are neither excessive nor miserly". Furthermore, extravagant behavior is included in the deeds of Satan, because Satan is really short of the blessings of Allah that have been given to him (Nasib, n.d.).

The wealth or food that we get is a blessing that Allah bestows on us, while on the other hand there are still many poor people who need the wealth and food. How sinful is the person who wastes and wastes treasure for useless things while there are still many people in need. Therefore, sharing economy is one way that wealth is not spent in vain.

Numerous factors contribute to food waste behavior in household consumption. Findings from previous studies indicate that factors driving food waste include household income, routine household expenditures, consumption patterns, family size, distance to markets or supermarkets, and the allocation of income for household needs. Conversely, factors that can mitigate Food waste behavior involves household awareness and understanding of the negative consequences associated with food wastage, engagement in worship activities, and practices of generosity or philanthropy.

Household income

Income is a major factor in consumption. Income influences individuals' ability to acquire goods and access services (Hernández et al., 2011). The amount of goods and services purchased depends on the amount of household income. Consequently, household income has a positive correlation with consumption; as income increases, the capacity to purchase goods and services also rises. High-income households possess greater purchasing power to acquire various goods and services they like even if they don't need them, including food. By buying too much food, the food ends up being wasted and redundant. Islam has made zakat obligatory on wealth and income. The level of income is the wealth or income owned by a *muzakki* has a big influence on the motivation to pay zakat. Likewise, if there is an increase in wealth or income, it can affect the increase in the amount of zakat that will be issued next. Therefore, an individual's income significantly impacts their intention to pay zakat, as it determines whether their assets have reached the *nisab* threshold and influences the amount of zakat to be contributed by the *muzakki* (Monica, 2023). From the explanation above, hypotheses are compiled as follows:

Ho1: Income has no significant effect on Food waste

Ha1: Income has a significant positive effect on Food waste

Ho2: Income has no significant effect on Philanthropy

Ha2: Income has a significant positive effect on Philanthropy

Household consumption

Household consumption patterns play a crucial role in determining the volume of food waste; more responsible consumption behavior leads to reduced levels of discarded food (Aschemann-Witzel et al., 2015).Good behavior in consumption for instance, when family members frequently dine at home or bring homemade meals to school and work, consume meals entirely and store leftovers properly that is not used up for re-consumption, cook and prepare food according to needs. From the explanation above, hypothesis as follows:

Ho3: Eating Habit does not have a significant effect on Food waste

Ha3: Eating Habit has a significant positive effect on Food waste

Demographics

Demographics are described by home location, education and family members. The distance between home and supermarkets affects a person's food shopping and consumption patterns (Dean & Sharkey, 2011) Meanwhile, the location of residence, whether urban or rural, also influences household consumption behaviors (Monge-Rojas et al., 2013) Households residing in rural regions exhibit consumption behaviors that differ from their urban counterparts. In urban settings, greater accessibility to goods and services enables residents to purchase more food compared to those in rural areas (ceteris paribus), primarily due to the convenience of shopping facilities. Urban areas typically have a greater availability of food compared to rural regions. As food supply increases, a larger portion of household income tends to be allocated toward food consumption (Witt, 2001) hence there is more food waste in

urban areas (Secondi et al., 2015) than in rural areas. Although there are now online applications for buying food and beverages, in rural areas food and beverages are mostly bought offline, this is because the number of food vendors in urban areas is much greater than in rural areas and also access in urban areas is easier than in rural areas. The proximity of houses to supermarkets or markets encourages households to buy more food compared to households that are far from markets and supermarkets, this results in more food being thrown away wasted (Abdullah et al., 2015). The more household members there are, the more food will be purchased, and the more will be discarded. Nations with high population densities tend to generate greater amounts of food waste compared to those with smaller populations (Thi, n.d.). This suggests that household size plays a significant role in influencing the amount of food waste generated.

From the explanation above, the 4th hypothesis is:

Ho_4: Demographics has no significant effect on Food waste

Ha_4: Demographics has a significant positive effect on Food waste

Routine household expenditure

Household routine shopping affects the food and beverages purchased. Numerous households fail to plan their food and beverage purchases, resulting in the acquisition of items that are unnecessary or misaligned with their preferences, which ultimately remain unbeaten and are discarded. According to research by Yi Jin Lim, et al, that subjective norms and perceived benefits affect a person's routine shopping (Lim et al., 2016). In line with Violeta Stancu, et al, that Adherence to moral norms, positive attitudes, strong commitment, and thoughtful shopping plans can significantly minimize food wastage (Stancu et al., 2016). Poorly organized household shopping routines tend to result in greater amounts of discarded food. Based on the preceding discussion, the following hypothesis is proposed:

Ho_5: Shopping behavior has no significant effect on Food waste

Ha_5: Shopping behavior has a significant positive effect on Food waste

$H0_6$: Shopping behavior does not have a significant effect on consumption/eating habits

Ha_6: Shopping behavior has a significant positive effect on consumption/eating habits

Worship activities or Religiosity

Religion holds a substantial influence in guiding the lives of most people around the world, with 80% of individuals worldwide identifying with a religious affiliation (Pew Forum, 2012). and more than 70% of Americans report that their daily actions are shaped by their religious convictions (Pew Forum, 2008). Religion also influences consumer behavior, particularly in areas such as information acquisition and the acceptance of new product innovations (Hirschman, 1981). Understanding the influence of religion on consumer behavior is significant, as people frequently express their religious identity and the strength of their beliefs through the products and services they choose to consume (Coşgel & Minkler, 2004). Religious practices, beliefs, and community involvement can shape individual behavior. Engagement in worship fosters moral restraint, encouraging individuals to adhere to religious teachings. Those who are devout tend to avoid excessive consumption, aligning their habits with religious prohibitions against wastefulness. From the explanation above, the hypothesis is as follows :

H_{07}: Religiosity does not significantly influence food waste.

