Inclusive Society and Sustainability Studies, Vol. 5 No. 2 (2025) https://doi.org/10.31098/issues.v5i1.3149

Check for updates

Research Paper

Assessment of Utilized Focused Educational Approaches Towards Enhancement of Community Knowledge, Attitudes, and Practices in Solid Waste Management

Rainiel Bryan V. Domasian[1]*, Ofelia B. Maningas[1], Jamine A. Bautista[1], Jomar P. Tañesa[1], Angelika Ross I. Tagum[1], Francis A. Martinez[1]

[1]Laguna State Polytechnic University, Philippines

Received: February 13, 2025	Revised: February 13, 2025	Accepted: June 2, 2025	Online: July 13, 2025

Abstract

This study examines the impact of the "I TEACH-Environmental Protection Project" on the knowledge, attitudes, and practices (KAP) of community members regarding solid waste management. A focused educational approach (FEA) serves as the intervention, which includes interactive seminar workshops, the distribution of educational materials such as tarpaulins and flyers, and active community participation in Clean-Up Drives. A total of 174 participants were selected using a stratified sampling technique, and pre- and post-intervention data were collected through surveys and observational assessments to measure changes in knowledge of waste segregation, policy awareness, and understanding of environmental impact. The seminar focused on key provisions of Republic Act 9003, the Ecological Solid Waste Management Act of 2000, which underscores proper waste management, resource conservation, and community responsibility. Discussions covered the adverse effects of poor waste disposal, the role of local government units, the use of colour-coded bins, and adherence to waste disposal schedules. The intervention emphasized the 5Rs strategy (Reuse, Reduce, Recycle, Repair, Recover) and the establishment of Material Recovery Facilities (MRFs). The results indicated a significant improvement in knowledge and attitudes, with practices showing the most notable progress, particularly in waste segregation, recycling, and proper disposal methods. Participants demonstrated enhanced compliance with waste management policies, including the strict implementation of five-colour bins. The study fills a critical gap in current knowledge by proving that targeted educational initiatives effectively shift KAP towards sustainable waste management. The results underscore the importance of ongoing public education and effective policy enforcement to ensure long-term environmental sustainability.

Keywords: *Focused Educational Approach, Solid Waste Management, Knowledge, Attitude, Practices*

INTRODUCTION

Environmental degradation resulting from rapid industrialisation and an increasing human population is considered a global dilemma. According to the World Population Review (2024) data sheet, the worldwide population is expected to increase by 46% from approximately 6.5 billion in 2005 to about 9.5 billion by 2050. While the population trend in most developed countries is decreasing, there is an accelerating increase in population in developing countries. Amidst efforts to protect the environment, the practices of basic waste management are often neglected at the individual level. Several studies have demonstrated significant barriers to the disposal, transportation, storage, and collection of solid waste in metropolitan settings. Cities in many developing countries, as well as those in East Africa and the North, face similar challenges. The leading cause of these issues is the poor economy in these areas, which impede the development of efficient solid waste management. However, in the Philippines, environmental issues have been linked to serious health issues. Adverse effects on human health could potentially lead to a reduced economy; thus, relevant and proactive programs for the environment should be implemented to address the imminent, irreversible deterioration.

From a global perspective, the world generates over 2 billion tons of municipal solid waste

Corresponding author's email: rvdomasian@lspu.edu.ph

annually, and this is expected to increase by 70% by 2050 (Lama, 2024). The majority of this increase will come from developing nations, where problems are made worse by unreliable waste collection services, a lack of source separation for different types of waste, and a reliance on open dumps and poorly managed landfills for disposal, which result in the creation of large, toxic mountains that harm public health, contaminate water supplies, and accelerate climate change.

Furthermore, in the context of the 2030 Agenda for Sustainable Development Goals (SDGs), adopted by all United Nations (UN) member states in 2015, it is stated that addressing global poverty requires focusing on strategies that reduce inequality and spur economic growth, while also responding to climate change (Ellerbeck, 2022). In alignment with SDG 13 (Climate Action), the leading causes of climate change include the greenhouse effect, deforestation, and the dumping of waste into rivers and oceans (Stanescu, 2022). The Intergovernmental Panel on Climate Change (IPCC, 2014) found that solid waste, particularly in developing nations where landfills are the primary means of disposing of trash, is a significant source of methane emissions. Average temperatures have increased noticeably due to these emissions and those from other sources, particularly in metropolitan areas. The impact on local climates is becoming more noticeable in nations like China and India, where increased urbanisation has led to a rise in waste generation. This is supported by Bolan et al. (2024), who investigated how methane and CO^2 emissions from landfills exacerbate the heat island effect and increase local temperatures. Inadequate solid waste management exacerbates the urban heat island effect, as open dumps and landfills retain heat while decomposing waste releases greenhouse gases, resulting in higher temperatures.

Meanwhile, the Philippines generates over 61,000 tons of waste daily (Environmental Management Bureau, 2024), with Metro Manila alone contributing a significant portion due to its dense population and industrial activities. A major problem in waste management is the lack of proper waste segregation at the household level, resulting in waste piling up in landfills and waterways (SEPO, 2017). The amount of waste produced exceeds the capacity of current waste disposal facilities, primarily due to a rapid increase in urbanisation and population. In addition, a study by Molina et al. (2021) found the seven key indicators, such as the definition of solid waste, the consequences of improper disposal, pertinent laws, and the roles of communities and schools, were used to gauge the level of awareness regarding solid waste management which implies that students' comprehension of solid waste is generally moderate. The assessment of community behaviour and perceptions of environmental issues reveals satisfactory knowledge and attitudes. At the same time, less than half demonstrated a satisfactory practice level in material recycling and participation in environmental programs among students (Barloa et al., 2016). This suggests that an individual's intention and attitude may drive human behaviour and can be argued to be self-interest, which plays a vital role in decision-making and action unless pressure to do so is applied (Green & Fox, 2007). However, unless external factors, such as laws, incentives, or community pressures, are applied, individual choices may not always align with larger social or environmental interests when it comes to environmental actions like waste segregation. People are more inclined to act in an environmentally friendly manner as decisions have clear benefits or consequences. In fact, in some developing countries, informational and supportive interventions enhance waste segregation efforts by appealing to both individual benefits and societal norms.

For instance, the municipality of Los Baños in Laguna province, Philippines, has been designated as a Special Science and Nature City due to the presence of several key research agencies and institutions. One of its 14 barangays, Barangay San Antonio, has the second-largest population, with approximately 15,978 residents (Sullivan, 2020). The high population density in the area contributes to increased waste production and poor management, exacerbated by a lack of environmental awareness, attitudes, and practices, as well as rapid institutional growth. To address this, a Focused Educational Approach (FEA) was implemented, including interactive seminar

workshops, the distribution of educational materials such as tarpaulins and flyers, and community involvement in a Clean-Up Drive. Therefore, this study aims to determine the pre-and post-test assessments of knowledge, practices, and attitudes by implementing focused educational programs (I-TEACH Environmental Protection Project) as effective waste management strategies. Specifically, the study aims to;

1. Determine the socio-demographic profile of the household respondents in terms of area, age, sex, civil status, family income, and educational attainment;
2. Determine the level of knowledge, attitude and practices regarding waste status of waste segregation, policies and environmental impact;
3. Determine the significant differences in the mean scores among socio-demographic profiles in terms of knowledge, attitude, and practices.
4. Evaluate the Pre- and post-assessment scores of the household respondents in terms of knowledge, attitude, and practices towards waste segregation, policies, and their environmental impact.

