Solid Waste Management Practices of the Community House-holds in the Province of Leyte, Philippines

Jessielyn Abordo and Wilfredo Dalugdog *

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Article

Solid Waste Management Practices of the Community Households in the Province of Leyte, Philippines

Jessielyn Abordo [1] and Wilfredo Dalugdog [2,*]

[1] Visayas State University, Province of Leyte, Philippines; jessielyn.abordo@vsu.edu.ph

[2] Laguna State Polytechnic University, Philippines

* Correspondence: wilfredo.dalugdog@lspu.edu.ph

Abstract: This study examines community household practices and the perceived effectiveness of the implementation of R.A. No. 9003, the Ecological Waste Management Act of 2000, in the province of Leyte, Philippines. A survey of 300 households revealed that waste reuse was the most frequently practiced method, while waste reduction was the least prioritized. The perceived effectiveness of the law's implementation was rated highest for waste disposal, but waste reduction remained the least effective aspect. Correlation analysis indicated significant associations between waste reuse and age, while educational attainment was linked to waste collection, treatment, and disposal. Furthermore, strong positive correlations were found between household waste management practices and the perceived effectiveness of R.A. No. 9003. The findings suggest a need for stronger waste reduction initiatives and increased community education to improve compliance and effectiveness. Strengthening policy enforcement and promoting awareness programs could enhance sustainable waste management practices in Leyte, Philippines.

Keywords: solid waste management; waste collection; waste disposal; waste reduction; waste reuse; waste recycling; waste treatment

1. Introduction

Challenges in managing waste have become one of the global problems. In 2019, the World Bank reported that waste-related data remains incomplete, indicating a gap in statistical information [1]. In 2016, cities around the world generated approximately 2.01 billion tons of solid waste, which equates to 0.74 kilograms per person per day. The rapid growth of the population and urbanization poses a threat to waste generation each year. It was projected to grow by 70% from 2016 to 2050, potentially reaching 2.4 billion tons. Environmental impacts of solid wastes are widespread, with waste pickers in direct contact with hazardous materials, marine litter, air, soil, and water contamination as the major issues [2]. Similarly, India faced significant environmental problems dues to inadequate waste management, including issues in collection, transport, treatment, and disposal [3].

On the other hand, there are numerous initiatives aimed at addressing waste collection and disposal issues affecting both major and small cities, as well as rural and urban areas [4]. However, the World Bank noted that many developing towns and nations still struggle with effective waste management [1].

In 2021, the United Nations Environment Program pointed out that the increasing complexity and volume of waste are linked to the modern economy, posing serious risks to both human health and ecosystems [5]. The lack of proper waste management, including inadequate collection methods and inefficient waste disposal, leads to significant societal problems, including water and air pollution, as well as soil contamination. These pose major health and safety risks. The World Bank warns that global waste could increase by 70% between 2016 and 2050. There must be a proactive

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response from people to ensure a healthy ecological and human future [6]. Introducing education on environmental sustainability at all school levels in developing nations could help reduce the knowledge gap in solid waste management [7].

As the global population grows, problems with improper waste disposal are compounded by increasing industrialization. Inefficient garbage collection techniques and a lack of disposal locations, especially in developing nations, are major issues in waste management [2]. In the Philippines, the Ecological Solid Waste Management Act (Republic Act 9003) was enacted to address solid waste management issues. The law aims to protect public health and the environment, promote resource conservation and recovery, and establish guidelines for waste separation, collection, transport, storage, treatment, and disposal. It also encourages research and development, market-based instruments, and public participation in waste management on both local and global scales. Formal and informal educational curricula should also be developed to increase citizens' knowledge and action on environmental issues.

Scholars emphasized that the enactment of R.A. 9003 is one approach to addressing solid waste management issues in the Philippines, despite some flaws in its provisions. While certain provisions may need revision, the law remains vital for protecting environmental health and safety [8, 9]. Similarly, one study focused on enforcing R.A. 9003, including the No Segregation, No Collection Policy, continuous information dissemination, posting of materials in barangays, incentivizing residents who comply with waste segregation, and the BASSURAFLE reward system [10]. However, areas for improvement include expediting the process, improving timelines, enhancing government collaboration, investing in technology and facilities, and involving both the public and private sectors [11].

