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Uncovering Food Waste Behavior and Its Determinants among Students at Universitas Ahmad Dahlan

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Abstract

Universitas Ahmad Dahlan (UAD) plans to advance the development of a green campus at Campus 4, with food waste management identified as a key supporting component. However, student behavior related to food waste has not yet been empirically examined, highlighting the need for this study. This research employed a multiple linear regression approach using questionnaire-based data collected from 421 students across 27 study programs at UAD Campus 4. The model tested the indirect influence of materialism, knowledge, and religiosity on food waste behavior, with environmental awareness functioning as a mediating variable. The findings indicate that UAD students' food waste behavior has an average score of 3.14, suggesting that students tend to generate relatively low amounts of food waste. The model further reveals that materialism, knowledge, and religiosity exert indirect effects on food waste, and that environmental awareness significantly mediates the relationships between these predictors and food waste behavior. This study highlights the importance of enhancing students' environmental awareness as a key mechanism to reduce food waste and support the achievement of a green campus.

Keywords: *Environmental Awareness, Food Waste Behavior, Green Campus, Religiosity, University Students*

Introduction

Food waste reduction plays a critical role in the transition toward environmentally sound and equitable food systems. According to Boiteau & Pingali [1], drawing on FAO, define food waste as the reduction in the quantity or quality of edible food intended for human consumption, whether through diversion to non-food uses or deterioration in nutritional value, safety, or other quality aspects from harvest or slaughter to consumption. Another definition of food waste from Soloha and Dāce [2], which refers to UN SDG 12.3, is food (edible and inedible) that is discarded at the retail, food service, and household stages. Conversely, Teigiserova et al. [3] conceptualize food waste as food originally intended for human consumption that is discarded or left uneaten, encompassing items that remain edible. Meanwhile, Gwendy et al. [4] define food loss and waste (FLW) as the edible or avoidable portions of food that are lost or discarded throughout the food supply chain. They emphasize that FLW imposes substantial burdens on society, the environment, and the economy, as it represents consumable resources that are unnecessarily wasted. A review of multiple definitions reveals variations in the understanding and scope of the term food waste. The lack of a standardized definition of food waste creates significant challenges for quantification and data comparison.

Food waste is generated at multiple stages of the supply chain, encompassing producers, distributors, food service providers, and consumers; however, consumer practices are consistently identified as the dominant source. As highlighted by Muhammade et al. [5], end consumers represent the largest contributors to the overall volume of food waste. It is also stated by Principato et al. [6] that in developed economies, the majority of food waste occurs at the final stage of the supply chain, where household consumption takes place. Existing literature consistently attributes this outcome to consumer-related factors, emphasizing that individual behaviors, routines, and attitudes are the principal drivers of waste generation. Moreover, according to Lodi et al. [7], food waste is predominantly driven by consumer behavior, manifested in practices such as excessive purchasing, improper storage, and over-preparation of meals, which collectively render end-users the principal contributors to overall food waste.

Universitas Ahmad Dahlan (UAD) plans to establish an environmentally conscious campus (green campus). To support this initiative, students are expected to play an active role in realizing sustainability practices on campus. Awareness and responsible behavior toward food waste are essential components in achieving this goal. However, no studies have previously examined UAD students' food waste behavior, leaving a gap in empirical data on the extent and determinants of their practices. This study addresses that gap by examining factors related to environmental concern and food waste behavior, drawing on the framework proposed by Abdelradi [8].

Theoretical Background

A. Literature Review

Effective waste management has become a critical challenge in urban and institutional environments due to increasing waste generation and limited infrastructure capacity. Optimizing the location and number of waste handling facilities is widely recognized as an essential strategy to improve efficiency, reduce environmental impacts, and support sustainable development goals. Conceptual and empirical studies emphasize that waste management systems must balance operational efficiency with social, environmental, and behavioral considerations to achieve long-term effectiveness [9],[10].

From a systems perspective, waste management optimization is closely linked to the spatial distribution of waste sources and the capacity of collection and processing facilities. Sustainable waste systems require careful planning to ensure adequate service coverage while avoiding unnecessary infrastructure expansion [11]. In this context, analytical and optimization-based approaches are frequently employed to support decision-making, particularly in densely populated areas where inefficiencies can significantly increase environmental burdens [12].

Beyond technical efficiency, consumer and community behavior play a crucial role in determining waste volumes and system performance. Studies on waste-related behavior highlight that attitudes, routines, and awareness strongly influence waste generation at the source, thereby affecting downstream management requirements [8],[13]. As a result, infrastructure optimization should be complemented by behavioral interventions aimed at reducing waste generation itself [14], [15].