LITERATURE REVIEW

Solid Waste Management (SWM) is a complex issue that encompasses political, socioeconomic, institutional, and environmental dimensions. The rapid urbanization in developing nations has exacerbated waste management challenges, making it one of the most pressing concerns in urban areas (Debrah et al., 2021). On a global scale, plastic waste presents a significant environmental challenge, with approximately 450 million tonnes of plastic trash generated annually. Single-use plastics account for 50% of this total, and only 9% of plastic waste is recycled. The remainder often pollutes land and water bodies, severely impacting ecosystems. China, the United States, and India are among the most significant contributors to global plastic pollution (World Population Review, 2024). A significant factor contributing to these issues is the disparity in environmental awareness between different age groups, which often results in ineffective waste disposal practices and unsustainable development, particularly in low-income regions (Hanen & Mahmod, 2024).

The integration of environmental consciousness in management practices has significantly influenced the development of sustainable waste management strategies (Pabilando et al., 2021). Environmental Accounting Practices (EAP) have emerged as a vital tool for businesses to monitor their ecological impact while optimizing operational efficiency and compliance with sustainability standards (Phan & Baird, 2015). Environmentally responsible behaviour is a key component of effective SWM. Maisaroh (2023) describes observable behaviour as active behaviour, which plays a fundamental role in waste management. Abubakar et al. (2022) identify five key indicators of environmentally responsible behaviour: proper waste disposal facilities, energy and water conservation, efficient waste management, and proactive engagement in environmental protection activities. Studies reveal that approximately 62 million tons of waste are generated annually, with only 28% being recycled. The remaining 72% often remains on roadsides or landfills, posing significant environmental and health hazards (Pabilando et al., 2021). Developing countries face similar challenges, underscoring the urgent need for adequate waste segregation, systematic waste collection, and sustainable waste disposal methods to mitigate the long-term impacts of improper waste management.

Furthermore, community participation is a pivotal element in effective waste management strategies. Research highlights numerous success stories where community involvement has significantly improved waste reduction and recycling rates (Kalra, 2020). Engaging local communities fosters a sense of environmental responsibility, enhances public awareness, and provides platforms for active participation in sustainable waste management practices.

Governments, organisations, and local leaders must prioritise community engagement initiatives to develop sustainable, environmentally responsible waste management systems (David, 2023). Communities must participate by ensuring proper disposal at designated locations and at designated times. Individual responsibilities include storing waste appropriately, separating recyclables from general waste, and maintaining cleanliness in residential areas. These small but essential actions collectively contribute to a more organized and efficient SWM framework (Kalra, 2020).

In response to the growing waste management crisis, various regulatory frameworks have been implemented, including the Ecological Solid Waste Management Act of 2000 (RA 9003) in the Philippines. This law requires local government units to develop solid waste management plans and establish a target to reduce municipal solid waste by 25%. Under the Municipal Environment and Natural Resources Office (MENRO), SWM programs aim to create long-term social, environmental, and political reforms, including increased public education, consumer accountability, and civic participation in waste management initiatives (Velasco et al., 2024).

Community extension programs in higher education institutions play a significant role in environmental protection efforts. These programs enhance instruction, support research, and encourage community engagement by fostering environmental awareness and promoting sustainable behaviours among individuals. Studies indicate that such programs foster a culture of cleanliness, sustainability, and responsibility within communities, ultimately leading to more effective SWM practices (Magnaye, 2021). As people become more aware of environmental challenges, their participation in community-led waste management efforts increases, leading to the successful implementation of sustainability initiatives.

Therefore, Solid Waste Management requires a multi-stakeholder approach, incorporating government policies, community engagement, and educational interventions. Strengthening environmental responsibility at individual and institutional levels can mitigate waste accumulation and promote sustainable barangay development. Enhancing public participation, enforcing policies, and expanding educational programs are crucial for achieving long-term waste management solutions.

RESEARCH METHOD

The study employed a quasi-experimental design with a one-group pre-test and post-test research design to assess the knowledge, attitude, and practices (KAP) towards waste segregation, policies, and environmental impact in Barangay San Antonio, Los Baños, Laguna (see Figure 1). A total of 174 household residents from six *Puroks* (small community zones or subdivisions) within Barangay San Antonio, Los Baños, Laguna, participated as respondents in the extension project. To ensure equitable representation from each sub-area, a stratified sampling technique was employed. In this approach, the population was divided into strata based on their respective Puroks, and respondents were proportionally selected from each stratum. This method enhances the representativeness of the sample by ensuring that all segments of the community are adequately represented, thereby improving the reliability and generalizability of the findings (Etikan & Bala, 2017).

The initial assessment of participants' KAP was conducted using a self-constructed survey questionnaire validated by experts in the field of environmental science, which demonstrated a high level of reliability with a Cronbach's alpha score of 0.9. An intervention was implemented through a Focused Educational Program utilising the I-TEACH (Integrated Training in Environment, Agri-Aquaculture, Careers, and Handiworks) Environmental Protection Extension program. This program aimed to enhance environmental awareness and promote sustainable practices within the community. It involved a series of interactive seminars on solid waste management, environmental

sustainability, and resource conservation, which provided foundational knowledge to participants. Complementing these seminars were hands-on workshops that focused on practical skills such as urban gardening, aquaponics, and basic livelihood activities like recycling and handicrafts. Educational materials, including brochures, posters, and instructional kits, were distributed to reinforce the learning experience and serve as references beyond the sessions. To further strengthen community involvement, a barangay-wide clean-up drive was conducted, encouraging participants and local volunteers to apply what they learned in a tangible, collaborative effort. The entire intervention spanned one month, with weekly sessions conducted in each Purok to ensure broad participation and sustained engagement. Throughout the program, barangay leadership played a key role in supporting logistics, communication, and the mobilization of community members.

Data were collected to assess changes in participants' knowledge, attitudes, and practices (KAP) before and after the intervention. A follow-up KAP evaluation was conducted two months after the program's implementation, allowing sufficient time for knowledge retention and behavioural adaptation. The use of a two-month interval is supported by existing literature; for instance, studies by El-Gilany et al. (2017) and Lyu et al. (2017) reported significant improvements in KAP scores within this timeframe following educational interventions.

Descriptive statistics, including frequency, mean, and standard deviation, were used to summarise the socio-demographic characteristics and KAP levels of the participants. For inferential analysis, a one-way ANOVA was conducted to assess variations in mean scores based on socio-demographic factors, including location, educational attainment, income, and civil status. Additionally, t-tests were performed to examine mean differences by sex and to identify significant changes in KAP scores between the pre-and post-intervention assessments.

Figure 1. Vicinity map of Barangay San Antonio, Los Baños, Laguna

FINDINGS AND DISCUSSION

Household Socio-demographic Profile

As summarised in Table 1, the socio-demographic profile of Barangay San Antonio is presented in terms of the respondents' area, sex, gender, civil status, family income, and educational attainment. The frequency and percentage distribution across various parks are also mentioned. Purok 6 has the highest frequency, with 45 individuals accounting for 25.9% of the total. Meanwhile, Purok 3 has the lowest frequency, with just 17 individuals, representing 9.80% of the total. Decreased participation in environmental-related events due to a lack of knowledge, a sense of irrelevance, or conflicting domestic concerns (Masud & Kari, 2015). Furthermore, the regional variance in participation may be due to varying degrees of community involvement or access to environmental programs. These findings are consistent with the notion that community dynamics

and leadership significantly influence community involvement in environmental projects (Jones et al., 2010).