There is substantial literature addressing the challenges of executing and enforcing proper solid waste management, particularly in business contexts. However, there are fewer studies focusing on the effectiveness and practices related to solid waste management in community households. Garbage collection, storage, transport, and final disposal are significant challenges in metropolitan areas, particularly in East and North Africa. Weak economies and limited resources in many developing nations hinder effective waste management [4]. Traditional and modern waste management methods face numerous challenges, with many participants unaware of proper waste management practices and limited recycling efforts [12]. The COVID-19 pandemic has further exacerbated plastic waste, especially in the Philippines (Cabico, 2020).

On the other hand, healthcare facilities continue to manage infectious waste following medical waste management procedures [13]. The WHO has urged support for the Stockholm Convention to improve the safe management of healthcare waste [14]. Given that the pandemic is expected to persist beyond 2025 [15], developing long-term waste management strategies is crucial. Proper waste management is not only the responsibility of waste collectors but also requires public awareness to protect frontline workers and vulnerable populations [16]. The Nepalese government takes steps to address household waste management, including public awareness campaigns, health practices, and effective legislation [17].

Waste management issues related to biomedical, plastic, and food waste, which have become significant concerns during the pandemic [18]. The report also proposes policy recommendations to address emerging challenges and improve waste management systems [19]. Appropriate disinfection methods and technology selection are essential to minimize infection transmission and improve sustainable waste management, particularly for infected waste [20].

The dynamics of waste generation, especially food, plastic, and biomedical waste, have aggravated the waste management problem [21]. Concerns about contamination and viral spread have led to reduced waste reception at Materials Recovery Facilities (MRFs). These obstacles significantly impact government waste budgets [21]. Encourage regional collaboration to enhance COVID-19 waste treatment capabilities [22], while other countries have implemented measures to break the virus transmission chain by limiting human contact [15].

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In light of the issues discussed and based on the collected literature, this study aimed to describe the demographic profile of community household respondents in the province of Leyte, Philippines, based on age, sex, civil status, educational attainment, and household size. Additionally, it sought to examine the community household practices related to the implementation of the Ecological Solid Waste Management Act of 2000 (R.A. No. 9003) in the province Leyte, in terms of waste reuse, reduction, collection, recycling, treatment and disposal. Furthermore, the study aimed to assess the perceived effectiveness of R.A. No. 9003 implementation in the province of Leyte in terms of waste reuse, reduction, collection, recycling, treatment and disposal. Moreover, this study tested the following null hypotheses: H_0: There is no significant relationship between the practices of the City Environment and Natural Resources Office (CENRO) or Municipal Environment and Natural Resources Office (MENRO) and their perceived effectiveness in implementing the Ecological Solid Waste Management Act of 2000 concerning waste reuse, waste reduction, waste collection, waste recycling, waste treatment, and waste disposal. H_1: There is no significant relationship between the practices of community households and their perceived effectiveness in implementing the Ecological Solid Waste Management Act of 2000 concerning waste reuse, waste reduction, waste collection, waste recycling, waste treatment, and waste disposal.

2. Materials and Methods

The descriptive-cross sectional research design was employed to examine the relationship between respondents' waste management practices – specifically waste reuse, waste reduction, waste collection, waste recycling, waste treatment, and waste disposal – and their perceived effectiveness of the implementation of Ecological Solid Waste Management Act of 2000 known as R.A. No. 9003. A stratified random sampling technique was used to identify and select the 300 community household respondents from 28 municipalities and two cities in the province of Leyte, Philippines. Households were categorized into lower, middle, and high-income levels, ensuring equal opportunity for random selected from each group.

The community household respondents are described mostly are in early adulthood (25+ years, 83%), with a smaller group in late adolescence (17%), indicating an age group capable of understanding solid waste management. The gender distribution is nearly equal, with 54.7% male and 45.7% female. Over half are married (54.7%), followed by single respondents (43.3%), and a small number are widowed (1.3%) or separated (0.7%). The majority have a bachelor's degree (90%), with fewer holding master's (8%) or doctorate degrees (2%), suggesting a well-educated group. Most households have one to five members (80.3%), followed by six to ten (18%) and eleven or more (1.7%).

