IJMR E-ISSN: 3109-9777
INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEACH

PUBLIC AWARENESS OF WASTE MANAGEMENT IN YOGYAKARTA THROUGH THE FRAMEWORK OF ISLAMIC ECOLOGICAL ETHICS

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E-ISSN : 3109-9777		
Received: November 2025	Accepted: November 2025	Published: Desember 2025

Abstract :

Municipal solid waste remains a pressing environmental challenge in the Special Region of Yogyakarta (DIY), characterized by the continuous increase in waste generation, limited waste-management infrastructure, and low levels of public awareness and participation. This study aims to identify and analyze public perceptions and attitudes toward waste management across the five administrative regions of DIY through the distribution of 250 questionnaires administered using a random-sampling technique. The collected data were examined using descriptive statistics, k-means clustering, and heatmap visualization. The findings indicate significant variations in awareness and participation levels based on demographic factors such as age, gender, educational background, occupation, and residential area. The clustering analysis categorized respondents into three groups low awareness (34%), moderate awareness (25%), and high awareness (41%) each requiring different forms of intervention. Beyond the social dimension, the results demonstrate that Islamic ethical principles such as cleanliness as part of faith, the prohibition of environmental destruction (fasād), and the human responsibility as khalifah (stewards of the Earth) serve as an ethical and spiritual foundation that can reinforce community-based waste-management initiatives. Overall, the study concludes that addressing the waste crisis in Yogyakarta requires more than infrastructural solutions; it demands cultural transformation, continuous environmental education, and cross-sector collaboration to build collective ecological awareness and sustainable public engagement.

Keywords : *Environmental Awareness; Islamic Perspective; Public Perception; Waste Management;*

INTRODUCTION

Waste-related challenges in Indonesia including in the Special Region of

Yogyakarta remain an unresolved environmental issue to this day. As the population continues to grow and consumer lifestyles become increasingly waste-intensive, the volume of solid waste generated daily continues to escalate. In response to this concern, the Government of Indonesia enacted Law No. 18 of 2008 on Solid Waste Management as a national legal framework in early May 2008 (Wikurendra et al., 2023). Law No. 18 of 2008 defines waste as the residual materials from human activities or natural processes, consisting of organic or inorganic substances that are considered no longer useful and subsequently discarded into the environment. Field observations, however, indicate that a portion of the community continues to underestimate this issue and relies solely on sanitation workers, while waste management facilities and infrastructure remain inadequate. The closure of several Final Disposal Sites (TPA) and the lack of alternative solutions from local authorities have further exacerbated the situation. Moreover, the weak implementation of the polluters pay principle reflects a deeper ecological and social awareness crisis within society. The challenge is amplified globally as population growth leads to a corresponding escalation in waste production, much of which is hazardous and poses significant health and environmental threats (Budiman & Jaelani, 2023; Serrano-Gomez et al., 2025).

From an Islamic perspective, the issue of waste is not merely a matter of technical environmental management but also a moral and spiritual concern. The Prophet Muhammad ﷺ stated, "الطُّهُورُ شَطْرُ الإِيمَانِ" "Ritual purification is half of faith" (Sahih Muslim). Although this hadith refers specifically to ritual purification (ṭahārah), scholars allow a broader interpretation in which physical and environmental cleanliness is inherently connected to faith, since the principles of ṭahārah require the removal of impurity and the maintenance of cleanliness. Accordingly, safeguarding the cleanliness of one's surroundings is considered a manifestation of genuine faith and an integral expression of religious devotion (Auwal et al., 2024; Derysmono & Kahfi, 2025; Niz et al., 2020).

The Qur'an explicitly prohibits human activities that lead to environmental degradation, as reflected in the verse: "Do not cause corruption on the earth after it has been set in order." (Qur'an, Surah Al-A'raf 56). In contemporary reality, the pollution of soil, rivers, and air caused by unmanaged waste represents a modern form of fasād that violates Islamic ethical principles and contradicts humanity's mandate as God's steward (khalifah) on earth (Qur'an, Surah Al-Baqarah 30) (Taisir et al., 2024). Islamic teachings also emphasize the social ethics of environmental cleanliness, as demonstrated in the Prophetic tradition: "Removing harmful objects from the road is an act of charity." (Sahih al-Bukhari and Sahih Muslim). In today's context, piles of litter obstructing sidewalks, drainage systems, markets, and public facilities constitute a form of public harm that must be eliminated as part of social worship (ʿibādah ghayr maḥḍah). Thus, building a culture of waste awareness is not merely an environmental campaign but a manifestation of religious devotion highly aligned with the religious and cultural identity of the people of Yogyakarta (Babakano et al., 2020a; Subli et al., 2025).