Global assessments further underline that improving waste management infrastructure alone is insufficient without parallel efforts to promote sustainable consumption and waste reduction practices [16]. Therefore, an integrated approach that combines system optimization, environmental awareness, and pro-environmental behavior is essential. Such an approach supports not only operational efficiency but also broader sustainability objectives, particularly in educational and urban settings where waste generation patterns are closely tied to daily human activities [17],[18].

Several factors may be considered in influencing food waste behavior. One of these factors is materialism. According to the Oxford English Dictionary, materialism refers to a value orientation that places attachment to material needs and desires as the central focus of life, often at the expense of spiritual aspects and non-material values [19]. Previous studies have consistently demonstrated the negative implications of materialism. For instance, Sari et al. [20] found that materialism has a significant negative effect on sustainable consumption, indicating that individuals with higher levels of materialism tend to exhibit lower engagement in sustainable consumption practices. Similarly, Wang and Huo [21] reported that materialistic values negatively influence pro-environmental behavior among younger generations. This suggests that a stronger orientation toward material possessions and wealth is associated with a reduced tendency to engage in behaviors that support environmental preservation. Furthermore, Cho and Jung [22] revealed that materialism is negatively associated with environmental awareness and pro-environmental consumption behavior, where individuals with higher environmental awareness generally demonstrate lower levels of materialism.

The next factor is knowledge. Knowledge refers to awareness or understanding of something or someone, encompassing facts, information, descriptions, or skills acquired through experience, education, perception, discovery, or learning processes [23]. Numerous studies have highlighted the influence of knowledge on environmental behavior. Edwar et al. [24] stated that more effective learning strategies that enhance students' knowledge can increase their environmental awareness. This suggests that students' knowledge plays a crucial role in shaping their environmental consciousness. Rasyid et al. [25] found a significant relationship between environmental knowledge and the formation of environmentally responsible attitudes among Geography Education students at Khairun University. Furthermore, Sya'ban et al. [26] reported that students' environmental concern is directly influenced by social environmental knowledge, environmental literacy, and environmentally friendly lifestyle practices. In addition, a study conducted by Rani et al. [27] among hospitality students in Malaysia revealed that integrating environmental education into hospitality curricula and emphasizing the importance of food waste reduction can enhance students' knowledge of relevant environmental issues. This increased knowledge subsequently fosters higher levels of environmental awareness, enabling hospitality students to become future professionals who are more sustainability-oriented. Thus, knowledge serves as a critical factor in strengthening environmental awareness.

Another factor influencing food waste behavior is religion. Religion can be defined as an institution grounded in beliefs in divinity that encompasses a set of understandings and practices guiding individual behavior [28],[29] further describes religion as a system of shared beliefs and rituals practiced collectively within a community. Several studies have examined the role of religiosity in environmental

behavior. Baran et al. [30] found that religiosity significantly influences environmental concern. This finding is consistent with Listyorini and Farida [31], who reported that adherence to religious teachings significantly enhances environmental concern as well as individuals' intentions to engage in green purchasing behavior. In addition, Lubis et al. [32] demonstrated that environmental awareness, religiosity, religious norms, and knowledge have a significant negative effect on food waste. These findings imply that higher levels of awareness, knowledge, religiosity, and internalization of religious norms are associated with lower levels of food waste generation.

According to Maqfirah et al. [33] environmental awareness encompasses understanding ecological issues, concern for the natural environment, and active involvement in actions aimed at environmental protection and conservation. Meanwhile, food waste is a component of the complex phenomenon of food loss and waste, which includes food that is consumed, discarded, or experiences quality deterioration throughout the stages from production to consumption [34]. Numerous studies have investigated the relationship between environmental awareness and food waste behavior. Purwanto et al. [35] emphasized that environmental awareness has a positive and significant effect on attitudes, intentions, and actions aimed at reducing food waste. Similarly, Purwanto et al. [36] found that environmental awareness significantly and positively influences individuals' intentions to reduce food waste. Consistent findings were also reported by Melnik et al. [37], who demonstrated that individual attitudes, environmental knowledge, and awareness of consequences significantly affect students' behavioral intentions to reduce food waste. Additionally, Chandra et al. [38] showed that students' awareness of the causes and negative impacts of food waste significantly influences their personal norms, which in turn shape their intentions to prevent food waste.