H_{a7}: Religiosity exerts a significant negative influence on food waste.

H_{08}: Religiosity does not have a significant impact on awareness.

H_{a8}: Religiosity has a significant negative impact on awareness.

H_{09}: Religiosity does not significantly affect philanthropy.

H_{a9}: Religiosity has a significant negative effect on philanthropy.

Generosity/Philanthropy

Generosity is rooted in a strong sense of empathy (Savitri & Purwaningtyastuti, 2020), and one of its key drivers is spiritual intelligence—individuals with higher levels of spiritual awareness tend to be more generous. A defining trait of devout individuals is their willingness to give, regardless of whether they are in times of ease or hardship. As empathy increases, so does one's concern for the welfare of others. Households that habitually allocate part of their wealth to support the poor and needy tend to reduce the portion of income spent on personal consumption. Consequently, the greater an individual's generosity,

the more likely they are to limit their consumption, thereby contributing to a reduction in food waste. From the explanation above, the 10th hypothesis is:
Ho_{10}: Philanthropy has no significant effect on Food waste
Ha_{10}: Philanthropy has a significant negative effect on Food waste

Awareness of not wasting food

Household consciousness of the negative impacts associated with food wastage exerts a negative influence on consumption patterns. The greater the household's recognition that discarding food is an unacceptable behavior, the less food will ultimately be wasted. Research by Aschemann-Witzel et al. emphasizes the importance of consumer willingness to reduce food waste, along with proficiency in meal planning and proper food management techniques, and prioritizing essential food purchases contribute positively to reducing food waste. Furthermore, awareness fosters motivation or intention to prevent food from being wasted. Intention, in this context, serves as a key determinant of consumption behavior (Lim et al., 2016), as it determines what individuals consume and their patterns of behavior concerning consumption and the disposal of food. Thus, higher levels of awareness correlate with a decline in food waste.

An individual's intention to prevent food waste signifies their perspective on food-related behavior, such as the belief that wasting food is inherently immoral or socially inappropriate. This concept aligns with Ajzen's Theory of Planned Behavior (TPB) (Ajzen, 1991), which suggests that intention is the primary determinant of an individual's actions. According to TPB, intentions are influenced by one's attitude toward the behavior, perceived social expectations, and the perceived ability to perform the behavior. A better attitude makes a stronger intention to do good deeds. From the explanation above, the 11th hypothesis is
Ho_{11}: Awareness does not have a significant effect on Food waste
Ha_{11}: Awareness has a significant negative effect on Food waste

Knowledge of the adverse effects of food waste

An individual's understanding exerts a favorable influence on attitudes and decision-making, particularly in selecting healthy food options (McDonell, Roberts, & Lee, 1998). This aligns with research demonstrating that knowledge significantly contributes to reducing food waste in Yogyakarta (Akhtar & Soetjipto, 2014). Furthermore, knowledge and behavior are positively correlated with environmental preservation (Tilikidou, 2007). Understanding the detrimental effects of food waste encourages households to adopt more economical and prudent consumption practices, as knowledge shapes both perceptions and behaviors. Consequently, the greater an individual's awareness of the greater their awareness of food waste's harmful effects, the more inclined they are to prevent it wasteful behaviors (Kasavan, Mohamed, & Halim, 2018). Drawing from the preceding discussion, the following hypotheses are formulated:
H_{012}: Knowledge does not significantly influence awareness.
H_{a12}: Knowledge exerts a significant positive influence on awareness.
H_{013}: Knowledge has no measurable impact on food waste.
H_{a13}: Knowledge significantly reduces food waste behavior.

METHODS

This study employed a field research approach and adopted a quantitative research method. According to Cresswell, quantitative research is characterized as an approach that explains phenomena by collecting numerical data, which is subsequently analyzed using mathematical and statistical techniques. Similarly, Bryman describes quantitative methods as strategies that prioritize the quantification of data during both collection and analysis. In essence, this method emphasizes the measurement of variables and aligns with the positivist paradigm, presenting an objective explanation of the research subject. The data sources utilized both primary and secondary sources of data. Secondary data were sourced from library sources, including reports, books, research journals, papers, and related references. Primary data, on the other hand, were gathered directly from the field by distributing questionnaires to Muslim households in Bandung City, in line with predetermined respondent criteria. The sampling technique applied was purposive sampling, a method that provides equal opportunities for eligible population members to be

selected as samples. According to Sugiyono, purposive sampling entails choosing samples according to predetermined considerations or selection criteria. The target population of this study consists of Muslim households in Indonesia, specifically in Bandung City. Based on BPS 2022 data, Bandung City has 2,309,210 Muslim residents, with an average of three family members per household. Accordingly, the estimated number of Muslim households is calculated as 2,309,210 ÷ 3 = 769,700 households. The sample size was determined using the Isaac & Michael table approach, which specifies that for a population exceeding 700,000, the minimum sample size at an alpha level (α) of 5% is 348 respondents. The primary data collection was conducted through survey techniques, involving the distribution of questionnaires to Muslim household respondents in Bandung City. The survey process adhered to the designed research framework, supplemented by a literature review that included books, journals, reports, papers, news articles, and other relevant sources.