However, the data indicate that a portion of the community still neglects their responsibility toward waste a behavior described by Islamic scholars as takhalli 'an al-mas'uliyyah (abandoning social responsibility). The Prophet Muhammad ﷺ reminded: "Each of you is a shepherd, and each of you will be held accountable for those under your care" (Sahih al-Bukhari). Beyond the issue of limited participation, consumptive behavior that drives the increase of plastic waste and single-use packaging is also inconsistent with Islamic teachings: "Eat and drink, but do not be excessive. Indeed, Allah does not like those who are excessive" (Qur'an 7:31). This verse underscores that human consumption patterns entail ecological consequences that must be considered within the ethics of religious practice (Ali & Agushi, 2024; Bin Lahuri & Elyanoor, 2025; Depczyński, 2022).

Conceptually, the Islamic value framework offers a comprehensive set of solutions from individual obligations (fardhu 'ain) to maintain personal and environmental cleanliness, to collective responsibilities (fardhu kifayah) implemented through mosque-based social movements, family units, neighborhood associations, schools, and community organizations, and even to circular-economy initiatives inspired by the principle of sadaqah, such as mosque-based waste banks, composting, ecobricks, recycling, and value-added waste processing. When community education, governmental policy systems, and Islamic values operate in an integrated manner, waste management can be understood not merely as an administrative duty, but also as an act of worship, a cultural practice, and a civilizational endeavor (Babakano et al., 2020b; Li et al., 2025).

These community based initiatives are critical for advancing the circular economy, which is supported by research into the valorization of agricultural waste, such as converting lignocellulosic materials into valuable products , and the utilization of waste for secondary raw materials (Castellani et al., 2022; D'Adamo et al., 2022). Therefore, the current policy framework must be assessed and aligned with circular economy goals to ensure efficiency in resource use and waste management practices (Blasi et al., 2023; Podara et al., 2024).

Building on this understanding, the present study was conducted to obtain an objective picture of the community's social conditions in addressing waste-related issues in the Special Region of Yogyakarta (D.I. Yogyakarta) (Castellani et al., 2022). Specifically, the study aims to identify and analyze public perceptions and attitudes toward waste management in the region, to map the levels of awareness, concern, and responsibility demonstrated by the community in waste-management practices, and to evaluate the social, cultural, and behavioral factors that shape waste-handling patterns at both the household and neighborhood levels (He et al., 2024; Tytko & Alwaeli, 2025).

RESEARCH METHOD

This study employed a quantitative survey approach to examine community perceptions and attitudes toward waste management in the Special Region of Yogyakarta. Data were collected through the distribution of structured

questionnaires to residents across the region's five administrative areas Yogyakarta City, Kulon Progo, Bantul, Gunung Kidul, and Sleman. In each area, 50 respondents were selected using a random sampling technique, yielding a total sample of 250 participants.

Figure 1. Randomized survey of 250 respondents across the Special Region of Yogyakarta (D.I. Yogyakarta)

The questionnaire was administered from 9 to 12 June 2024. The collected data were analyzed using descriptive statistics to characterize public perceptions, k-means clustering to identify behavioral patterns and levels of environmental concern, and heatmap visualizations to illustrate correlations among variables within the waste-management system. Data processing and analysis were conducted using ChatGPT 5.0, Open-Source Linux tools, and Microsoft Excel.

FINDINGS AND DISCUSSION

Descriptive statistical methods were employed to obtain demographic information on respondents, categorized by age, gender, education level, and occupation. The age-based demographic distribution is presented in Table 1. The data show that the majority of respondents fall within the late-adulthood groups >49 years and 40–49 years which together account for more than half of the total sample. This distribution suggests that concerns regarding waste management are more prominent among older adults, who generally possess longer-term exposure to, and awareness of, the cumulative environmental and health impacts of inadequate waste handling.

At the same time, participation from younger age groups reflects a positive trend in the rise of environmental awareness. Although smaller in proportion, respondents aged 20–29 representing nearly one quarter of the sample demonstrate that younger generations are increasingly attentive to waste-management issues. This indicates an emerging cross-generational shift in ecological consciousness that may strengthen future sustainability efforts.

