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RA 9003 awareness and waste management practices in Cabanatuan City: A correlational study

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Abstract Effective solid-waste management is essential for protecting public health, preserving environmental quality, and supporting sustainable urban development. In Philippine cities such as Cabanatuan City, challenges remain in ensuring proper disposal, segregation, and community participation in waste management. This study examined residents' awareness of Republic Act 9003 (Ecological Solid Waste Management Act of 2000) and their corresponding solid-waste management practices. A descriptive-correlational design was employed, with 1,113 residents selected from three barangays. Data were collected through structured questionnaires assessing both awareness of RA 9003 and the frequency of specific waste management behaviors, including segregation, recycling, participation in community initiatives, and compliance with proper disposal guidelines. Descriptive results indicate that residents rarely engage in improper or harmful disposal behaviors, with violation practices (e.g., littering, open burning, dumping, and burying waste) reported as Never (grand mean = 1.05). Compliance practices were more frequently observed, ranging from Sometimes to Always (grand mean = 3.53), with practicing the 3Rs (Reduce, Reuse, Recycle) being the most consistent behavior. Awareness of RA 9003 was generally high (grand mean = 4.40, Extremely Aware), particularly regarding prohibitions against littering, open burning, operation of open dumps, and unauthorized removal of recyclables. However, awareness was lower for provisions related to handling non-segregated waste and mixing recyclables with other waste, highlighting areas for targeted education. Pearson correlation analysis revealed a strong, positive, and statistically significant relationship between awareness and practices ($r = .778$, $p = .001$), indicating that residents with greater knowledge of RA 9003 are more likely to consistently engage in responsible waste management behaviors. These findings underscore the critical role of awareness in promoting environmentally responsible practices and suggest that interventions aimed at increasing knowledge of specific legal provisions may enhance compliance and participation in sustainable solid-waste management initiatives.

Keywords: environmental crime and law, environmental impact, environmental education, community engagement, sustainable practices

1. Introduction

Maintaining environmental sustainability and safeguarding public health required efficient solid waste management (Abubakar et al., 2022). In order to lessen negative effects on health, culture, and aesthetics, garbage had to be collected, transported, treated, and disposed of in a methodical manner. Growing trash volumes, increasingly complicated waste streams, and ongoing service shortages put pressure on systems globally and presented new difficulties for municipalities and cities. Unmanaged disposal and illegal dumping damaged soils, contaminated waterways, and changed microbial ecosystems, which increased the hazards to human and ecological health and made remediation more difficult (Vinti et al., 2021). Stronger infrastructure and enforcement were necessary to address these issues, but so were ongoing community involvement and public awareness campaigns to alter disposal practices and promote safe, circular solutions (Zhou et al., 2022).

In many cities in the Philippines, including Cabanatuan City, solid waste continued to be a persistent environmental and public health concern even after Republic Act 9003, also known as the Ecological Solid Waste Management Act of 2000, was passed. The law's efficacy was hampered by improper garbage disposal, inadequate household segregation, and insufficient community involvement in waste reduction programs (Camarillo & Bellotindos, 2021). Although the policy offered a robust legal framework for managing ecological waste, public awareness and compliance were ultimately critical to its success. The question of whether awareness of RA 9003 transferred into appropriate waste management practices was highlighted by this discrepancy between law and practice (Romualdo et al., 2022).

This study explored this relationship by examining the correlation between residents' awareness of Republic Act 9003 (RA 9003) and their daily solid-waste management practices. Previous studies have highlighted the significance of environmental knowledge in forming pro-environmental attitudes; nevertheless, improvements in knowledge and favorable attitudes do not always lead to sustained behavioral change (Braun et al., 2017).