For data analysis, the study employed the Structural Equation Modeling (SEM) technique using SmartPLS 3.0 software. SEM involves two types of latent variables: exogenous variables (X) and endogenous variables (Y), which are empirically measurable and often referred to as indicators. Structural equation modeling is commonly implemented using software such as AMOS, EQS, LISREL, and Mplus, among others. Over recent decades, SEM has become one of the most widely adopted analytical techniques in the social sciences due to its versatility and robustness.

RESULTS AND DISCUSSION

Descriptive Analysis of Food Waste Behavior

Table 1 presents the results of the descriptive analysis for the Food Waste Behavior variable based on respondent responses. The findings reveal an interesting discrepancy between theoretical expectations and practical outcomes in the field. While factors such as awareness, knowledge, generosity, religiosity, and religious norms are classified within the good category, the overall food waste behavior remains in the poor category.

Based on the processed data presented in the table, the total score for Food Waste Behavior is 8106, with an average value of 2.30. This mean score falls within the range of 1.80–2.60 on the continuum scale, indicating that respondents' perceptions of food waste behavior are categorized as poor. Observations and brief interviews conducted by the researchers provide insights into the underlying reasons for this phenomenon. Factors such as households with young children who tend to be picky eaters often result in uneaten food being discarded. Additionally, food frequently becomes stale as it is repeatedly processed or prepared, ultimately leading to its disposal. This is what causes many people to throw away food not intentionally but there are several reasons that cause them to throw away food.

Table 1. Descriptive Analysis of Food Waste Behavior in Bandung City

No	Statement	Alternative Answer					Total Score	Average	Category
		1	2	3	4	5			
1	I often throw away or leave rice	91	255	123	104	14	1456	2.48	Not Good
2	I often throw away or leave fruits and vegetables discarded	95	322	110	55	5	1314	2.24	Not Good
3	I often throw away or leave fish, meat, chicken, eggs, tofu, tempeh thrown away	116	343	79	45	4	1239	2.11	Not Good
4	I often throw away or leave drinks	94	324	98	67	4	1324	2.26	Not Good
5	I often throw away or leave out cakes and snacks	81	313	88	103	2	1393	2.37	Not Good
6	I often throw away or leave out condiments	84	317	92	84	10	1380	2.35	Not Good

Food Waste Behavior	8106	2.30	Not Good
Percentage	46.0%		Not Good

Source: Processed Research Data, 2024

Partial Least Square Structural Model Testing Results

This research employed SmartPLS to evaluate two distinct models: the measurement model (outer model) and the structural model (inner model). The analytical process starts with the outer model, which aims to determine the validity and reliability of reflective indicators associated with latent constructs. This evaluation is performed using three measurement approaches. Once confirmatory factor analysis (CFA) is conducted, and all indicators are confirmed to be valid and reliable, the next step involves testing the overall structural model (inner model). The structural or inner model is examined through the R^2 value, which indicates the proportion of variance in the endogenous latent variables that is accounted for by the exogenous latent variables. Additionally, a bootstrapping technique is employed to calculate t-values for assessing to determine the statistical significance of the relationships among variables.

The outer or measurement model illustrates how latent constructs are connected to their corresponding observed indicators. The assessment process includes confirmatory factor analysis (CFA), which emphasizes testing the validity and reliability of the latent variables. The evaluation of the measurement model includes three essential tests: convergent validity, discriminant validity, and reliability.

Outer Structural Model

Convergent validity reflects the expectation that indicators used to measure a construct are strongly correlated. In confirmatory studies, this is typically demonstrated by factor loading values exceeding 0.7. For exploratory research, a loading value in the range of 0.6–0.7 is still deemed acceptable. Additionally, an Average Variance Extracted (AVE) value above 0.5 signifies sufficient convergent validity. Nonetheless, during the initial development of a measurement scale, factor loadings in the range of 0.5 to 0.6 are generally deemed acceptable. Reliability assessment focuses on determining the instrument's consistency, accuracy, and precision in capturing constructs, typically through Composite Reliability (CR). For confirmatory research, a CR value above 0.7 is recommended, whereas values ranging from 0.6 to 0.7 are still considered adequate in exploratory studies.

By applying the Partial Least Squares (PLS) estimation approach, the path diagram representing the complete structural model is generated, as shown in the figure below.