Table 1. Demographic Analysis of Respondents Based on Age

Age Group	Frequency	Percent	Valid Percent	Cumulative Percent
< 20 years	13	5.2	5.2	5.2
20–29 years	57	22.8	22.8	28.0
30–39 years	43	17.2	17.2	45.2
40–49 years	68	27.2	27.2	72.4
> 49 years	69	27.6	27.6	100.0
Total	**250**	**100.0**	**100.0**	

Overall, these findings provide a compelling indication that efforts to enhance public awareness and participation in waste management must engage all age groups through tailored communication strategies. Each age cohort possesses distinct perspectives, needs, and priorities regarding environmental issues; thus, a one-size-fits-all approach is likely to be less effective. Older adults tend to respond more favorably to initiatives grounded in lived experience and long-term sustainability values, whereas younger individuals are more effectively engaged through educational interventions, digital campaigns, and the promotion of environmentally responsible lifestyles as part of social identity.

In addition, demographic patterns based on gender were examined to further explore variations in public participation and perceptions related to waste management. The results of this analysis are presented in Table 2.

Table 2. Demographic Analysis of Respondents Based on Gender

Gender	Frequency	Percent	Valid Percent	Cumulative Percent
Male	106	42.4%	42.4%	42.4%
Female	144	57.6%	57.6%	100.0%
Total	**250**	**100.0%**	**100.0%**	**100.0%**

Based on Table 2, the number of female respondents is notably higher than that of male respondents. This higher proportion of women carries important implications for understanding community attitudes and perceptions toward waste management, given that women often hold central roles in household and community-level waste practices ranging from sorting waste and managing household product use to influencing family consumption patterns. Consequently, women's engagement represents a strategic factor in driving behavioral change in waste management at both household and neighborhood scales (Varaprasad et al., 2020).

Conversely, although male respondents constitute a smaller proportion of the sample, their participation still reflects a meaningful contribution. Men's involvement is essential for developing comprehensive and sustainable waste-management solutions, particularly in activities requiring physical labor, logistical coordination, community policy implementation, and decision-making

within local organizations. Collaborative engagement between men and women yields far more comprehensive outcomes than efforts involving only one group.

Overall, these findings underscore the necessity of incorporating gender considerations into strategies aimed at enhancing public awareness and participation in waste management. Future programs and policies must effectively motivate both groups by acknowledging their distinct social roles, spheres of influence, and responsibilities within the waste-management context (Tesseme & Chakma, 2020).

Subsequently, the demographic analysis of respondents based on educational attainment is presented in Table 3.

Table 3. Demographic Analysis of Respondents Based on Education Level

Education Level	Frequency	Percent	Valid Percent	Cumulative Percent
Diploma (D3)	5	2.0%	2.0%	2.0%
Master's Degree (S2)	1	0.4%	0.4%	2.4%
Doctoral Degree (S3)	1	0.4%	0.4%	2.8%
Bachelor's Degree (Sarjana/D4)	32	12.8%	12.8%	15.6%
Elementary School (SD)	20	8.0%	8.0%	23.6%
Senior High School (SLTA)	149	59.6%	59.6%	83.2%
Junior High School (SLTP)	42	16.8%	16.8%	100.0%
Total	**250**	**100.0%**	**100.0%**	**100.0%**

Based on Table 3, the majority of respondents possess a medium level of formal education, namely senior and junior secondary schooling. This pattern indicates that middle-educated groups dominate the demographic profile of the surveyed population, while also suggesting that waste-management issues receive considerable attention within this educational segment. Nevertheless, the inclusion of respondents from other educational levels provides a more comprehensive overview of community perceptions regarding waste management (Rahim & Othman, 2022).

Overall, these findings suggest that strategies aimed at enhancing public awareness and participation in waste management must effectively reach individuals across all educational backgrounds. Educational programs should be designed with sensitivity to variations in educational attainment to ensure that messages are both accessible and actionable. Language, media, and delivery

methods may be tailored accordingly for instance, using hands-on, example-based approaches for certain groups and more analytical, data-driven approaches for respondents with higher levels of education.