The structured survey questionnaire used in this study is composed of three parts: first part is focused on the profile variables of the community household in terms of age, sex, civil status, educational attainment, and household size. The second part was focus on the solid waste management practices in terms of waste reuse, reduction, collection, recycling, treatment, and disposal. Respondents will be given choices to answer the question using the five-point Likert scale with a verbal interpretation of "*always*", "*often*", "*sometimes*", "*rarely*", and "*never*". The third part is focused on the perceived effectiveness of the implementation of R.A. No. 9003 in terms of waste reuse, reduction, collection, recycling, treatment, and disposal. Respondents will be given choices to answer the question using the five-point Likert scale with a verbal interpretation of "*fully implemented*", "*implemented*", "*Neither Implemented nor Implemented*", "*partially implemented*", and "*not implemented*".

The content of the structured survey questionnaire was validated by the two (2) employees from the Department of Environment and Natural Resources (DENR); and 1 (one) Engineer or focal person from Environment Management Bureau (EMB). All their comments, suggestions and recommendations were incorporated in the questionnaire before the conduct of pilot test. The questionnaire used underwent test on the reliability and internal consistency using Cronbach's alpha

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through pilot testing. Based on the data collected during the pilot testing, items on inter-reliability gained .934, which depicted high acceptable reliability.

The researchers first obtained approval from the University's Ethics Review Committee before conducting the study. Official letters were sent to the mayors of municipalities and cities in the province of Leyte to request permission for the research and to obtain data on the selected personnel and community households within their jurisdiction for random sampling. Upon securing approval, informed consent was obtained from respondents, ensuring they were fully aware of their participation in the study. Between June and August 2023, the researchers distributed the survey questionnaires in person, providing respondents with explanations regarding the instrument's content. The completed questionnaires were immediately retrieved, collated, tallied, and tabulated. The collected data were tallied, summarized, and analyzed using appropriate statistical tools aligned with the research questions. The mean score, standard deviation and ranking were used to interpret and analyze the data gathered on community household practices related to the implementation of the Ecological Solid Waste Management Act of 2000 (R.A. No. 9003) in the province in terms of waste reuse, reduction, collection, recycling, treatment and disposal and the perceived effectiveness of R.A. No. 9003 implementation in the province of Leyte in terms of waste reuse, reduction, collection, recycling, treatment and disposal. Pearson's correlation coefficient was applied to assess the relationship between respondents' profiles and their perceived effectiveness in implementing R.A. 9003, specifically in waste reuse, reduction, collection, recycling, treatment, and final disposal.

This study adhered to the ethical standards set by the University for conducting research. Approval from the Ethics Review Committee was obtained before data collection, ensuring that all research procedures were communicated to the respondents. Participation in the study was strictly voluntary, with assurances that it would not affect respondents' personal lives or their families. Informed consent was secured, and confidentiality and anonymity were maintained throughout the study. Additionally, all data collection materials were properly stored and disposed of upon the study's completion.

3. Results

Table 1 illustrates the profiles of the community households. The age group is concentrated with the early adulthood having the age range of 25 years old and above (freq=249, %=83.0) while those ages fall to late adolescence (freq=51, %=17.0). There is almost an equal representation for both sex – male respondents (freq=163, %=54.7) and female representatives (freq=137, %=45.7). About their civil status, total respondents who are married are more than half (164, 54.7%), followed by single (130, 43.3%). Next on the list is the widower with four (1.3%) respondents and separated (2 or 0.7%). Bachelor's degree is mostly completed by the respondents (freq=270, %=90.0%), followed by master's degree holder (freq=24, %=8.0%) and doctorate degree holder (freq=6, %=2.0%). In terms of household members, predominantly are one to five members (241 or 80.3%), six to ten members (54 or 18.0%), and eleven and above members (5 or 1.7%).

Table 1. Summary Profile of the Community Household Respondents'.