In terms of age, the Silent Generation (5.7%) is the least represented, with Baby Boomers (23.6%) and Generation X (31.6%) making up the majority of responses. This age distribution aligns with evidence indicating that middle-aged adults—such as Gen Z —tend to participate more in community initiatives due to their established roles in local government and at home (Ardoin & Bowers, 2020). Conversely, younger generations, such as Millennials and Generation Z, may be less engaged due to time constraints associated with their careers or education.

A majority of respondents (69.9%) were female, based on the gender distribution, which may suggest that women are more likely to participate in community-driven environmental activities. According to studies, women are typically more involved in waste management and environmental sustainability programs, and they frequently occupy important roles in home management (Si et al., 2022). Regarding civil status, the distribution shows an equal split between single and married respondents, with each comprising 46% of the sample. This balance suggests that both family-oriented individuals and single households share a concern for environmental matters, although their motivations may differ.

The table on family income and educational attainment provides significant insights into the socio-economic characteristics of the respondents in Barangay San Antonio. The majority (77%) of households fall under the "poor" category, earning less than 12,030 PHP monthly, while only a small percentage (1.1%) belongs to the "upper-middle-income bracket, earning between 144,360 and 240,600 PHP. This economic gap highlights the financial constraints faced by the majority of households, which can have a direct impact on their ability to participate in environmental activities. Lower-income households may prioritise their immediate financial survival over environmental concerns (Hajat et al., 2015), and their limited resources and access to information may hinder their ability to participate in community-based environmental activities.

In terms of educational attainment, more than half (58.6%) of the respondents are high school graduates. At the same time, a smaller percentage have reached higher educational levels, such as college graduates (10.3%) or those with a master's degree (2.3%). This suggests that the community has a relatively basic level of education that could influence their understanding of complex environmental issues. Higher education levels have been linked to increased environmental awareness and participation, according to research (Torgler & Valiñas, 2007). Hence, outreach initiatives are customised to the educational level of the population. The community's generally lower educational attainment may present difficulties for effectively including residents in environmental projects.

Table 1. Socio-demographic profile of the household respondents in Brgy. San Antonio

Socio-demographic Profile	Actual Count	Percentage (%)
Area		
Purok 1	37	21.3
Purok 2	24	13.8
Purok 3	17	9.80
Purok 4	24	13.8
Purok 5	27	15.5
Purok 6	45	25.9
Age		
Generation Z (<25)	30	17.20
Millennials (24-39)	38	21.80
Generation X (40-45)	55	31.60
Baby Boomers (56-74)	41	23.60

Socio-demographic Profile	Actual Count	Percentage (%)
Silent Gen. (75-92)	10	5.70
Sex		
Male	54	31.00
Female	120	69.90
Civil Status		
Single	80	46.0
Married	80	46.0
Widow	14	8.00
Family Income		
Poor (<12,030. Php)	134	77.00
Low Income (12,030 - 24,060 Php)	27	15.50
Lower Middle Income (24,060 - 48,120 Php)	3	1.70
Middle Income Class (48,120-84,120 Php)	8	4.60
Upper Middle Income (144,360 - 240,600 Php)	2	1.10
Educational Attainment		
Elementary level (currently attending/incomplete)	6	3.40
Elementary Graduate	30	17.2
High School (currently attending/incomplete)	6	3.40
High School Graduate	102	58.6
College (currently attending/incomplete)	8	4.60
Bachelor's degree	18	10.3
Master's degree	4	2.30

Pre-Assessment on the Level of Knowledge, Attitude and Practices towards Status of waste segregation, Policies and Environmental impact

The pre-assessment in Table 2 investigates household knowledge about waste segregation rules, as well as how this problem affects the environment. The majority of respondents agreed with key waste management statements, including the fines for improper waste disposal, the collection schedules, and the use of municipal and barangay vehicles for transporting biodegradable garbage. On the other hand, knowledge on the use of Material Recovery Facilities (MRFs) and color-coded bins varies, which may indicate a lack of understanding or application. Most consensus has been identified about the necessity of recycling materials like plastics and metals and the significance of minimizing inappropriate waste collection to prevent flooding and environmental degradation.

The composite mean score of 2.86, which is classified as "Moderately High," shows that despite waste management is generally acknowledged, there are still some areas that need to be improved, especially in terms of informing individuals about the more technical aspects of segregation, like color-coding systems and MRF functionality. Local governments should focus on education and community outreach programs to make these facilities and processes clearer to the public in order to increase the efficacy of waste management initiatives. Studies have highlighted the importance of education and regular communication in enhancing waste segregation. Furthermore, infrastructure, awareness, and enforcement are critical for the effective implementation of waste management systems (Guerrero et al., 2013).

Table 2. Pre-assessment on the level of knowledge of the resident towards waste segregation, policies, and their environmental impact

Statement	Mean+SD	Descriptive Rating
RA 9003 or the Ecological Solid Waste Management Act of	2.58+1.03	Agree

Statement	Mean+SD	Descriptive Rating
2000 outlines guidelines for proper waste management, spreading knowledge on the proper use of natural resources, and implementing programs that encourage citizen participation to reduce waste.		
Improper disposal of waste comes with penalties as stated in the municipal solid waste ordinance.	3.00+0.99	Agree
Barangays provide a schedule for waste disposal days.	3.20+0.97	Agree
Municipalities and barangays assign vehicles to collect biodegradable waste and transport it to designated composting facilities, including waste from markets, restaurants, and other establishments.	2.86+0.90	Agree
There are five (5) color-coded bins to make waste collection easier.	2.29+0.87	Disagree
MENRO and the Public Information Office (PIO), in consultation with the barangays, should maintain communication to inform the public about mandatory segregation and collection.	2.52+0.99	Agree
The 5Rs represent Reuse, Reduce, Recycle, Repair, and Recover.	2.57+0.99	Agree
A Material Recovery Facility (MRF) is a facility that temporarily holds recyclables from households.	2.40+0.94	Disagree
Proper material organization can contain energy.	2.53+0.90	Agree
Improper waste disposal can cause diseases.	3.33+0.88	Strongly Agree
Proper waste disposal reduces the risk of flooding and improves environmental conditions.	3.35+0.89	Strongly Agree
Bottles, plastics, and metals can be recycled.	3.33+0.89	Strongly Agree
Returning paper bags and plastics helps reduce waste.	3.28+0.92	Strongly Agree
There is an existing municipal ordinance on waste segregation.	2.72+1.05	Agree
Proper material organization can contain energy.	2.91+0.96	Agree
Composite Mean Score	**2.86+0.56**	**Moderately High**

Legend: Descriptive Rating; Strongly Agree (3.26-4.00); Agree (2.51-3.25); Disagree (1.76-2.50); Strongly Disagree (1.0-1.75): Remarks Rating; High (3.26-4.00); Moderate High (2.51-3.25); Moderate Low (1.76-2.50); Low (1.0-1.75)

Table 3 presents an initial assessment of the household's attitude concerning policies, environmental impact, and waste segregation. With a high mean score of 3.37 and 3.51, respectively, it indicates that residents strongly agree with the significance of teaching about environmental issues and effective waste management in the community. It is widely agreed upon that waste segregation is everyone's responsibility and that it is just as important as other societal problems like unemployment and crime. A strong consensus is evident in the need for frequent waste collection and public waste management education, which emphasises the community's awareness of its responsibility in addressing the waste issue.