B. Research Model

The model employed in this study is adapted from Andelradi [8], which positions environmental awareness as a mediating variable in the relationships among materialism, knowledge, religiosity, and food waste behavior. The conceptual model is illustrated in Fig. 1.

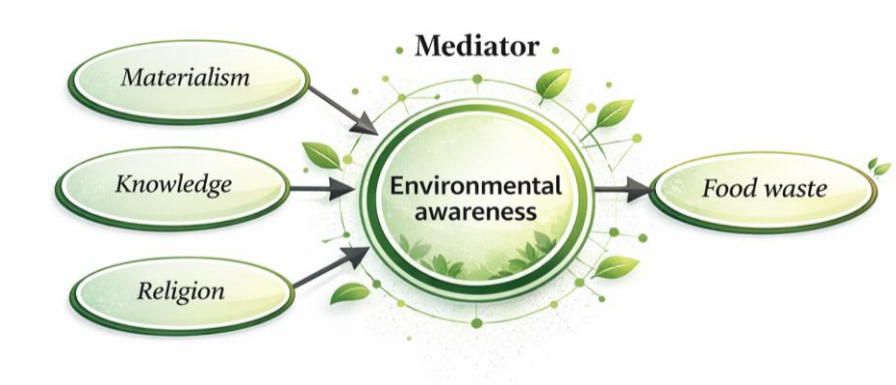


Fig. 1. Research Model

To enhance clarity, Table 1 outlines the definitions of each variable included in the research model, providing concise descriptions of their meanings and roles in the analysis.

Table 1. Definitions of Research Variables

No	Variable	Operational Definition
1	Food Waste	Describes behaviors related to awareness and management of food waste.
5	Materialism	Describes student tendencies toward valuing material possessions.
6	Knowledge	Describes students' understanding of issues related to food waste.
8	Religion	Describes students' religious knowledge related to food waste concerns.
9	Environmental Awareness	Describes students' concern and attitudes toward environmental sustainability.

Methods

The subjects of this study were undergraduate students at Universitas Ahmad Dahlan (UAD) Yogyakarta from the 2015 to 2018 cohorts. The research model incorporated materialism, knowledge, and religiosity as independent variables that exert indirect effects on food waste behavior, with environmental awareness serving as the mediating variable.

A quantitative approach was employed using multiple linear regression analysis to examine the relationships among the variables. Data were collected through a structured questionnaire distributed to students across various study programs. The responses were then processed and analyzed using SPSS 15 to assess model fit, direct and indirect effects, and the mediating role of environmental awareness.

Results and Discussions

A. Descriptive Results of Food Waste Behavior

Responses to the food waste variable are summarized in Table 2, which presents participants' answers to each food waste indicator, reflecting the frequency and patterns of food waste behavior observed in the study.

Table 2. Responses to Food Waste Indicators

No	Indicator	Score 1	Score 2	Score 3	Score 4	Score 5	Index Total	Index (%)	Mean Score
1	I never leave leftover food on my plate after eating.	54	76	103	128	60	315.20	63.04	3.15
2	I never cook more food than I need.	38	102	109	127	45	309.26	61.85	3.09
3	I never store food that ends up not being eaten or being thrown away.	39	107	107	124	44	306.41	61.28	3.06
4	I never open canned food, sauces, condiments, etc., that I eventually do not consume/use.	37	75	111	146	52	323.99	64.80	3.24
	Average	—	—	—	—	—	**313.72**	**62.74**	**3.14**

The descriptive findings indicate that students demonstrate a moderate yet generally positive pattern of food waste behavior, as reflected by an overall index score of 62.74 and a mean score of 3.14. According to the Three-Box Method, this level suggests that food waste is not entirely avoided but is relatively controlled. This result is consistent with previous research showing that food waste behavior among young adults typically falls between awareness-driven intentions and habitual consumption practices rather than at extreme levels of wastefulness or sustainability [17], [39].

The dominance of responses at scores 3 and 4 across all indicators indicates that students exhibit situationally dependent food waste behavior. In particular, the highest mean score relates to avoiding

the opening of food items that are ultimately not consumed. This finding supports earlier studies emphasizing the importance of planning, portion estimation, and cautious food handling as critical determinants of reduced food waste [8], [40], [41]. These studies argue that food waste is not solely driven by attitudes but also by everyday routines and micro-level consumption decisions.