Furthermore, research has shown that limited awareness of waste management policies, weak enforcement, and insufficient community engagement continue to hinder effective implementation of RA 9003 at the local level (Camarillo &

Bellotindos, 2021; Coracero & Gallego, 2021). As a result, the present study sought to address a critical gap in environmental research and policy implementation, particularly in urban barangay settings. Its findings were intended to inform local government units (LGUs), educators, and environmental planners on the need for evidence-based, targeted awareness campaigns and community-based interventions that go beyond information dissemination and encourage sustained behavioral compliance. Similar studies have highlighted that localized education programs, combined with social norms and institutional support, are more effective in improving waste management behaviors than awareness campaigns alone (Abubakar et al., 2022; Tonglet et al., 2004).

The study also culminated in the development of a community extension project aimed at enhancing residents' awareness of the Ecological Solid Waste Management (ESWM) Act and improving solid-waste management practices at the barangay level. Drawing on the study's empirical findings, the project was designed to implement targeted interventions addressing identified knowledge gaps and promoting proper segregation, recycling, and responsible waste disposal. The primary beneficiaries of the project were the residents and barangay officials of the selected barangays, while secondary beneficiaries included the local government units of Cabanatuan City and Nueva Ecija, as well as policymakers, educators, and community-based organizations engaged in environmental management and sustainable urban development.

The Theory of Planned Behavior (TPB) served as the conceptual framework for this study. According to TPB, attitudes toward the conduct, subjective norms, and perceived behavioral control are the three main elements that influence human behavior (Ajzen, 1991). In this study, awareness of RA 9003 was theorized to influence these factors: residents who understood the environmental impacts of improper disposal (attitude), recognized community expectations for proper waste segregation (subjective norm), and felt capable of following guidelines (perceived behavioral control) were more likely to adopt compliant waste management practices. This framework allowed the research to examine how cognitive awareness shaped attitudes, social expectations, and control beliefs, which together predicted behavioral compliance with RA 9003.

Republic Act No. 9003 remained the primary policy framework for managing waste in the Philippines, yet implementation was inconsistent. Only 39% of barangays operated Materials Recovery Facilities (MRFs), and just 29% of local government units had sanitary landfills. In addition to infrastructure gaps, weak community engagement and limited public awareness further undermined the law's impact. Empirical studies showed that knowledge of proper waste disposal correlated positively with actual practices (Wu et al., 2022). However, persistent barriers, including inadequate collection systems, lack of segregation facilities, and weak political will, emphasized that awareness alone was insufficient to create lasting behavioral change (Salinas, 2022).

2. Materials and Methods

The target population consisted of residents living in barangays located within or near the city center, as these areas represent densely populated urban communities with diverse household characteristics and varying exposure to municipal waste management programs. Although the total number of respondents was relatively large (n = 1,113), participants were selected based on accessibility and willingness to participate, making the sampling approach primarily a form of convenience sampling. Respondents were generally approached in their households or local community areas and invited to participate. While the study aimed to include adults with direct involvement in household or personal waste disposal practices, no strict criteria were enforced to achieve a statistically representative sample, and participation was voluntary.

Random sampling was not employed due to practical and methodological constraints. The absence of an updated and comprehensive household sampling frame at the barangay level, combined with access restrictions and the need for barangay approval, limited the feasibility of probability-based sampling. Residents who were minors, temporary visitors, or who had no direct role in waste disposal were excluded to maintain relevance of the data. Given these conditions, the findings should be interpreted with consideration of the convenience-based nature of the sample, which may limit generalizability.

The primary data-gathering instrument was a structured survey questionnaire adapted from Carmen (2023). The questionnaire consisted of two main parts: Part I measured respondents' daily waste management practices, and Part II assessed their level of awareness of RA 9003, covering its objectives, specific provisions, prohibited acts, and penalties for non-compliance. Within Part I, items 1–4 represented violation practices, reflecting improper or environmentally harmful behaviors such as littering, dumping, burying hazardous waste, and open burning, while items 5–10 represented compliance practices, capturing responsible behaviors such as waste segregation, recycling, conversion of biodegradable waste, participation in community clean-up activities, and reporting violations.