The composite mean score of 3.13, categorized as "Moderate High," indicates a well-developed sense of responsibility among residents regarding waste management. Statements regarding the importance of following waste disposal schedules and using colour-coded bins also received high ratings. Although most items scored strongly, the slightly lower score for reporting neighbours (3.05) suggests that residents may be hesitant to report violations, which could be due to social or cultural factors.

This highlights the importance of community involvement and education as vital components of effective waste segregation initiatives. Furthermore, Guerrero et al. (2013) point out that frequent public education and the establishment of a structured system are highly related to effective waste disposal. Stronger government support for environmental law enforcement and more effective communication tactics should help alleviate the difficulty of promoting active engagement in reporting infractions, as indicated by the somewhat lower scores (Abubakar et al., 2022).

Table 3. Pre-assessment on the level of attitudes of the residents towards waste segregation, policies, and their environmental impact

Statement	Mean+SD	Descriptive Rating
Environmental issues should be taught in the community.	3.37+0.67	Strongly Agree
Proper waste management should be taught in the community.	3.51+0.65	Strongly Agree
Waste segregation is the responsibility of everyone.	3.34+0.83	Strongly Agree
Environmental waste management is as important as other issues such as crime, unemployment, and social stability, among others.	3.35+0.70	Strongly Agree
Regular waste collection is one way to address the waste crisis.	3.38+0.65	Strongly Agree
Picking up litter is my responsibility as a Filipino citizen.	3.44+.064	Strongly Agree
Public education on waste management is necessary.	3.34+0.67	Strongly Agree
Local Government Units (LGUs) should strictly enforce policies and programs on solid waste management.	3.40+0.69	Strongly Agree
Following the waste disposal schedule is necessary.	3.43+0.69	Strongly Agree
Using the five (5) color-coded bins for waste is necessary.	3.26+0.74	Strongly Agree
Following strategies like the 5Rs (Reuse, Reduce, Recycle, Repair, and Recover) should be implemented.	3.37+0.62	Strongly Agree
Participating in and attending barangay activities related to waste segregation is necessary.	3.44+0.62	Strongly Agree
Imposing penalties or appropriate punishments on those who violate environmental laws is correct.	3.29+0.68	Strongly Agree
Reporting neighbors and informing authorities about violations of environmental laws is my responsibility.	3.05+0.83	Agree
Providing information from the barangay about the waste situation in the community is appropriate.	3.31+0.71	Strongly Agree
Composite Mean Score	**3.13+0.41**	**Moderate High**

Legend: Descriptive Rating; Strongly Agree (3.26-4.00); Agree (2.51-3.25); Disagree (1.76-2.50); Strongly Disagree (1.0-1.75): Remarks Rating; High (3.26-4.00); Moderate High (2.51-3.25); Moderate Low (1.76-2.50); High (1.0-1.75)

As mentioned in Table 4, the pre-assessment of households' practices regarding waste segregation, policies, and their environmental impact is provided. Most respondents reported engaging in key waste management practices "almost every time," such as separating biodegradable from non-biodegradable waste (mean = 2.71), reducing material usage (mean = 2.57), and recycling solid materials (mean = 2.93). However, the use of colour-coded waste bins was rated lower, with a mean of 1.72, suggesting that this system is either underutilized or poorly understood by residents. Additionally, reporting violations of environmental laws to authorities was rated lower (mean 2.36), indicating a potential barrier to community-based enforcement of

environmental policies.

The composite mean score of 2.50, categorized as "Moderate Low," suggests that while residents are generally aware of proper waste segregation practices, consistent application of these practices could be improved. Notably, practices such as not pouring oils into drains (1.86) and avoiding littering (1.77) were only performed "sometimes," which presents an opportunity for education on the environmental impacts of these actions. Moreover, the low adoption of colour-coded bins and the hesitance to report violators highlight areas where public education and enforcement could be strengthened.

As cited in Magalang's (2014) study, successful waste management initiatives often require the active participation of the community, along with substantial support from the local government. Similarly, awareness efforts that highlight the negative environmental effects of improper disposal, such as connecting drains with oil, can significantly increase compliance (Magante & Domingo, 2013). The challenges faced by residents in fully adopting all waste management practices underscore the importance of continuous education, infrastructure improvements, and strict enforcement of policies.

Table 4. Pre-Assessment On The Level of Practices of The Resident Towards Waste Segregation, Policies, and their Environmental Impact.

Statement	Mean+SD	Descriptive Rating
Separating waste, particularly biodegradable from non-biodegradable.	2.71+0.95	Almost Every time
Reducing the use of materials regularly.	2.57+0.84	Almost Every time
Participating in environmental projects is our community.	2.66+0.92	Almost Every time
Recycling solid materials such as bottles, cans, and paper.	2.93+0.86	Almost Every time
I prefer reusable batteries over disposable ones.	2.74+0.95	Almost Every time
Disposing of waste in the proper bins.	2.74+0.84	Almost Every time
Using the five (5) color-coded waste bins.	1.72+0.65	Never
Following the correct days for putting out and disposing of waste according to its type.	3.02+0.78	Almost Every time
Attending and listening to barangay announcements about solid waste management.	2.82+0.84	Almost Every time
Reporting to authorities about people who violate environmental laws.	2.36+0.87	Almost Every time
Implementing strategies like the 5Rs (Reuse, Reduce, Recycle, Repair, and Recover) inside and outside the house.	2.57+0.88	Almost Every time
Educating family members about proper waste segregation and disposal.	3.01+0.84	Almost Every time
Not pouring oils, such as used cooking oil, directly into the drain.	1.86+0.75	Sometimes
Not throwing candy wrappers and snack packaging anywhere.	1.77+0.78	Sometimes
Not mixing biodegradable and non-biodegradable waste in one container or sack.	2.03+0.87	Sometimes
Composite Mean Score	**2.50+0.39**	**Moderate Low**

Legend: Descriptive Rating; Every time (3.26-4.00); Almost every time (2.51-3.25); Sometimes (1.76-2.50); Never

(1.0-1.75): Remarks Rating; High (3.26-4.00); Moderate High (2.51-3.25); Moderate Low (1.76-2.50); Low (1.0-1.75)

Knowledge, Attitude, and Practices Mean Variations Between Socio-Demographic Factors