Despite the generally positive pattern, plate waste remains evident, as indicated by the moderate mean score for leaving food uneaten. This aligns with research suggesting that plate waste among students and young adults is influenced by contextual and situational factors such as portion sizes, taste preferences, and time constraints rather than a lack of environmental concern [42], [43]. Such findings reinforce the argument that behavioral inconsistency is common even among individuals with relatively high awareness of sustainability issues.

From a theoretical perspective, the results align with environmental behavior frameworks proposed by Barr and Gilg [10]. which highlight the interaction between attitudes, situational constraints, and perceived behavioral control. Similarly, Kaiser et al. [13] emphasize that positive environmental attitudes do not automatically translate into consistent pro-environmental behavior. The moderate index score observed in this study reflects this well-documented attitude–behavior gap, which is also frequently identified in food waste research [15].

At the macro level, these findings are consistent with global reports indicating that consumer-level food waste remains a significant issue despite increasing awareness of food security and sustainability challenges [11], [16]. The relatively positive behavior observed among students may be associated with greater exposure to sustainability narratives within higher education environments, as suggested by previous studies on student food waste in Indonesia [17] and green campus initiatives [18].

Furthermore, existing literature suggests that food waste behavior among young adults is shaped by lifestyle factors, material values, and convenience-oriented consumption patterns [39], [44]. The moderate scores in this study may therefore reflect a balance between environmentally responsible intentions and practical constraints such as shared living arrangements, irregular schedules, and limited food management skills. Richter [45] similarly found that knowledge and awareness alone are insufficient to ensure optimal food waste behavior.

Overall, the results indicate that while students demonstrate a baseline level of responsible food waste behavior, substantial opportunities remain for behavioral improvement. Interventions focusing on habit formation, portion control, and meal planning are likely to be effective in further reducing food waste [14], [15], [41], [46]. Consistent with consumer behavior approaches, future strategies should integrate cognitive, emotional, and habitual dimensions to promote more sustainable food consumption practices among students.

B. Mediation Analysis

Regression analysis was performed to assess the mediating role of environmental awareness in the relationships between materialism, knowledge, religiosity, and food waste. The P and SP values used in the Sobel test are illustrated in Fig. 2.

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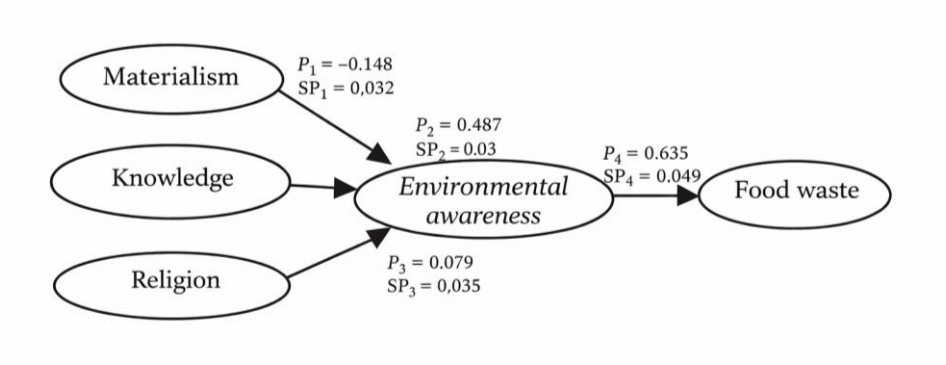


Fig. 2. The Result (P and SP value) Model

The t-value is determined using the following equations:

$$SPnP4 = \sqrt{Pn^2SP1^2 + Pn^2SP4^2 + SPn^2SP4^2} \quad (1)$$

$$t_{calculated} = \frac{PnP4}{SPnP4} \quad (2)$$

Where:

- (Pn) = P-value of the independent variable *n*
- (P4) = P-value of the *environmental awareness* variable
- (SPn) = Standard error (SP) of the independent variable *n*
- (SP4) = Standard error (SP) of the *environmental awareness* variable

Table 3 presents the mediation analysis results, showing the indirect effects of materialism, knowledge, and religion on food waste behavior through environmental awareness, including path coefficients and standard errors that indicate the strength and significance of the mediated relationships.

Table 3. Mediation Effects of Environmental Awareness on Food Waste Behavior

Independent Variable	Indirect Effect	Sobel SE	t-value	Significance (α = 0.05)	Mediation Conclusion
Materialism	−0.094 (−0.148 × 0.635)	0.0216	−4.35		Significant (−4.35 < −1.96)
Knowledge	0.309 (0.487 × 0.635)	0.0306	10.10	Significant (10.1 > 1.96)	Environmental awareness strengthens the positive effect of knowledge on reducing food waste.
Religiosity	0.046 (0.073 × 0.635)	0.0225	2.06	Significant (2.06 > 1.96)	Environmental awareness enhances the positive influence of religiosity on reducing food waste.