Furthermore, to deepen the understanding of the relationship between social conditions and levels of environmental concern, the demographic characteristics of respondents based on occupation are presented in Table 4.**Table 4**. Demographic Analysis of Respondents Based on Occupation

Occupation	Frequency	Percent	Valid Percent	Cumulative Percent
Laborers	34	13.6%	13.6%	13.6%
Teachers	8	3.2%	3.2%	16.8%
Housewives	48	19.2%	19.2%	36.0%
Others	18	7.2%	7.2%	43.2%
Students	33	13.2%	13.2%	56.4%
Traders	1	0.4%	0.4%	56.8%
Civil Servants / Government Employees	58	23.2%	23.2%	80.0%
Entrepreneurs	50	20.0%	20.0%	100.0%
Total	**250**	**100.0%**	**100.0%**	**100.0%**

Based on the data presented in Table 4, variations in occupational backgrounds appear to influence the level of awareness and participation in waste management. This finding highlights the need for environmental engagement strategies that account for occupational diversity to ensure that interventions are well targeted. Each professional group operates within distinct activity patterns, social environments, and workloads; therefore, a uniform approach may not be equally effective across all sectors. For instance, educational and outreach programs may be integrated into the workplace for civil servants, private employees, and entrepreneurs, while community-based or neighborhood-oriented approaches may be more appropriate for homemakers and workers in the informal sector. Tailoring messages, media, and dissemination methods to occupational characteristics has the potential to enhance the overall effectiveness of community participation (Mazzuco et al., 2020).

To obtain a deeper understanding of variations in public perceptions and attitudes toward waste management, a further analysis was conducted using the K-means clustering technique. This approach groups respondents into three clusters based on similarities in their perceptions, enabling the identification of community segments with differing levels and types of environmental concern. These findings are expected to support the development of more targeted educational strategies and policy interventions tailored to the specific profiles of

each cluster (Abbar et al., 2020; Mishra et al., 2020).

Table 5. Clustering of Respondents Based on Public Awareness Level into Three Clusters

Parameter	Cluster 1	Cluster 2	Cluster 3
Age	Young adults (18–30)	Middle-aged adults (31–45)	Older adults (>46)
Education	Medium education level	High education level	Low education level
Public Awareness Level	Low awareness	High awareness	Moderate awareness
Percentage	34%	41%	25%
Recommendation	Education programs and social media campaigns targeted at young adults to improve their awareness.	Involving this group as change agents within communities to educate other groups.	Community-based educational programs and direct engagement through environmental cadres to improve awareness.

Table 5 reveals substantial differences in waste-management perceptions and awareness levels across age and educational groups. These findings underscore that environmental awareness programs cannot rely on a single, uniform approach; instead, they require strategies tailored to the specific characteristics of each community segment. Accordingly, the clustering results provide an important foundation for designing targeted interventions ranging from community-based direct education to digital campaigns or engagement through educational institutions and workplaces to enhance the effectiveness of waste-management efforts in the Special Region of Yogyakarta.

In addition to the clustering analysis, heatmap visualization was employed to further strengthen the interpretation of perceptual patterns across regions. In the heatmap, darker shades indicate a higher number of respondents within a given perception level, whereas lighter shades represent fewer respondents. This visualization facilitates the identification of areas requiring greater attention or more intensive intervention in waste-management practices. The variables displayed include the surveyed regions and community perception levels, categorized on a scale from 1 (very low) to 5 (very high). The perception map of waste management in the Special Region of Yogyakarta is presented in