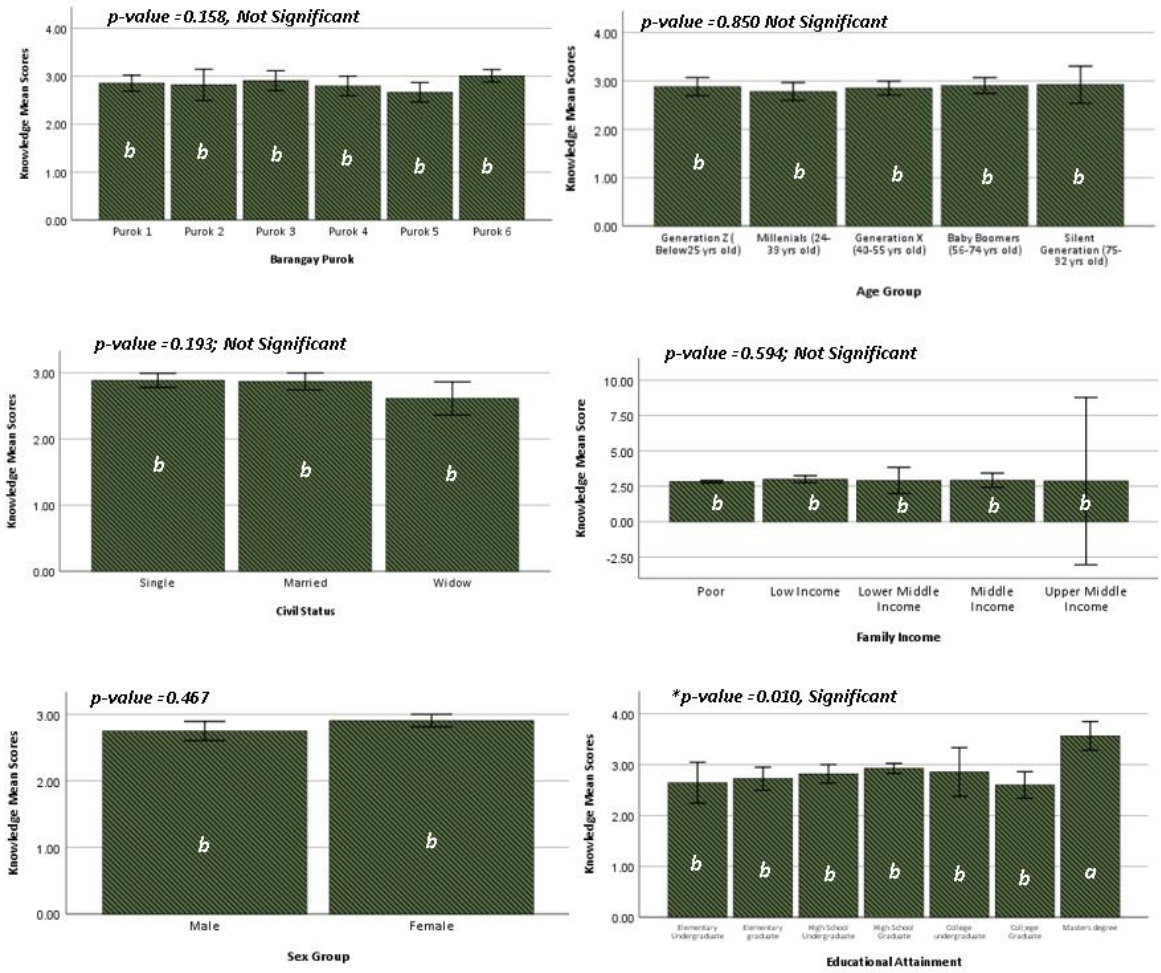

Figure 2. Mean variations between socio-demographic factors in the level of knowledge
Notes: (a) High (3.26-4.00); (b) Moderate High (2.51-3.25); (c) Moderate Low (1.76-2.50); (d) Low (1.0-1.75); *Significant at 0.05; **Significant at 0.10

Figure 2 presents the variations in knowledge levels about waste management among different socio-demographic factors, including barangay, age group, civil status, family income, sex, and educational attainment. For most variables, including barangay, age group, civil status, family income, and sex, the p-values indicate no statistically significant differences, as all p-values exceed 0.05. This suggests that these factors do not significantly impact the respondents' knowledge levels regarding waste segregation. Interestingly, educational attainment exhibits significant variation (p-value = 0.010), indicating that individuals with higher education levels, particularly those holding a master's degree, have significantly higher knowledge scores compared to those with lower levels of education. This finding aligns with research showing that higher educational attainment is often associated with increased environmental awareness and a better understanding of waste management practices (Al-Khatib et al., 2009). While there is no significant difference based on barangay, civil status, or age group, the notable finding is that education plays a key role in shaping knowledge levels about waste segregation. This highlights the significance of educational interventions in enhancing environmental knowledge and practices.

On the other hand, family income does not significantly affect knowledge, suggesting that awareness of waste segregation may not be directly linked to economic status in this context. Thus, the analysis highlights the crucial role of education in enhancing knowledge of waste management while showing that socio-demographic factors, such as age, gender, and income, have a limited impact. For future policies and programs, targeting educational improvements and awareness campaigns can potentially enhance community-level understanding and participation in waste segregation (Ajzen et al., 2011).

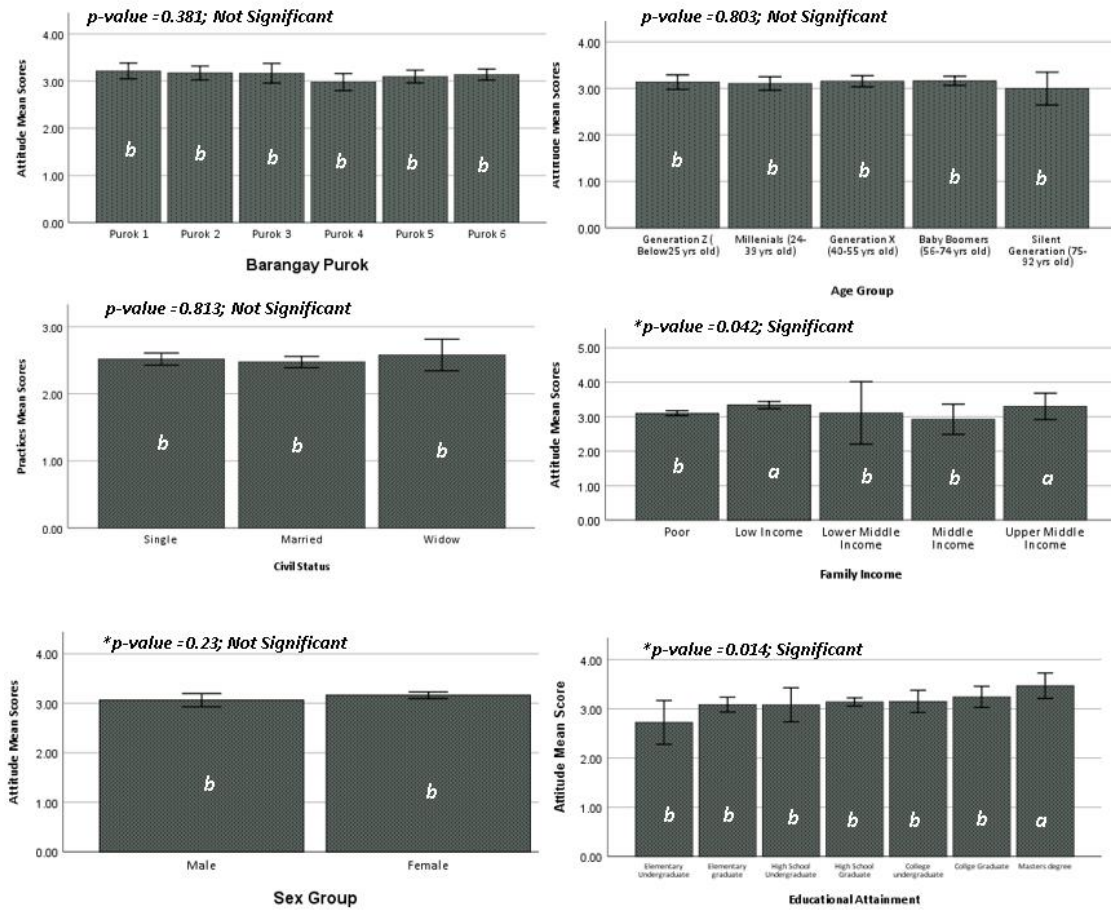

Figure 3. Mean variations between socio-demographic factors in level of attitude
Notes: (a) High (3.26-4.00); (b) Moderate High (2.51-3.25); (c) Moderate Low (1.76-2.50); (d) Low (1.0-1.75); *Significant at 0.05