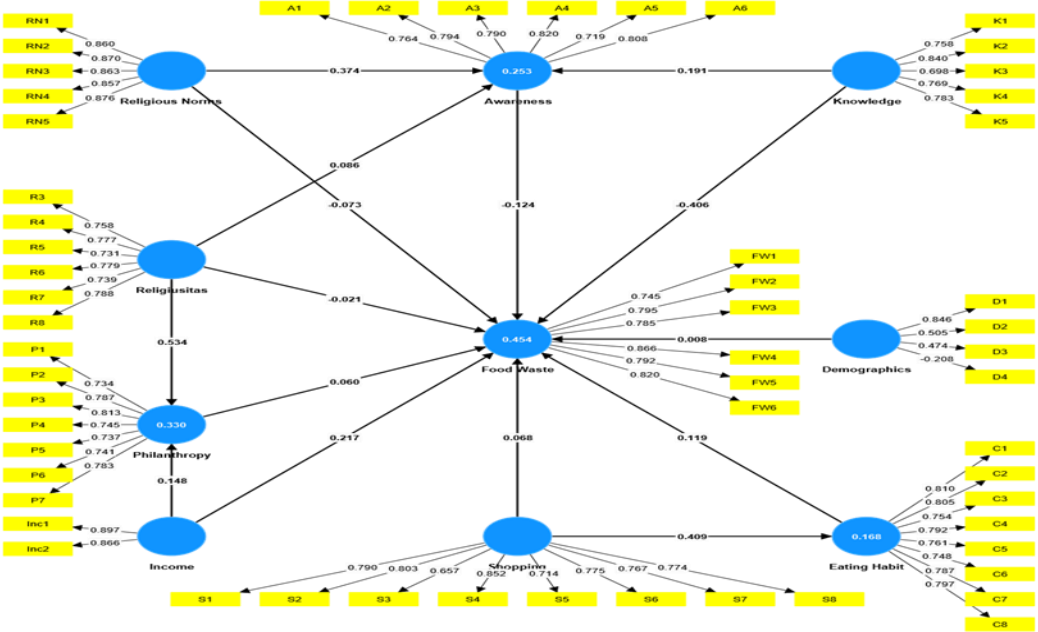

Figure 2. Overall Structural Model (Outer)

The figure above presents details of the factor loadings corresponding to each observed variable. The results indicate that all indicators for latent variables and dimensions have loading factor values exceeding 0.6, confirming their validity. Furthermore, the table demonstrates that all variables achieve an Average Variance Extracted (AVE) value greater than the threshold of 0.5, indicating that the manifest variables effectively explain the corresponding latent variables. Consequently, all manifest variables meet the criteria necessary to establish convergent validity. Convergent validity refers to validity established when instruments measuring the same concept—using either identical or differing methods—exhibit a high degree of correlation.

In addition to convergent validity, discriminant validity is evaluated through cross-loading factor comparisons and the comparison between AVE values and latent variable correlations. A variable is said to possess high discriminant validity if the correlation of its construct with its primary indicators (cross-loading values) is greater than its correlation with other constructs. The cross-loading values are detailed as follows:

Table 2. Table of Factor Cross Loading Test Results

	Awareness	Eating Habit	Food Waste	Knowledge	Philanthropy	Religiousity	Religious Norms	Shopping
A1	0.764	0.000	-0.179	0.185	0.167	0.210	0.313	-0.049
A2	0.794	0.042	-0.279	0.287	-0.022	0.085	0.406	-0.018
A3	0.790	0.098	-0.283	0.325	-0.057	0.026	0.388	-0.021
A4	0.820	-0.060	-0.315	0.309	0.022	0.109	0.386	-0.174
A5	0.719	-0.010	-0.141	0.169	0.275	0.293	0.297	-0.044
A6	0.808	-0.042	-0.198	0.218	0.192	0.241	0.378	-0.130
C1	0.059	0.810	0.202	-0.167	0.074	-0.055	0.023	0.334
C2	-0.010	0.805	0.317	-0.195	0.038	-0.070	0.043	0.303
C3	-0.056	0.754	0.287	-0.199	0.026	-0.055	-0.014	0.296
C4	0.008	0.792	0.221	-0.204	0.139	-0.018	-0.038	0.344
C5	0.013	0.761	0.227	-0.183	0.119	-0.004	0.021	0.298
C6	-0.080	0.748	0.206	-0.239	0.023	-0.025	0.011	0.315
C7	0.088	0.787	0.170	-0.075	0.075	-0.042	0.115	0.315
C8	0.036	0.797	0.204	-0.131	0.035	-0.119	0.039	0.356
FW1	-0.242	0.268	0.745	-0.449	0.032	-0.032	-0.190	0.226
FW2	-0.202	0.311	0.795	-0.446	-0.061	-0.124	-0.094	0.215
FW3	-0.215	0.280	0.785	-0.452	-0.019	-0.104	-0.116	0.205
FW4	-0.276	0.245	0.866	-0.541	0.171	0.058	-0.307	0.227
FW5	-0.302	0.144	0.792	-0.472	0.171	0.016	-0.380	0.191
FW6	-0.226	0.193	0.820	-0.486	0.201	0.090	-0.286	0.199
K1	0.253	-0.161	-0.462	0.758	-0.093	-0.051	0.312	-0.138
K2	0.273	-0.172	-0.498	0.840	-0.075	-0.032	0.273	-0.167
K3	0.222	-0.160	-0.438	0.698	0.017	0.037	0.264	-0.118
K4	0.280	-0.176	-0.432	0.769	0.035	0.076	0.309	-0.151
K5	0.229	-0.195	-0.459	0.783	-0.023	0.023	0.236	-0.156
P1	0.136	0.032	0.015	0.051	0.734	0.418	0.088	0.080
P2	0.087	0.050	0.047	0.034	0.787	0.429	0.114	0.001
P3	0.099	0.138	0.115	-0.038	0.813	0.426	0.074	0.095
P4	0.108	0.065	0.050	0.004	0.745	0.416	0.052	0.065