To ensure the reliability of the instrument, a pilot test was conducted among 30 residents in Sumacab Este, Cabanatuan City prior to full administration. These pilot respondents were not included in the main study sample. The pilot test allowed for refinement of the questionnaire to improve clarity, consistency, and content validity. Reliability analysis of the instrument indicated excellent internal consistency, with 10 items each, a sum of item variances of 0.63, a total score variance of 4.41, and a Cronbach's alpha of 0.9523 for practices and for awareness, a sum of item variances of 0.50, a total score variance of 4.41, and a Cronbach's alpha of 0.9862, confirming that the instrument reliably measured respondents' practices and awareness regarding solid waste management.

Data collection was conducted through face-to-face administration following approval from barangay chairpersons. Ethical standards were strictly observed, including informed consent, voluntary participation, confidentiality of responses, and the right to withdraw at any time without penalty.

Collected data were organized and analyzed using descriptive and inferential statistical techniques. Frequencies and percentages summarized demographic variables and categorical responses, while means and standard deviations described levels of awareness and waste management practices. To ensure consistency in interpretation and accuracy in correlational analysis, the first four items of the practices questionnaire (violation practices) were reverse-coded, so that higher scores consistently indicated greater adherence to recommended waste management behaviors. This step ensured that the grand mean accurately reflected overall engagement in positive practices. The Pearson correlation coefficient was then employed to examine the strength and direction of the relationship between awareness of RA 9003 and solid waste management practices, allowing for the identification of statistically significant associations while maintaining analytical rigor.

3. Results and Discussion

3.1. Respondents' practices on solid waste management

The first research question examined the intensity of residents' solid-waste management practices. Table 1 presents respondents' practices in the selected barangays of Cabanatuan City, organized by specific behaviors related to waste handling, including disposal, recycling, and participation in community initiatives. Items are categorized as violation practices (improper or environmentally harmful behaviors) and compliance practices (positive, responsible behaviors).

Table 1 Respondents' responses on their practices on solid waste management.

Statements	Mean	Description
Violation Practices		
Littering or throwing waste in public places	1.17	Never
Dumping waste in public places or rivers	1.00	Never
Burying hazardous waste underground	1.03	Never
Burning solid waste in open areas	1.00	Never
Mean	1.05	Never
Compliance Practices		
Converting biodegradable waste into useful products like organic fertilizer	3.04	Sometimes
Segregating biodegradable and non-biodegradable wastes properly	4.02	Often
Practicing the 3Rs of waste management (Reduce, Reuse, Recycle)	4.98	Always
Selling recyclable waste to junk shops or collectors	3.05	Sometimes
Participating in community clean-up drives and environmental initiatives	3.05	Sometimes
Reporting illegal dumping and other environmental violations	3.05	Sometimes
Mean	3.53	Often

The findings in Table 1 reveal that residents in the selected barangays of Cabanatuan City demonstrate very low engagement in violation practices related to solid waste management, with mean scores ranging from 1.00 to 1.17, all descriptively categorized as Never (mean = 1.05, Never). This suggests that respondents seldom engage in improper waste behaviors such as littering, dumping, burying hazardous waste, or open burning. In contrast, compliance practices displayed moderate to high engagement, with mean scores ranging from 3.04 (Sometimes) to 4.98 (Always), resulting in an overall mean of 3.53 (Often). Notably, practicing the 3Rs (Reduce, Reuse, Recycle) was the most consistently observed behavior (Always), while activities such as converting biodegradable waste into fertilizer, selling recyclables, participating in clean up drives, and reporting violations were generally performed Sometimes. Overall, these results indicate that residents largely avoid environmentally harmful behaviors and tend to participate more frequently in responsible solid waste management practices.

Studies on solid waste management in recent years similarly highlight the importance of compliance with environmentally responsible practices and the variability of engagement across different behaviors. Research in Barangay Balaring found that residents' adherence to waste segregation, composting, and other waste management activities was generally strong, though some reduction and reuse behaviors were inconsistently applied (Hermosora & Padios, 2025).