As discussed in Figure 3, attitudes toward waste management very across different socio-demographic factors. While most factors, such as barangay, age group, and civil status, show no significant differences in attitude (p-values > 0.05), notable findings are observed for family income, sex, and educational attainment, where significant variations are present. Family income presents a p-value of 0.042, indicating a statistically significant difference in attitude levels. Individuals from the "Upper Middle Income" group exhibit the highest attitudes, suggesting that economic standing may influence how people perceive and engage with waste management practices. This aligns with previous studies that link higher income levels to greater access to environmental resources and awareness (Hajat et al., 2015). Educational attainment also shows a significant variation (p-value = 0.041), where respondents with a master's degree display significantly higher attitude scores compared to those with lower educational levels. This reinforces the critical role of education in shaping environmental attitudes, suggesting that individuals with higher levels of education are

more likely to adopt favourable attitudes towards waste segregation and management (Si et al., 2022).

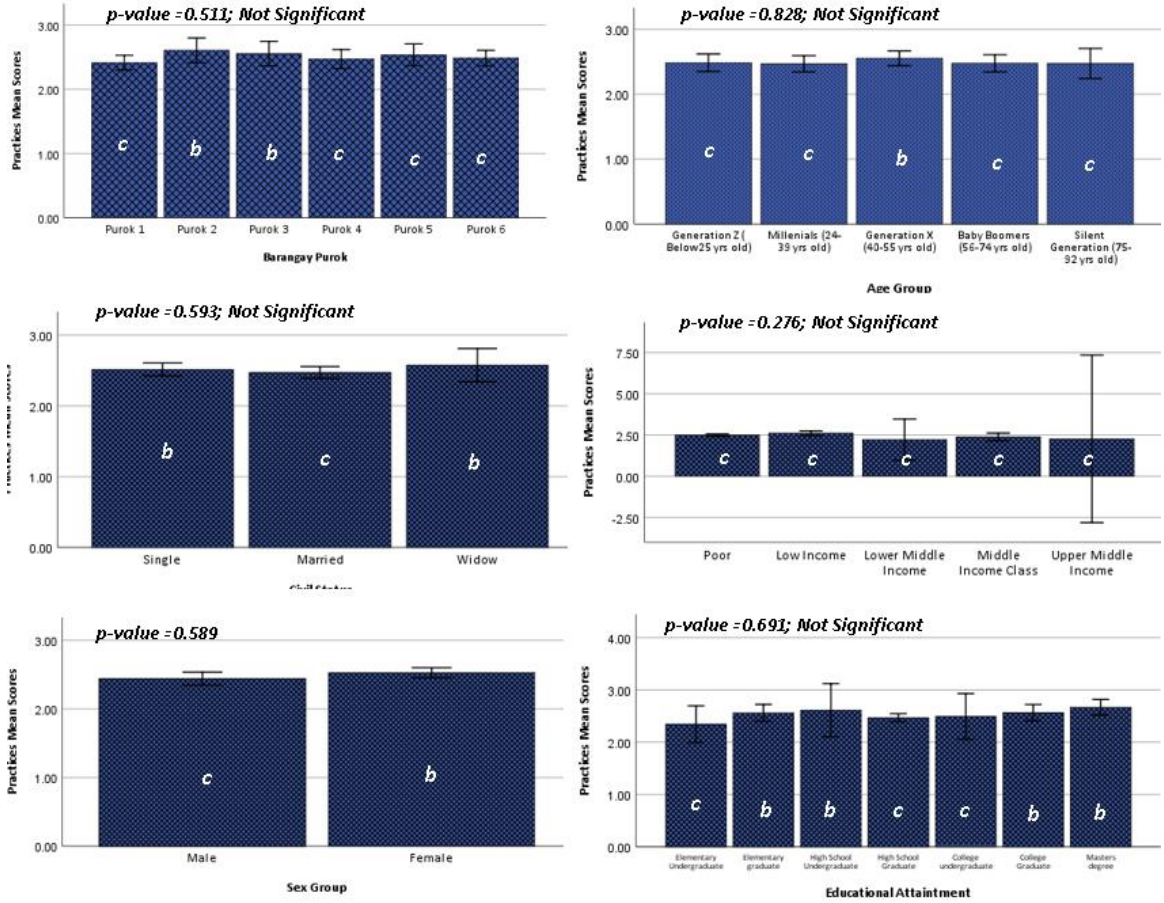

Figure 4. Mean variations between socio demographic factors in level of attitude
(a) High (3.26-4.00); (b) Moderate High (2.51-3.25); (c) Moderate Low (1.76-2.50);
(d) Low (1.0-1.75); *Significant at 0.05

Figure 4 depicts mean variations in attitude levels across different socio-demographic factors. While patterns in the data suggest some differences between groups, none of the p-values are below the 0.05 threshold, indicating that the differences are not statistically significant. For instance, the p-value for the barangay purok groups is 0.511, meaning that variations in attitude between the groups (Purok 1 to Purok 6) are not significant. Similar patterns are observed for other socio-demographic factors, such as age groups (p = 0.828) and educational attainment (p = 0.691), reinforcing the conclusion that no clear relationship between these factors and attitude levels was identified. Despite the lack of statistical significance, trends in the data provide insight into how different groups may perceive attitudes. For example, in the age category, Baby Boomers (56–74 years old) exhibit relatively higher mean scores compared to younger generations, aligning with studies suggesting that older adults may possess more established attitudes due to greater life experience (Abdullah & Tuna, 2014). Likewise, the slight difference in attitude levels between males and females, although not significant (p = 0.589), mirrors findings from other research that often explores gender-based differences in social attitudes (Desa et al., 2011). The educational attainment data shows that individuals with higher education (e.g., college graduates) exhibit lower attitude scores compared to those with lower levels of education (e.g., elementary level). While not statistically significant, this could reflect changing attitudes associated with higher educational exposure, as higher education is often linked to greater critical thinking and openness to diverse

perspectives (Tartiu, 2011).

Pre-Post Mean Variation of Household Knowledge, Attitudes, Practices on Waste Segregation

The bar charts in Figure 5 illustrate the pre-and post-intervention scores for household respondents' knowledge, attitudes, and practices regarding waste segregation and environmental impact. The mean scores for knowledge, practices, and attitudes all show significant improvements after the intervention, with p-values below 0.05. For knowledge, the pre-intervention mean score of 2.857 increased to 3.453 post-intervention, indicating a greater understanding of waste segregation policies and environmental issues. Similarly, practices improved from a mean score of 2.50 to 3.30, reflecting better adherence to environmentally friendly waste management practices. The attitudes also underwent a significant shift, with scores rising from 3.352 to 3.73, indicating a more positive disposition toward waste management and environmental protection.

The increase in post-intervention means scores across all categories highlights the effectiveness of educational or policy interventions in raising awareness and changing behaviours. This finding aligns with previous studies, such as those by Abdullah and Tuna (2014) and Ahmad et al. (2015), which have also found that targeted interventions can significantly improve environmental knowledge and practices.