P5	0.086	0.006	0.117	-0.057	0.737	0.403	0.005	0.015
P6	-0.038	0.068	0.156	-0.145	0.741	0.383	-0.107	0.106
P7	0.074	0.080	0.097	-0.046	0.783	0.485	0.052	0.052
R3	0.307	-0.055	-0.074	0.092	0.410	0.758	0.346	-0.020
R4	0.073	-0.021	0.076	-0.094	0.501	0.777	0.132	0.013
R5	0.029	-0.046	0.018	-0.029	0.450	0.731	0.065	0.008
R6	0.102	-0.103	-0.032	0.004	0.394	0.779	0.179	-0.012
R7	0.058	-0.040	0.014	-0.050	0.342	0.739	0.163	-0.066
R8	0.258	-0.030	-0.057	0.112	0.419	0.788	0.330	-0.025
RN1	0.415	0.032	-0.315	0.364	-0.110	0.125	0.860	-0.127
RN2	0.405	0.072	-0.291	0.336	-0.070	0.112	0.870	-0.097
RN3	0.381	-0.015	-0.182	0.264	0.186	0.355	0.863	-0.145
RN4	0.406	-0.021	-0.198	0.272	0.181	0.385	0.857	-0.123
RN5	0.407	0.053	-0.267	0.314	0.084	0.238	0.876	-0.065
S1	-0.128	0.345	0.216	-0.129	0.103	0.025	-0.119	0.790
S2	-0.098	0.298	0.206	-0.184	0.016	-0.013	-0.122	0.803
S3	-0.103	0.259	0.174	-0.124	-0.031	-0.070	-0.087	0.657
S4	-0.085	0.346	0.223	-0.162	0.053	-0.020	-0.091	0.852
S5	-0.102	0.295	0.177	-0.220	0.064	-0.021	-0.154	0.714
S6	-0.060	0.302	0.244	-0.135	0.032	-0.038	-0.088	0.775
S7	-0.035	0.321	0.151	-0.146	0.063	-0.023	-0.094	0.767
S8	0.018	0.341	0.211	-0.080	0.151	0.024	-0.039	0.774

Based on the output table from the PLS software, it is clear that each latent construct exhibits higher cross-loading values with its own indicators compared to those of other constructs. This indicates that the indicators employed to assess the latent variables meet the established requirements for discriminant validity.

Reliability assessment in Partial Least Squares (PLS) can be carried out through two primary approaches: Composite Reliability (CR) and Cronbach's Alpha. The outcomes of these reliability tests are presented as follows:

Table 3. Composite Reliability (CR) and Cronbach's Alpha Test Results

	Cronbach's Alpha	Composite Reliability
Awareness	0.874	0.883
Eating Habit	0.909	0.910
Food Waste	0.888	0.892
Income	0.714	0.721
Knowledge	0.828	0.831
Philanthropy	0.880	0.882
Religious Norms	0.916	0.919
Religiosity	0.856	0.861
Shopping	0.900	0.904

With respect to the reliability evaluation, the findings show that all variables have Composite Reliability (CR) scores above 0.7 and Cronbach's Alpha values surpassing 0.6. This confirms the data's reliability and indicates that the variables consistently represent their associated constructs.

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Structural Model Testing (Inner Model)

The purpose of assessing the structural model is to analyze the effect that one latent construct has on another. This testing is conducted by analyzing the path coefficient values to determine the significance of the relationships. The significance is assessed based on the t-values derived from the bootstrapping process. The following figure illustrates the outcomes of the bootstrapping procedure conducted in this research:

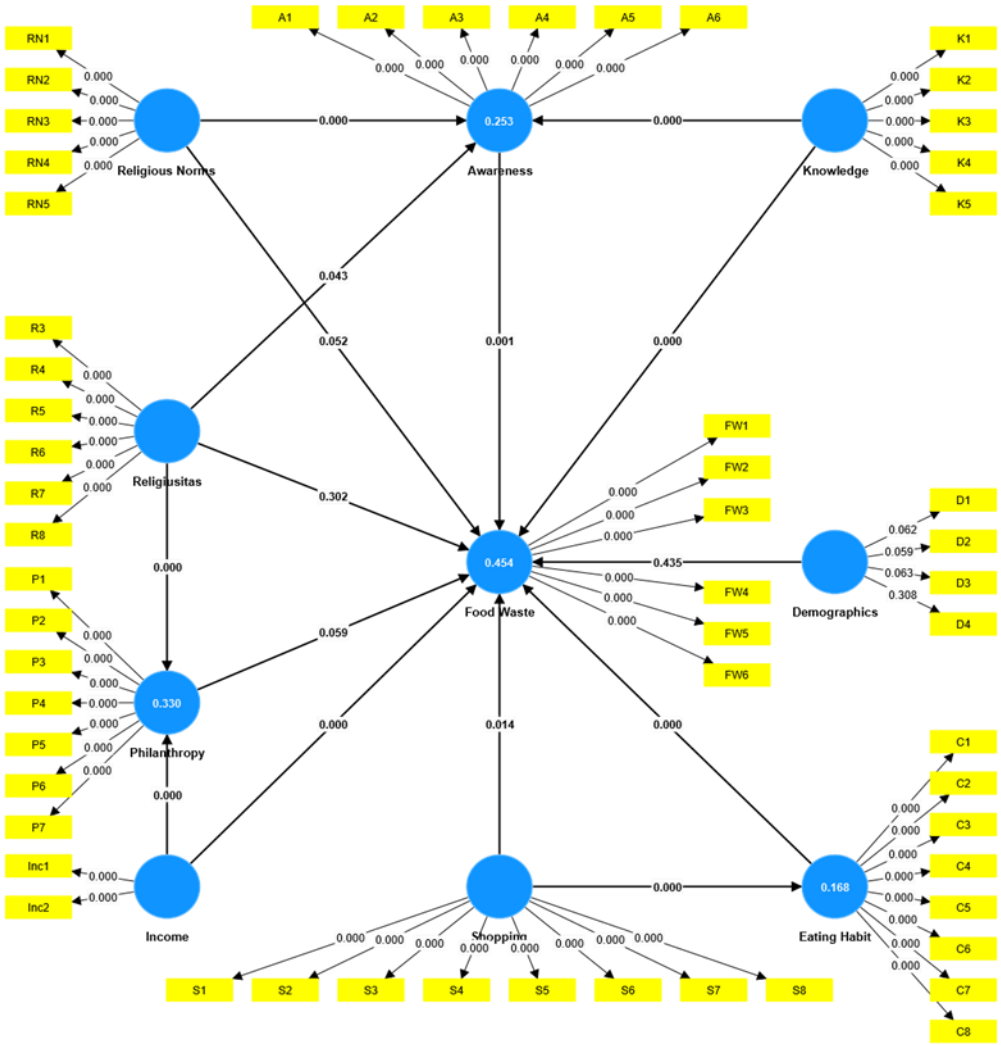

Figure 2. Bootstrapping Result (Inner Model)

Table 4. R-Square Test Result

Variables	R-square
Awareness	0.253
Eating Habit	0.168
Food Waste	0.454
Philanthropy	0.330

Referring to the R-square values presented in the table above, it is evident that the Awareness variable in substructure 1 has an R-square value of 0.253, indicating that 25.3% of the variance in Awareness is accounted for by the variables Religiosity, Religious Norms, and Knowledge. In substructure 2, the R-square value for the Eating Habit variable is 0.168, demonstrating that 16.8% of the variance in Eating Habit is influenced by the Shopping variable. For substructure 3, the R-square value of the Food Waste variable reaches 0.454, signifying that 45.4% of its variance can be explained by the variables Awareness, Religiosity, Religious Norms, Knowledge, Demographics, Philanthropy, Income, Shopping, and Eating

Habit. Lastly, in substructure 4, the R-square value for the Philanthropy variable is 0.330, indicating that 33.0% of its variance can be explained by the model in Philanthropy is attributable to the variables Religiosity and Income.

F2 Effect Size Test

To assess the extent of each variable's contribution to the overall increase in R-square, an additional analysis was conducted using the f^2 test. According to Ghozali PLS (2020), an f^2 value of ≥ 0.02 indicates a small effect size, ≥ 0.15 reflects a medium effect, and ≥ 0.35 represents a large effect, as detailed below:

Table 5. Result of F2 Effect Size Test

Impact	Value Effect Size	Conclusion
Awareness → Food Waste	0.021	Low impact
Demographics → Food Waste	0.000	Low impact
Eating Habit → Food Waste	0.019	Low impact
Income → Food Waste	0.067	Low impact
Knowledge → Food Waste	0.201	Medium Impact
Philanthropy → Food Waste	0.004	Low impact
Religious Norms → Food Waste	0.006	Low impact
Religiosity→ Food Waste	0.000	Low impact
Shopping → Food Waste	0.007	Low impact
Knowledge → Awareness	0.042	Low impact
Religious Norms → Awareness	0.149	Medium Impact
Religiosity → Awareness	0.009	Low impact
Income → Philanthropy	0.032	Low impact
Religiosity → Philanthropy	0.416	High impact
Shopping → Eating Habit	0.201	Medium Impact

The table above clearly shows that the Religiosity variable has the strongest impact on Philanthropy, with an effect size of 0.416.

The Goodness of Fit (GoF) index is employed to evaluate the overall adequacy of the model. The GoF index serves as a unified metric to evaluate the combined performance of both the measurement model (outer model) and the structural model (inner model). The GoF index value is derived by multiplying the average communalities index by the model's R^2 value. The formula for the GoF index is as follows:

$$GoF = \sqrt{Average\ AVE\ x\ Average\ R^2}$$

$$GoF = \sqrt{0.638\ x\ 0.301}$$

$GoF = \sqrt{0.192}$ = 0.438

Based on the calculation results, the Gof value is 0.438, so the goodness of fit (GoF) model is included in the medium GoF category.

Hypothesis	Influence	Original Sample (O)	T statistics (|O/STDEV|)	P values	Description
H1	Income -> Food Waste	0.217	5.174	0.000	Significant
H2	Income -> Philanthropy	0.148	3.681	0.000	Significant
H3	Eating Habit -> Food Waste	0.119	3.887	0.000	Significant
H4	Demographics -> Food Waste	0.008	0.164	0.435	Not Significant
H5	Shopping -> Food Waste	0.068	2.189	0.014	Significant
H6	Shopping -> Eating Habit	0.409	9.067	0.000	Significant
H7	Religiousness -> Food Waste	-0.021	0.520	0.302	Not Significant
H8	Religiosity -> Awareness	0.086	1.714	0.043	Significant
H9	Religiosity -> Philanthropy	0.534	16.008	0.000	Significant

H10	Philanthropy -> Food Waste	0.060	1.559	0.059	Not Significant
H11	Awareness -> Food Waste	-0.124	3.198	0.001	Significant
H12	Knowledge -> Awareness	0.191	3.949	0.000	Significant
H13	Knowledge -> Food Waste	-0.406	8.521	0.000	Significant
H14	Religious Norms -> Food Waste	-0.073	1.622	0.052	Not Significant
H15	Religious Norms -> Awareness	0.374	7.475	0.000	Significant

Partial Hypothesis Testing

The hypotheses in this research are tested by examining the path coefficient values along with their corresponding t-statistics to determine the significance of the relationships. Additionally, the results of the path analysis present the parameter estimates (original sample values), which represent the strength and statistical significance of the influence exerted by each research variable.