The determinants of waste management behaviors vary across specific practices, with environmental knowledge, social norms, and perceived behavioral control influencing engagement in actions like segregation and proper disposal in different ways, according to supporting evidence from broader contexts (Wu et al., 2022). Additionally, targeted educational interventions have been demonstrated to improve community solid waste management knowledge and behaviors, highlighting the importance of ongoing environmental education for enhancing compliance (Domasian et al., 2025). All of these research support the present conclusions that the 3Rs and appropriate segregation are more important than other behaviors, even though waste management compliance can be significant.

3.2. Respondents' level of awareness on ecological solid waste management act of 2000

The second research question entails the level of awareness of respondents on Ecological Waste Management Act of 2000. Table 2 shows the respondents' levels in the selected barangays of Cabanatuan City. The items reflect specific provisions and prohibitions under the law, and each is accompanied by its mean score and descriptive category. The grand mean provides an overall summary of the respondents' awareness across all the listed statements.

Table 2 Respondents' level of awareness on solid waste management act of 2000.

Statements	Mean	Description
Littering, throwing, or dumping of waste in public places, or allowing others to do so is prohibited.	4.99	Extremely Aware
Open burning of solid waste is prohibited.	4.98	Extremely Aware
Causing or allowing the collection of non-segregated waste is prohibited.	2.02	Slightly Aware
Open dumping or burying of biodegradable or non-biodegradable waste in flood-prone areas is prohibited.	4.97	Extremely Aware
Unauthorized removal of recyclable materials set aside for authorized collection is prohibited.	4.98	Extremely Aware
Mixing source-separated recyclables with other solid waste during collection or disposal is prohibited.	2.12	Slightly Aware
Establishing or operating open dumps is prohibited.	4.98	Extremely Aware
Manufacturing, distributing, or using non-environmentally acceptable packaging materials is prohibited.	4.97	Extremely Aware
Importing consumer products packaged in non-environmentally acceptable materials is prohibited.	4.98	Extremely Aware
Conducting operations or using equipment that violates sanitation or permit requirements is prohibited.	4.97	Extremely Aware
Grand Mean	4.40	Extremely Aware

The results in Table 2 indicate that respondents in the selected barangays of Cabanatuan City generally demonstrate a high level of awareness regarding the provisions of the Solid Waste Management Act of 2000 (RA 9003), with a grand mean of 4.40, corresponding to Extremely Aware. Specifically, respondents showed near-complete awareness of prohibitions against littering, open burning, unauthorized collection of recyclables, operation of open dumps, and the use of non-environmentally acceptable materials (mean scores 4.97–4.99, Extremely Aware). However, awareness was slightly lower regarding the prohibition of causing or allowing the collection of non-segregated waste (mean = 2.02, Slightly Aware) and mixing source-separated recyclables with other waste (mean = 2.12, Slightly Aware). These results suggest that while the community is highly informed about most aspects of RA 9003, there are specific provisions, particularly those involving proper segregation and handling of recyclables, that require further awareness-raising initiatives.

It was proven that higher knowledge of environmental laws and waste management concepts is positively correlated with improved waste management practices, according to recent studies on public awareness of solid waste management legislation. Residents in urban areas typically exhibit a high level of awareness regarding the prohibitions against improper disposal, burning, and open dumping; however, their knowledge of more technical provisions, like the handling and segregation of recyclables, tends to be lower, which reflects the variability in the adoption of various waste management practices (Mukena et al., 2024).

Similarly, studies conducted in Philippine towns demonstrate that ongoing environmental education and communication efforts greatly enhance adherence to and appropriate application of solid waste management regulations. For instance, residents' awareness of solid waste management policies, including important provisions of RA 9003, increased significantly as a result of a targeted educational intervention that included interactive seminars and workshops, the distribution of educational materials, and community involvement. Waste segregation and other environmentally responsible practices also improved in tandem (Domasian et al., 2025).