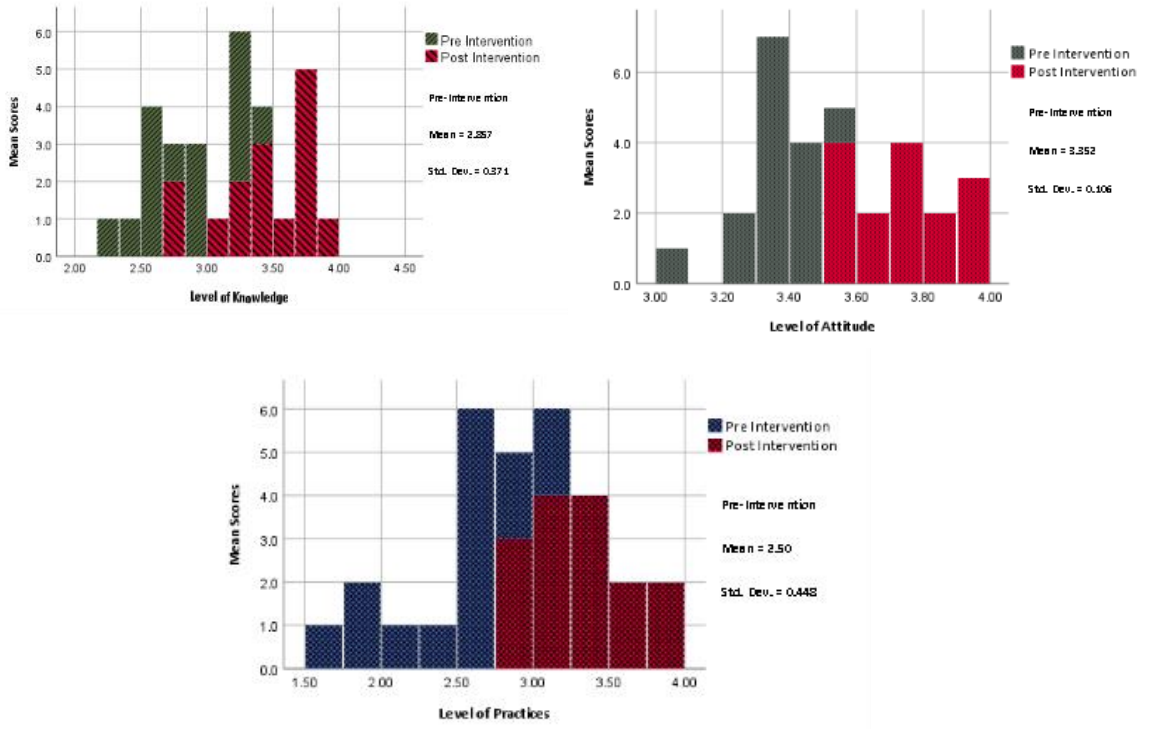

Figure 5. Pre- and Post-Intervention Mean Scores on Knowledge, Attitudes, and Practices Towards Waste Segregation

CONCLUSIONS

The pre-and post-assessment results demonstrate the effectiveness of the intervention in enhancing households' knowledge, attitudes, and practices (KAP) regarding waste segregation. While the intervention significantly improved awareness of waste management policies and the importance of community responsibility, challenges persist, particularly in the consistent application of colour-coded bins and technical knowledge of Material Recovery Facilities (MRFs). Additionally, sustainability remains a concern, as long-term adherence to improved waste management behaviours depends on continued education, infrastructure support, and community

engagement. Addressing these limitations through sustained efforts will be crucial for ensuring lasting environmental and socio-economic benefits, including job creation in recycling and poverty alleviation. Furthermore, the study highly suggests:

1. Implement local ordinances mandating periodic household waste management training, to be enforced by the barangay council in coordination with the Municipal Environment and Natural Resources Office (MENRO). Training sessions should be conducted bi-annually and designed to cover essential topics such as proper waste segregation, composting, recycling techniques, and the environmental and health impacts of improper waste disposal.
2. Provide accessible segregation bins in strategic community areas, such as markets, schools, and barangay halls, to promote proper waste sorting at the source and reduce household waste mismanagement.
3. Develop a structured monitoring system to track compliance with waste management policies and strengthen enforcement mechanisms, utilising performance indicators such as household segregation rates, collection compliance rates, volume of recyclables, and training participation rates. Assessment tools will include waste audits, compliance checklists, surveys, and photographic documentation, with monitoring conducted quarterly by the Barangay Environment Committee in coordination with the Municipal Environment and Natural Resources Office (MENRO).
4. Organise quarterly community clean-up drives with incentives, such as grocery vouchers, utility bill discounts, or public recognition (e.g., certificates or social media features), to encourage active participation. The barangay council, in partnership with local businesses and the Municipal Environment and Natural Resources Office (MENRO), will be responsible for funding and sustaining the incentive program through budget allocations and sponsorships.
5. Establish a *Bantay Kapaligiran* Task Force comprising local NGOs and community volunteers, managed by the Barangay Committee Head on Environment, to support environmental initiatives, monitor waste practices, and promote community engagement.

LIMITATION & FURTHER RESEARCH

Despite the results, the study has several limitations. First, reliance on self-reported data introduces potential biases, as participants may underreport their waste management practices. Second, the short-term nature of the assessment limits the ability to measure long-term behavioural changes. Finally, geographic constraints limit the generalizability of the findings, as the study focused on a specific community and may not fully represent other regions with different socio-economic and environmental conditions. This could be achieved by conducting longitudinal studies to evaluate the long-term impact of educational interventions on waste management behaviours.

REFERENCES

Abdullah, I. K., & Tuna, F. (2014). Nigerian students' knowledge and perceptions about environmental problems and management: A case study of Kano State. *International Journal of Scientific Knowledge, 4,* 26–34.

Abubakar, I. R., Maniruzzaman, K. M., Dano, U. L., AlShihri, F. S., AlShammari, M. S., Ahmed, S. M. S., Al-Gehlani, W. A. G., & Alrawaf, T. I. (2022). Environmental sustainability impacts of solid waste management practices in the Global South. *International Journal of Environmental Research and Public Health, 19(19)*, 12717. https://doi.org/10.3390/ijerph191912717

Ahmad, J., Noor, S. M., & Ismail, N. (2015). Investigating students' environmental knowledge, attitude, practice, and communication. *Asian Social Science, 11*, 284-293.

Ajzen, I., Joyce, N., Sheikh, S., & Cote, N. G. (2011). Knowledge and the prediction of behavior: The

role of information accuracy in the theory of planned behavior. *Basic and Applied Social Psychology, 33(2)*, 101–117. https://doi.org/10.1080/01973533.2011.568834

Al-Khatib, I. A., Arafat, H. A., Daoud, R., & Shwahneh, H. (2009). Enhanced solid waste management by understanding the effects of gender, income, marital status, and religious convictions on attitudes and practices related to street littering in Nablus—Palestinian territory. *Waste Management, 29(1)*, 449–455. https://doi.org/10.1016/j.wasman.2008.02.004

Ardoin, N. M., & Bowers, A. W. (2020). Early childhood environmental education: A systematic review of the research literature. *Educational Research Review, 31*, 100353. https://doi.org/10.1016/j.edurev.2020.100353

Barloa, E. P., Lapie, L. P., & de la Cruz, C. P. (2016). Knowledge, attitudes, and practices on solid waste management among undergraduate students in a Philippine state university. *Journal of Environment and Earth Science, 6*(6). https://www.iiste.org/Journals/index.php/JEES/article/view/30204

Bolan, S. (2024). Impacts of climate change on the fate of contaminants through extreme weather events. *Science of The Total Environment, 909*, 168388. https://doi.org/10.1016/j.scitotenv.2023.168388.