The analysis results obtained through SMART PLS at a 5% significance level demonstrate a T-statistic value of 5.174, which exceeds the t-table threshold of 1.64, and a P-value of 0.000, which is below 0.05. As a result, Hypothesis 1 supports the rejection of H_{01} and the acceptance of H_{a1}, demonstrating that Income significantly and positively influences Food Waste. The original sample coefficient for Income is 0.217 in a positive direction, implying that an increase in income leads to a 0.217-unit rise in food waste.

The analysis conducted using SMART PLS at a 5% significance level yields a T-statistic of 3.681, exceeding the critical t-value of 1.64, with a P-value of 0.000—indicating statistical significance. Thus, the results for Hypothesis 2 reject H_{02} and accept H_{a2}, confirming that Income has a significant positive effect on Philanthropy. The original sample coefficient for Income is 0.148, demonstrating a positive coefficient direction, meaning an increase in income corresponds to a 0.148 increase in philanthropic activities.

Based on the SMART PLS analysis at a 5% level of significance, the T-statistic value is 3.887—surpassing the critical value of 1.64—with a P-value of 0.000, indicating statistical significance. Consequently, the results for Hypothesis 3 lead to the rejection of H_{03} and the acceptance of H_{a3}, confirming that Eating Habits significantly and positively influence Food Waste. The original sample coefficient for the Eating Habit variable is 0.119, indicating a positive relationship, signifying that improved eating habits lead to a 0.119 increase in food waste.

The analysis results derived from SMART PLS at a 5% significance level show a T-statistic value of 0.164, which is lower than the t-table threshold of 1.64, and a P-value of 0.435, exceeding 0.05. Thus, the results for Hypothesis 4 confirm that H_{04} is accepted and H_{a4} is rejected, indicating that Demographics do not significantly influence Food Waste. The Demographics variable has an original sample coefficient of 0.008, indicating a positive relationship, suggesting that improvements in demographic factors would lead to only a 0.008 increase in food waste.

The analysis results derived using SMART PLS at a 5% significance level reveal that the T-statistic value of 2.189 surpasses the critical t-table value of 1.64, with a P-value of 0.014, which is below 0.05. Hence, the test results for Hypothesis 5 show that H_{05} is rejected and H_{a5} is accepted, verifying that Shopping has a significant and positive influence on Food Waste. The original sample value for the Shopping variable is 0.068, with a positive directional coefficient, implying that improvements in shopping practices are associated with a 0.068 increase in food waste.

The results obtained through SMART PLS at a 5% significance level demonstrate that the T-statistic value of 9.067 considerably exceeds the t-table threshold of 1.64, and the P-value of 0.000 is well below 0.05. Consequently, the findings for Hypothesis 6 reveal that H_{06} is rejected and H_{a6} is accepted, signifying that Shopping has a significant positive impact on Eating Habits. The original sample value for the Shopping variable is 0.409, reflecting a positive direction, which indicates that enhanced shopping behavior corresponds to a 0.409 increase in eating habits.

The analysis results generated through SMART PLS with a 5% significance level, the T-statistic value of 0.520 is below the critical threshold of 1.64, and the P-value of 0.302 exceeds the 0.05 significance level.

Accordingly, the results for Hypothesis 7 support the acceptance of H_{07} and the rejection of H_{a7}, implying that Religiosity has no significant effect on Food Waste. The original sample value for Religiosity is -0.021, with a negative coefficient direction, suggesting that although insignificant, an increase in religiosity is associated with a slight 0.021 reduction in food waste.

Based on the SMART PLS analysis at a 5% significance level, the T-statistic value of 1.714 exceeds the critical value of 1.64, while the P-value of 0.043 falls below the 0.05 threshold. These results for Hypothesis 8 indicate that H_{08} is rejected and H_{a8} is accepted, confirming that Religiosity significantly and positively influences Awareness. The original sample coefficient for Religiosity is 0.086, indicating a positive direction of effects, indicating that greater levels of religiosity are associated with an 0.086 increase in awareness.

The analysis results obtained through SMART PLS at a 5% significance level show that the T-statistic value is 16.008, which far exceeds the t-table threshold of 1.64, with a P-value of 0.000, well below 0.05. Therefore, the test results for Hypothesis 9 indicate that H_{09} is rejected and H_{a9} is accepted, confirming that Religiosity has a significant positive effect on Philanthropy. The original sample value for the Religiosity variable is 0.534 in a positive direction, suggesting that higher levels of religiosity correspond to a 0.534 increase in philanthropy.