Profile	Frequency *(N=300)*	Percent
Age		
Late *Adolescence (18-24 years old)*	51	17.0
Early Adulthood (25 years old and above)	249	83.0
Sex		
Male	163	54.3
Female	137	45.7
Civil Status		
Single	130	43.3
Married	164	54.7

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Separated	2	.7
Widowed	4	1.3
Educational Attainment		
Bachelor's Degree	270	90.0
Master's Degree	24	8.0
Doctorate Degree	6	2.0
Household Members		
One (1) to Five (5) members	241	80.3
Six (6) to Ten (10) members	54	18.0
Eleven (11) and above	5	1.7

Table 2 shows that waste reuse is the most commonly practiced waste management method among community households in the province of Leyte, with a mean score of 4.05 (SD = 0.913). This is followed by waste treatment, which obtained a mean score of 3.90 (SD = 1.054), both verbally interpreted as 'often practiced' in the implementation of R.A. No. 9003. Waste recycling ranked third, with a mean score of 3.80 (SD = 1.105) and the same verbal interpretation. However, waste reduction, waste disposal, and waste collection had the lowest mean scores, yet they were still classified as 'often practiced' by community households.

Table 2. Community Household Practices in the Implementation of R.A. No. 9003 in the province of Leyte.

Indicators	Mean	SD	Verbal Interpretation	Rank
Waste reuse	4.05	.913	Often	1
Waste reduction	3.66	1.1398	Often	6
Waste collection	3.71	1.201	Often	5
Waste recycling	3.80	1.105	Often	3
Waste treatment	3.9	1.0538	Often	2
Waste disposal	3.76	1.1358	Often	4

Table 3 shows that waste disposal received the highest mean score of 3.91 (SD=1.019), with a verbal interpretation of often. Waste reuse ranked second with a mean score of 3.84 (SD=0.999), indicating that reusing waste materials is perceived as an integral component of solid waste management efforts. Waste collection followed closely with a mean score of 3.83 (SD=1.091), reflecting that community members acknowledge the systematic collection of waste as part of local governance initiatives. However, waste reduction received the lowest mean score of 3.66 (SD=1.032), indicating that although implemented.

Table 3. Perceived effectiveness of the implementation of R.A. No. 9003 in the province of Leyte.

Indicators	Mean	SD	Verbal Interpretation	Rank
Waste reuse	3.84	.999	Implemented	2
Waste reduction	3.66	1.032	Implemented	6
Waste collection	3.83	1.091	Implemented	3
Waste recycling	3.7	1.062	Implemented	4.5
Waste treatment	3.7	1.04	Implemented	4.5
Waste disposal	3.91	1.019	Implemented	1

Table 4 shows the correlation between community households' waste reuse practices and their profile variables. Using the 300 community households' responses, the associations between waste reuse practices and profile variables were analyzed. The results indicate that age (r_{obt} = 0.136, p = 0.019) has a significant positive correlation with waste reuse practices. However, sex (r_{obt} = 0.063, p = 0.280), civil status (r_{obt} = 0.090, p = 0.120), educational attainment (r_{obt} = -0.001, p = 0.985), and the

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number of household members (r_{obt} = -0.042, p = 0.472) were not significantly associated with waste reuse practices. These findings suggest that among the demographic factors examined, only age is positively correlated with waste reuse, while the other variables do not exhibit a significant relationship.

Table 4. Correlation of Community Households' Practices and the Profile Variables.

	Age	Sex	Status	Educl Attain	#House Mem	Use	Red	Col	Rec	Treat	Dis
Age	1										
Sex	.023	1									
Status	.332**	-.037	1								
Educl Attain	.119*	.098	.188**	1							
#Household Members	-.042	.056	-.031	-.052	1						
Reuse	.136*	.063	.090	-/001	-.042	1					
Reduction	.067	-.004	-.017	-.074	-.068	.758**	1				
Collection	.083	-.034	-.034	-.120*	-.003	.708**	.768**	1			
Recycling	.089	.021	-.007	-.110	-.016	.752**	.787**	.808**	1		
Treatment	.046	.058	.022	-.127*	-.012	.701**	.761**	.734**	.795**	1	
Disposal	.040	.038	-.025	-.167**	-.003	.598**	.676**	.773**	.734**	.784**	1

*. Correlation is significant at the 0.05 level (2-tailed). **. Correlation is significant at the 0.01 level (2-tailed).The correlation analysis between community households' waste reduction practices and their profile variables yielded the following results: age (r_{obt} = -0.067, p = 0.247), sex (r_{obt} = -0.004, p = 0.940), civil status (r_{obt} = -0.017, p = 0.763), educational attainment (r_{obt} = -0.074, p = 0.200), and number of household members (r_{obt} = 0.068, p = 0.240). All variables were found to be not significantly associated with waste reduction practices, indicating that demographic factors do not have a notable influence on households' engagement in waste reduction.