David, B. (2023). Community engagement in waste management and recycling: Best practices and success stories. *Environmental Waste Management Recycling, 6(4)*, 158. https://doi.org/10.35841/aaewmr-6.4.158.

Debrah, J. K., Vidal, D. G., & Dinis, M. A. P. (2021). Raising awareness on solid waste management through formal education for sustainability: A developing countries evidence review. *Recycling, 6(1)*, 6. https://doi.org/10.3390/recycling6010006

Desa, A., Kadir, N., & Yusooff, F. (2011). A study on the knowledge, attitudes, awareness status, and behaviour concerning solid waste management. *Procedia - Social and Behavioral Sciences, 18*, 643–648. https://doi.org/10.1016/j.sbspro.2011.05.095

El-Gilany, A. H., El-shaer, S., Khashaba, E., El-Dakroory, S. A., & Omar, N. (2017). Knowledge, attitude, and practice (KAP) of 'teaching laboratory'technicians towards laboratory safety and waste management: a pilot interventional study. *Journal of Hospital Infection*, *96*(2), 192-194. https://doi.org/10.1016/j.jhin.2017.02.007

Ellerbeck, S. (2022). How much progress is being made on the U.N.'s sustainable development goals? *World Economic Forum.* https://www.weforum.org/agenda/2022/09/un-sustainable-development-goals-progress-report/

Environmental Management Bureau. (2024). *Philippine environmental quality report 2023–2024*. Department of Environment and Natural Resources. https://emb.gov.ph/environmental-quality-report-2024

Etikan, I., & Bala, K. (2017). Sampling and sampling methods. *Biometrics & Biostatistics International Journal*, *5*(6), 00149. https://doi.org/10.15406/bbij.2017.05.00149

Green, D. P., & Fox, J. (2007). Rational choice theory. In W. Outhwaite & S. P. Turner (Eds.), *The SAGE handbook of social science methodology* (pp. 269–281). SAGE.

Guerrero, L. A., Maas, G., & Hogland, W. (2013). Solid waste management challenges for cities in developing countries. *Waste Management, 33*, 220–232. https://doi.org/10.1016/j.wasman.2012.09.008

Hajat, A., Hsia, C., & O'Neill, M. S. (2015). Socioeconomic disparities and air pollution exposure: A global review. *Current Environmental Health Reports, 2(4),* 440–450. https://doi.org/10.1007/s40572-015-0069-5.

Hanen, H., & Mahmod, Z. (2024). Environmental accounting practices and corporate global performance in an emerging market: The mediating role of environmental disclosure. *Inclusive Society and Sustainability Studies, 4(2)*. https://doi.org/10.31098/issues.v4i2.2855

IPCC 2014 Summary for policymakers In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change ed C B Field et al (Cambridge)(Cambridge University Press)(Cambridge, United Kingdom and New York, NY, USA) pp 1–32

Jones, P., Selby, D., & Sterling, S. (2010). Sustainability education: Perspectives and practice across higher education. Earthscan.

Kalra, N. (2019). Community participation and waste management. In S. K. Ghosh (Ed.), *Sustainable waste management: Policies and case studies* (Vol. 1). Springer. https://doi.org/10.1007/978-981-13-7071-7_10

Lama, N. (2024). The world has a waste problem. Here's how to fix it. *International Finance Corporation (IFC).*https://www.ifc.org/en/blogs/2024/the-world-has-a-waste-problem.

Lyu, Y., Hu, C. Y., Sun, L., Qin, W., Xu, P. P., Sun, J., ... & Zhang, X. J. (2018). Impact of an intervention programme on knowledge, attitudes and practices of population regarding severe fever with thrombocytopenia syndrome in endemic areas of Lu'an, China. *Epidemiology & Infection*, *146*(1), 125-136. https://doi.org/10.1017/S0950268817002679

Magalang, A. A. (2014). Municipal solid waste management in the Philippines. In A. Pariatamby & M. Tanaka (Eds.), *Municipal solid waste management in Asia and the Pacific Islands: Challenges and strategic solutions* (pp. 281–287). Springer Science & Business Media.

Magante, G. L. M., & Domingo-Almase, A. D. (2013). *The disaster of non-compliance to solid waste management act in the Philippines*. Manila.

Magnaye, D. R., & Ylagan, D. A. (2021). Effectiveness and impact of community extension programs of one Philippine higher education institution as basis for sustainability. *Asia Pacific Journal of Academic Research in Business Administration, 7(2)*, 7–16.

Maisaroh, K., Laila, A., & Basori, M. (2023). Kapin (Smart Card) Media: Evaluating Learning Tools Efficacy to Improve Reading Skills of Second Grads. *Utamax: Journal of Ultimate Research and Trends in Education*, *5*(3), 246-256.

Masud, M., & Kari, F. (2015). Community attitudes towards environmental conservation behaviour: An empirical investigation within MPAs, Malaysia. *Marine Policy, 52*, 138–144. https://doi.org/10.1016/j.marpol.2014.10.015

Molina, R. A., & Catan, I. (2021). Solid waste management awareness and practices among senior high school students in a state college in Zamboanga City, Philippines. *Aquademia, 5(1),* ep21001. https://doi.org/10.21601/aquademia/9579.

Pabilando, R., Caparro, K., & Bantilan, J. (2021). Waste management practices of beach resorts in Biliran Province. *Inclusive Society and Sustainability Studies, 1(2),* 1–9. https://doi.org/10.31098/issues.v1i2.698

Phan, T. N., & Baird, K. (2015). The comprehensiveness of environmental management systems: The influence of institutional pressures and the impact on environmental performance. *Journal of Environmental Management, 160*, 45–56. https://doi.org/10.1016/j.jenvman.2015.06.006

Senate Economic Planning Office. (2017). *Philippine solid waste at a glance.* https://legacy.senate.gov.ph/publications/SEPO/AAG_Philippine%20Solid%20Wastes_Nov2017.pdf

Si, W., Jiang, C., & Meng, L. (2022). The relationship between environmental awareness, habitat quality, and community residents' pro-environmental behavior: Mediated effects model analysis based on social capital. *International Journal of Environmental Research and Public Health, 19(20)*, 13253. https://doi.org/10.3390/ijerph192013253

Stanescu, M. D. (2022). Goals for sustainable development and the environmental protection. *Romanian Journal of Ecology & Environmental Chemistry, 9(4)*, 56–61.

https://doi.org/10.21698/rjeec.2022.205

Sullivan, T. A. (2020). *Census 2020: Understanding the issues*. Springer Nature.

Tartiu, V. (2011). Evaluation of attitudes and knowledge regarding municipal waste among students: Case study: *Bucharest Academy of Economic Studies. Economia. Seria Management, 14*, 263–267.

Torgler, B., & Valiñas, M. A. (2007). The determinants of individuals' attitudes towards preventing environmental damage. *Ecological Economics, 63(2–3)*, 536–552. https://doi.org/10.1016/j.ecolecon.2006.12.013

Velasco, K. F. D., Visco, E. S., & Geges, D. B. (2024). Perceived impacts of a community-based solid waste management initiative in Santa Cruz, Laguna, Philippines. *Journal of Human Ecology and Sustainability, 2(5)*, 2. https://doi.org/10.56237/jhes-che50-04

World Population Review. (2024). *Plastic pollution by country.* World Population Review. https://worldpopulationreview.com/country-rankings/plastic-pollution-by-country