The mediation analysis confirms that environmental awareness plays a pivotal role in shaping food waste behavior, acting as a significant intermediary between materialism, knowledge, religiosity, and food waste outcomes. The findings demonstrate that environmental awareness not only amplifies positive behavioral drivers but also attenuates negative tendencies, reinforcing its central position in contemporary models of pro-environmental behavior [10], [13].

The negative indirect effect of materialism on food waste behavior (−0.094) indicates that higher materialistic values are associated with increased food waste, a result consistent with prior studies linking materialism to excessive consumption and reduced environmental concern [44], [47]. However,

the significant mediating role of environmental awareness suggests that materialistic orientations do not inevitably lead to unsustainable behavior. When individuals possess heightened environmental awareness, the adverse impact of materialism on food waste can be substantially reduced. This finding supports Abdelradi's [8] conceptual framework, which emphasizes the moderating and mediating influence of cognitive and awareness-based factors on waste-related behaviors.

In contrast, knowledge exhibits a strong and positive indirect effect on food waste reduction (0.309), indicating that students with greater understanding of food waste issues are significantly more likely to engage in waste-reducing behaviors when environmental awareness is present. This result aligns with earlier research demonstrating that knowledge enhances individuals' ability to translate intentions into action, particularly when supported by environmental consciousness [13], [45]. FAO reports similarly emphasize that consumer knowledge, when embedded within broader awareness of environmental and food security challenges, is a key driver of sustainable consumption practices [16].

Religiosity also shows a positive and statistically significant indirect effect (0.046), suggesting that religious values contribute to reduced food waste through the pathway of environmental awareness. This finding resonates with studies highlighting the moral and ethical dimensions of environmental behavior, where values such as stewardship, moderation, and responsibility are reinforced through religious beliefs [48], [49]. When coupled with environmental awareness, religiosity appears to provide a normative foundation that strengthens commitment to sustainable food practices.

Taken together, these findings reinforce the argument that environmental awareness serves as a critical cognitive and moral bridge connecting individual values and knowledge to observable food waste behavior. This is consistent with two-route models of food waste behavior, which distinguish between value-driven motivations and situational or awareness-based mechanisms [41]. The strong mediating effects observed in this study also echo Russell et al. [15], who emphasize the importance of integrating habits, emotions, and awareness to achieve lasting behavioral change.

From a practical perspective, the results suggest that interventions aimed at reducing food waste among university students should not focus solely on increasing knowledge or promoting moral values in isolation. Instead, integrated strategies that strengthen environmental awareness through curriculum design, campus campaigns, and green campus initiatives are more likely to yield meaningful behavioral change [17], [18]. By embedding environmental awareness within educational and religious contexts, universities can more effectively mitigate materialistic tendencies while reinforcing positive drivers of sustainable food consumption.

Overall, the mediation findings underscore environmental awareness as a key leverage point for policy and practice in higher education. Strengthening this awareness can simultaneously weaken negative influences, such as materialism, and amplify positive ones, such as knowledge and religiosity, thereby supporting the long-term goal of reducing food waste and fostering sustainable consumption behaviors among students.

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Conclusion

The findings of this study indicate that Universitas Ahmad Dahlan students exhibit a moderate yet positive level of food waste awareness, reflected in an index score of 62.74 and an average score of 3.14. These results suggest that students tend to generate relatively low amounts of food waste. Furthermore, the analysis reveals that materialism, knowledge, and religiosity each exert indirect effects on food waste behavior, with environmental awareness serving as a significant mediating variable. This highlights the crucial role of environmental awareness in shaping students' attitudes and actions related to food waste, either by strengthening positive influences or reducing negative behavioral tendencies.

Recommendations

Based on these findings, several recommendations can be proposed for relevant stakeholders, particularly the Environmental Agency (Dinas Lingkungan Hidup or DLH) of Yogyakarta City and future researchers interested in exploring this issue further. First, the research model used in this study can serve as a valuable reference for Universitas Ahmad Dahlan in formulating policies related to food waste reduction on campus. Second, the university is encouraged to provide both preventive and persuasive educational programs on food waste management, especially targeting study programs with lower awareness scores. Such initiatives can help enhance student understanding and foster a stronger commitment toward reducing food waste within the campus environment.

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