These findings are consistent with the present results, highlighting that while general awareness of RA 9003 is high, targeted programs are needed to enhance understanding of specific technical provisions that are less widely known among residents.

3.3. Relationship between respondents' awareness and practices on solid waste management

Table 3 presents the results of the third research question on the correlation between respondents' awareness of the Ecological Solid Waste Management Act of 2000 (RA 9003) and their solid waste management practices. For the sake of accuracy in computing the Pearson correlation coefficient, the first four items of the practices, representing improper or environmentally harmful behaviors such as littering, dumping, burying hazardous waste, and open burning, were reverse-coded so that higher scores consistently indicate more responsible waste management practices. The table shows the Pearson correlation coefficient (r), the p-value indicating statistical significance, and an interpretation of the relationship between the two variables, providing an overview of how awareness and practices are related among the respondents.

Table 3 Relationship between awareness and practices on solid waste management.

Variable 1	Variable 2	r (Correlation Coefficient)	p-value	Interpretation of Relationship
Practices on Solid Waste Management	Level of Awareness on Ecological Solid Waste Management Act of 2000	.778	0.001	Residents who are more aware of the Ecological Solid Waste Management Act (RA 9003) are much more likely to practice proper solid waste management.

The results in Table 3 show a strong, positive, and statistically significant relationship between residents' level of awareness of the Ecological Solid Waste Management Act of 2000 (RA 9003) and their practices on solid waste management ($r = .778$, $p = .001$). This implies that as awareness increases, the likelihood of engaging in responsible solid waste management practices also increases. In practical terms, residents who are more knowledgeable about the provisions and prohibitions of RA 9003 are much more likely to consistently engage in proper waste handling, segregation, recycling, and other environmentally beneficial behaviors. The high correlation coefficient suggests that awareness is a key determinant of solid waste management behavior among the community respondents in this study.

The conclusion that solid waste management awareness and real waste management behavior are closely related is supported by a number of recent studies. Higher awareness is linked to more effective solid waste behaviors, according to a study conducted in Bacolod City among Grade 12 and graduating college students. The study found a moderately strong positive correlation between awareness of solid waste management principles and self-reported waste management practices, including segregation, reduction, reuse, recycling, and disposal (Alvarado et al., 2025). In addition, a study of residential waste segregation in Tuguegarao City found that household awareness and compliance with waste segregation practices were significantly positively correlated in household contexts, highlighting the importance of improved information and community understanding in improving waste management compliance (Salud et al., 2025).

Additionally, studies conducted on college students found that awareness and waste management practices were positively correlated; yet gaps in knowledge and consistent behavior underscore the need for more institutional support and education (Decoro & Cajucom, 2025). When taken as a whole, these studies confirm that awareness is a crucial precondition for proper solid waste management behavior and that interventions aimed at raising awareness, particularly with regard to certain legislative provisions, can greatly improve sustainable practices.

3.4. Proposed community extension project to enhance the residents' awareness and SWM practices

Table 4 presents the proposed community extension project titled "Eco-Living 101: Barangay Awareness and Solid Waste Management Enhancement Program," which was formulated based on the findings of the assessment on residents' level of awareness and actual practices related to the Ecological Solid Waste Management Act of 2000 (RA 9003). The assessment results revealed that while residents generally demonstrate high awareness of the law, certain gaps persist in the consistent application of proper solid waste management practices at the household and community levels. In response to these findings, the proposed project was designed as a comprehensive intervention aimed at reinforcing existing knowledge, addressing identified weaknesses, and promoting sustainable behavioral changes among residents.