The analysis results using SMART PLS at a 5% significance level reveal that the T-statistic value of 1.559 is below the t-table threshold of 1.64, and the P-value of 0.059 is greater than 0.05. Consequently, the test results for Hypothesis 10 demonstrate that H_{010} is accepted and H_{a10} is rejected, indicating that Philanthropy does not exert a significant effect on Food Waste. The original sample value for Philanthropy is 0.060, with a positive direction, implying that although insignificant, improved philanthropy slightly increases food waste by 0.060.

According to the results generated using SMART PLS at a 5% significance level, the T-statistic value is 3.198, surpassing the critical t-table value of 1.64, while the P-value of 0.001 is significantly lower than 0.05. Thus, the findings for Hypothesis 11 confirm that H_{011} is rejected and H_{a11} is accepted, signifying that Awareness has a significant negative effect on Food Waste. The original sample value for Awareness is -0.124, with a negative coefficient direction, indicating that an improvement in awareness correlates with a 0.124 reduction in food waste.

The results of the analysis conducted via SMART PLS at a 5% significance level demonstrate that the T-statistic value of 3.949 exceeds the t-table value of 1.64, with a P-value of 0.000, which is below 0.05. Accordingly, the test results for Hypothesis 12 indicate that H_{012} is rejected and H_{a12} is accepted, confirming that Knowledge has a significant positive effect on Awareness. The original sample value for Knowledge is 0.191, with a positive coefficient, suggesting that higher levels of knowledge lead to a 0.191 increase in awareness.

The results of the analysis conducted using SMART PLS at a 5% significance level indicate a T-statistic value of 8.521, which surpasses the t-table threshold of 1.64, with a P-value of 0.000, well below 0.05. Therefore, the test results for Hypothesis 13 confirm that H_{013} is rejected and H_{a13} is accepted, demonstrating that Knowledge has a significant negative effect on Food Waste. The original sample value for the Knowledge variable is -0.406, with a negative coefficient direction, implying that increased knowledge leads to a 0.406 reduction in food waste.

The findings from the SMART PLS analysis at a 5% significance level show a T-statistic value of 1.622, which is lower than the t-table value of 1.64, and a P-value of 0.052, which exceeds 0.05. As a result, the test results for Hypothesis 14 indicate that H_{014} is accepted and H_{a14} is rejected, confirming that Religious Norms do not have a significant effect on Food Waste. The original sample value for Religious Norms is -0.073, with a negative direction, suggesting that while not statistically significant, an improvement in religious norms correlates with a slight 0.073 reduction in food waste.

According to the results derived from the SMART PLS analysis at a 5% significance level, the T-statistic value is 7.475, surpassing the t-table threshold of 1.64, and the P-value is 0.000, which is well below 0.05. Consequently, the test results for Hypothesis 15 confirm that H_{015} is rejected and H_{a15} is accepted, indicating that Religious Norms have a significant positive effect on Awareness. The original sample value

for Religious Norms is 0.374, with a positive coefficient direction, meaning that an increase in adherence to religious norms results in a 0.374 increase in awareness.

CONCLUSIONS

Research on food waste behavior in Muslim household consumption and prevention strategies was taken from 567 Muslim household respondents in Kota Bandung, both living in urban, suburban and rural areas. The conclusions of this research are as follows: Many household food waste behavior are caused by consumer behavior. This can be seen from the number of household members, especially children and teenagers, who throw food in the trash because it is expired and the food is not used up. This shows that households buy food in excess of their needs and do not pay attention to sustainable behavior (sustainability). Rice, vegetables and fruit, and food sources of protein are the types of food that are most often thrown away by household members, because these types of food are the ones most consumed and are affordable and easy to obtain. Muslim households in Indonesia do not yet fully practice Islamic consumption, where the goal of consumption is to achieve *maslahah* which contains benefits and blessings. Muslim households still behave wastefully and excessively (*tabzir* and *israf*) both in shopping and consumption.

Food waste behavior is primarily driven by routine shopping practices and unhealthy eating habits or consumption patterns. Factors such as awareness, religious norms, knowledge, and religiosity exhibit a negative influence on food waste behavior. Furthermore, knowledge indirectly reduces food waste behavior by enhancing household awareness. In addition, religiosity and religious norms play a significant role in fostering greater awareness regarding the importance of avoiding food wastage. As awareness increases, food waste behavior improves, leading to a measurable reduction in the quantity of food waste. Food waste has a negative effect on the environment, health quality, economy, wastes resources, disrupts food security, and also conflicts with sustainable development goals (SDG's). The higher the food waste, the more it can hinder the achievement of a country's sustainable development goals. Strategies for preventing food waste, both external and internal, according to experts and practitioners using a network process analysis (ANP) approach are: First, the internal strategy for households is sharing food for those they need. Sharing also plays a role in efforts to achieve SDGs, namely reducing hunger and poverty; Second, the external strategy is a campaign and socialization of the negative impacts of throwing away food by the government, agencies and community organizations to households, because with increased knowledge, less food will be thrown away; The third strategy from the internal side is that households must be wise in shopping and cooking, by not shopping and overcooking food can reduce the potential for food to bloat; The fourth external strategy is providing education on food processing, storage and management of waste, both carried out by agencies and communities; The fifth strategy from the external or government side is the existence of policies or regulations related to the prevention and management of food waste at every level of society.

PATENTS

This section is optional but may be included if any patents have been generated as a result of the work presented in this manuscript.

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CONFLICTS OF INTEREST

There are no conflicts of interest exist in this research.

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