figure 2

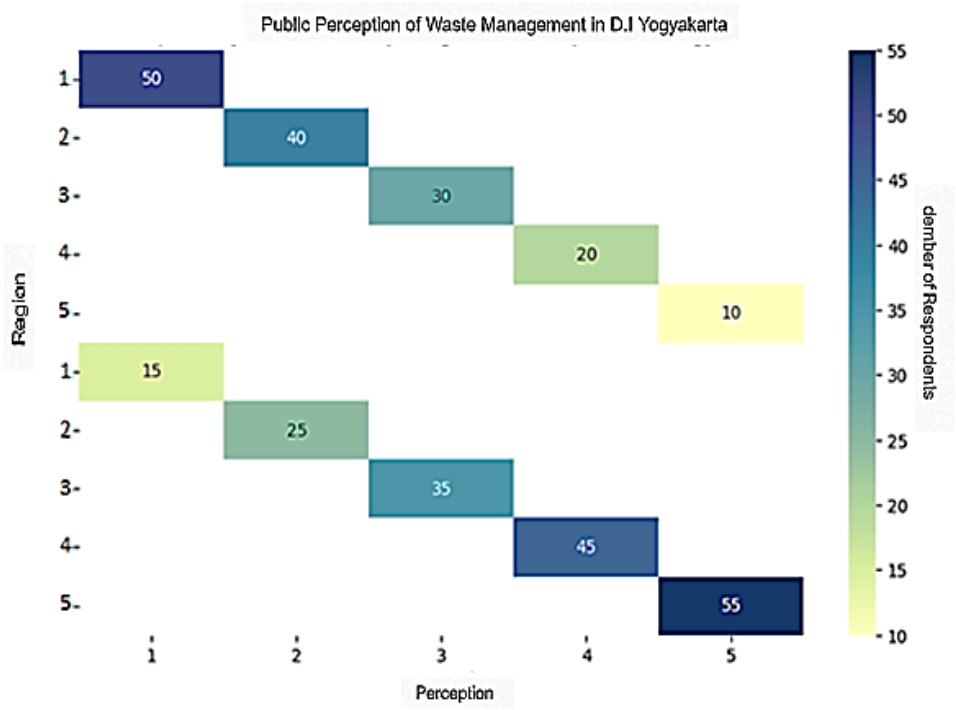

Figure 2. Public Perception of Waste Management in the Special Region of Yogyakarta

Based on the heatmap visualization in the figure above, it is evident that public perceptions of waste management vary considerably across the different administrative areas of the Special Region of Yogyakarta. Yogyakarta City (Region 1), as the administrative center and the most urbanized area, benefits from relatively more advanced facilities and infrastructure compared with other regions. Sleman Regency (Region 2) represents a rapidly developing district characterized by numerous educational institutions and residential areas, making waste-management issues particularly relevant to its dense and dynamic community activities. Bantul Regency (Region 3) combines agrarian communities with growing tourism zones, whereas Kulon Progo Regency (Region 4) reflects a more rural area with large-scale development projects that contribute to increasing waste generation. Gunungkidul Regency (Region 5), with its hilly topography and prominent natural tourism sites, faces unique challenges in waste management, especially in high-traffic tourist destinations.

The perception scale displayed in the heatmap provides an overview of satisfaction and awareness levels in each region. Respondents with a Level 1 perception (very low) consider waste management in their area to be highly inadequate, reflected by visible waste accumulation, limited waste-processing facilities, and weak public education. Level 2 (low) indicates some recognition of existing waste-management efforts, though these are perceived as insufficient and ineffective. A Level 3 perception (moderate) suggests that waste-

management systems are functioning reasonably but still require improvement. Level 4 (high) reflects a generally positive perception, with respondents acknowledging overall effectiveness despite some remaining gaps. Meanwhile, Level 5 (very high) represents the highest satisfaction level, indicating that respondents perceive facilities, system performance, and public education to be functioning optimally.

The heatmap offers analytical advantages by visually illustrating the distribution of public perceptions, enabling rapid identification of regions with high or low levels of awareness. This spatial interpretation not only enhances understanding of local perceptual conditions but also provides a foundation for developing more precisely targeted intervention strategies. Overall, the findings indicate that public awareness levels in the Special Region of Yogyakarta remain insufficient to fully optimize waste management. Therefore, more substantial efforts through strengthened public education, improved infrastructure provision, and robust governmental support are required to foster a sustainable waste-management culture across all regions of D.I. Yogyakarta.

CONCLUSION

This study demonstrates that public perceptions and awareness levels regarding waste management in the Special Region of Yogyakarta remain heterogeneous and are shaped by factors such as age, gender, educational background, occupation, and regional characteristics. The k-means clustering analysis and heatmap visualization further reveal the presence of community groups with high, moderate, and low levels of awareness, indicating the need for tailored literacy and participation interventions for each segment. The challenges of waste management in Yogyakarta extend beyond infrastructure limitations to encompass behavioral and cultural dimensions; therefore, effective solutions must integrate public education, environmental policy, and strengthened community-based initiatives. The integration of Islamic values such as the principle of cleanliness as part of faith and the prohibition against causing harm on Earth offers the potential to serve as a shared moral foundation for cultivating an environmentally conscious culture. Through collaborative efforts involving government agencies, local communities, educational institutions, and religious organizations, Yogyakarta holds significant potential to advance toward becoming a sustainable, zero-waste region.

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