The table details the project's rationale, overall goal, and specific objectives, as well as the identified target beneficiaries, which include household heads, youth leaders, barangay volunteers, and other key stakeholders involved in waste management. It further outlines the major project components and activities, such as information and education campaigns, development and distribution of IEC materials, hands-on demonstrations, and community engagement initiatives. In addition, the table presents the expected outputs and outcomes, project timeline, budgetary requirements, monitoring and evaluation mechanisms, and sustainability plan. Collectively, these components provide a clear and systematic framework for implementing a community-based solid waste management program intended to strengthen residents' understanding of RA 9003 and translate awareness into consistent, effective, and sustainable solid waste management practices within the barangay.

Table 4 Proposed community extension project to enhance the residents awareness and SWM practices of residents.

Project Title:	Eco-Living 101: Barangay Awareness and Solid Waste Management Enhancement Program
Proponents	Jan Vincent S. Carmen, PhD, RCrim
Partner Community/Agency	Nueva Ecija
Rationale	The assessment conducted among residents of selected barangays in Cabanatuan City revealed that residents generally demonstrate high awareness of RA 9003 (Ecological Solid Waste Management Act of 2000), with a grand mean of 4.40 (Extremely Aware). Awareness is particularly strong regarding prohibitions on littering,

	open burning, operation of open dumps, and unauthorized removal of recyclables. However, gaps remain in knowledge about proper handling of non-segregated waste and mixing source-separated recyclables, suggesting that awareness does not always translate into consistently effective practices. Observations of waste management behaviors indicate that residents rarely engage in harmful disposal practices, such as littering, dumping, burning, or burying waste (grand mean = 1.05, Never), while compliance practices—such as practicing the 3Rs, recycling, composting, and participating in community clean-up drives—are performed at moderate to high levels (grand mean = 3.53, Often). Pearson correlation analysis shows a strong, positive, and statistically significant relationship between awareness and practices (r = .778, p = .001), emphasizing that residents with higher knowledge of RA 9003 are more likely to adopt proper waste management behaviors. Given these findings, the "Eco-Living 101" project aims to further strengthen and sustain solid waste management behaviors by reinforcing areas of weaker awareness and translating existing knowledge into consistent household and community practices. The program will use structured education, hands-on demonstrations, and community engagement to enhance understanding and encourage compliance with RA 9003.
Project Goal	To enhance residents' understanding of RA 9003 and strengthen sustainable solid waste management practices through education, skills training, and community mobilization.
Specific Objectives	To reinforce residents' knowledge of RA 9003 provisions, particularly regarding proper segregation and handling of recyclables. To improve household adoption of responsible waste management practices, including segregation, composting, recycling, and participation in community initiatives. To develop and distribute localized IEC materials highlighting proper waste practices and common violations. To engage residents in interactive activities that promote sustainable solid waste management and environmental stewardship
Target Beneficiaries	Residents aged 18 years and above Household heads Youth leaders and parent leaders Waste collectors and barangay volunteers Barangay Environment and Natural Resources Council (BENRC)
Project Components and Activities	A. Information and Education Campaign (IEC) Sessions Seminar on RA 9003 provisions Orientation on segregation, composting, and recycling Presentation of barangay waste data and identified issues B. Development and Distribution of IEC Materials Posters (Proper Segregation, RA 9003 Key Provisions, Prohibited Acts) Flyers and brochures Social media infographics C. Hands-on Demonstration Activities Proper household waste segregation Composting demonstration (for biodegradable waste) Recycling and upcycling guides D. Community Engagement Activities Eco-Quiz Bee for youth Slogan/poster-making contest on SWM Community pledge signing for RA 9003 compliance E. Monitoring and Evaluation Pre- and post-awareness surveys Monitoring of household segregation practices Documentation and evaluation reports
Expected Output	At least 3–5 barangay-wide IEC sessions conducted Distribution of 200–300 localized IEC materials Conduct of hands-on segregation and composting demonstrations Participation of at least 70% of targeted households Community engagement activities successfully conducted
Expected Outcomes	Increased community awareness and understanding of RA 9003

	Improved household solid waste management behaviors
	Reduction in common violations (e.g., littering, burning, improper dumping)
	Stronger barangay–community cooperation in environmental management
Project Timeline	Month 1 – Planning and coordination
	Month 2 – Baseline survey and resource preparation
	Month 3–5 – IEC sessions, demonstrations, and activities
	Month 6 – Monitoring and evaluation
	Month 7 – Final reporting and turnover
Budgetary	Printing of IEC materials
Requirements	Tarpaulins and posters
	Training kits and demonstration materials
	Meals/snacks for participants
	Token/honorarium for speakers
	Documentation expenses
Monitoring and	Pre- and post-tests to measure change in awareness
Evaluation	Feedback forms and participation records
	Household observation checklist
	Waste volume tracking in coordination with barangay waste collectors
	Final evaluation and impact assessment
Sustainability Plan	Turnover of IEC modules and materials to barangay
	Establishment of Barangay SWM Education Team
	Training of youth volunteers as peer educators
	Annual awareness reinforcement sessions

4. Conclusions

This study examined the solid waste management practices of residents in selected barangays in Cabanatuan City, their level of awareness of the Ecological Solid Waste Management Act of 2000 (RA 9003), and the relationship between these two variables. The findings showed that residents rarely engaged in improper or harmful waste behaviors, such as littering, open burning, dumping, or burying waste (grand mean = 1.05, Never). In contrast, compliance practices, including practicing the 3Rs (Reduce, Reuse, Recycle), segregation, recycling, reporting violations, and participating in community initiatives, were performed with moderate to high frequency (grand mean = 3.53, Often), with practicing the 3Rs being the most consistently observed behavior. These results suggest that while environmentally harmful behaviors are largely avoided, proactive and community-centered waste management practices are performed inconsistently.

Assessment of residents' awareness of RA 9003 revealed that they were generally highly aware of the law (grand mean = 4.40, Extremely Aware), particularly regarding prohibitions against littering, open burning, operation of open dumps, and unauthorized removal of recyclables. However, awareness was slightly lower for provisions related to handling non-segregated waste and mixing recyclables with other waste, indicating specific knowledge gaps that require reinforcement through targeted education and community campaigns.

Correlational analysis demonstrated a strong, positive, and statistically significant relationship between awareness and solid waste management practices ($r = .778$, $p = .001$). This indicates that residents with higher knowledge of RA 9003 are more likely to consistently adopt responsible waste management behaviors. Taken together, the findings emphasize the critical role of awareness in promoting sustainable and environmentally responsible practices and underscore the need for educational initiatives, hands-on community engagement, and supportive local policies to strengthen both knowledge and practical compliance among residents.

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5. Declarations

5.1. Ethical considerations

All participants were fully informed about the purpose, procedures, and potential risks of the study, as well as their rights to decline participation or withdraw at any point without consequence. Written informed consent was obtained from each participant before the administration of the survey questionnaire. The consent forms also explained the voluntary nature of participation and assured respondents that all information provided would be treated confidentially and used solely for research purposes. Additional safeguards were implemented to protect vulnerable populations within the study, including participants who were elderly or had limited literacy. In such cases, consent procedures were adapted to ensure clear understanding, and assistance was provided to complete the questionnaires when necessary. The confidentiality and dignity of all participants were strictly maintained throughout the research process, in compliance with international ethical standards and UNESCO recommendations. No identifiable images or personal data were published in this study. The anonymity of respondents was preserved through coding and secure storage of all data. Only aggregated results are presented in the findings. Overall, all procedures adhered to institutional, national, and international ethical guidelines for research with human participants, ensuring respect for persons, beneficence, and justice in the conduct of this study.

5.2. Use of artificial intelligence (AI)

The author declares that no generative artificial intelligence (AI) tools were used in the preparation, analysis, or writing of this manuscript.

5.3. Conflict of interest

The author declares that there is no conflict of interest.

5.4. Funding

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