The correlation analysis between waste collection practices and the profile variables of community households yielded the following results: age (r_{obt} = 0.083, p = 0.153), sex (r_{obt} = -0.034, p = 0.557), civil status (r_{obt} = -0.034, p = 0.555), educational attainment (r_{obt} = -0.120, p = 0.037), and number of household members (r_{obt} = -0.003, p = 0.959). Among these, only educational attainment showed a significant negative correlation ($p < 0.05$), indicating that higher levels of education are associated with lower engagement in waste collection. The other variables did not exhibit significant associations with waste collection practices.

The correlation analysis between waste recycling practices and the profile variables of community households yielded the following results: age (r_{obt} = 0.089, p = 0.125), sex (r_{obt} = 0.021, p = 0.721), civil status (r_{obt} = -0.007, p = 0.908), educational attainment (r_{obt} = -0.110, p = 0.057), and number of household members (r_{obt} = -0.016, p = 0.789). All variables were found to be not significantly associated with waste recycling practices, indicating that demographic characteristics do not play a major role in influencing recycling behavior among community households.

The correlation analysis between waste treatment practices and the profile variables of community households yielded the following results: age (r_{obt} = 0.046, p = 0.424), sex (r_{obt} = 0.058, p = 0.320), civil status (r_{obt} = 0.022, p = 0.702), educational attainment (r_{obt} = -0.127, p = 0.027), and number of household members (r_{obt} = -0.012, p = 0.838). Among these, only educational attainment showed a significant negative correlation ($p < 0.05$), suggesting that higher levels of education are associated with lower engagement in waste treatment. The other variables did not exhibit significant associations with waste treatment practices.

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The correlation analysis between waste disposal practices and the profile variables of community households produced the following results: age (r_{obt} = 0.040, p = 0.485), sex (r_{obt} = 0.038, p = 0.510), civil status (r_{obt} = -0.025, p = 0.670), educational attainment (r_{obt} = -0.167, p = 0.004), and number of household members (r_{obt} = -0.003, p = 0.955). Among these, only educational attainment showed a significant negative correlation ($p < 0.01$), indicating that individuals with higher education levels are less likely to engage in waste disposal practices. The other variables were found to be not significantly associated with waste disposal. As a result, the alternative hypothesis was accepted, and the null hypothesis was rejected for educational attainment.

Table 5 shows a total of 300 community household respondents who were surveyed to assess the correlation between their waste management practices and the perceived effectiveness of R.A. No. 9003 implementation. The correlation analysis revealed significant relationships between waste reuse practices and all six effectiveness factors: Reuse (r_{obt} = 0.622, $p < 0.01$, significant), Reduction (r_{obt} = 0.629, $p < 0.01$, significant), Collection (r_{obt} = 0.671, $p < 0.01$, significant), Recycling (r_{obt} = 0.722, $p < 0.01$, significant), Treatment (r_{obt} = 0.701, $p < 0.01$, significant), and Disposal (r_{obt} = 0.759, $p < 0.01$, significant). These findings indicate strong positive correlations, suggesting that waste reuse is closely linked to the overall effectiveness of waste management practices.

Table 5. Correlation of Community Households' Practices and Perceived Effectiveness.

	IUse	IRed	ICol	IRec	ITreat	IDis	EUse	ERed	ECol	Erec	ETreat	EDis
I_Reuse	1											
I_Reduction	.758**	1										
I_Collection	.708**	.768**	1									
I_Recycling	.752**	.787**	.808**	1								
I_Treatment	.701**	.761**	.734**	.795**	1							
I_Disposal	.598**	.676**	.773**	.734**	.784**	1						
E_Reuse	.622**	.629**	.671**	.722**	.701**	.759**	1					
E_Reduction	.656**	.730**	.708**	.761**	.733**	.692**	.785**	1				
E_Collection	.566**	.612**	.746**	.700**	.625**	.691**	.739**	.751**	1			
E_Recycling	.600**	.617**	.680**	.657**	.648**	.744**	.775**	.756**	.795**	1		
E_Treatment	.533**	.618**	.694**	.653**	.652**	.779**	.760**	.743**	.799**	.840**	1	
E_Disposal	.541**	.625**	.688**	.656**	.647**	.732**	.759**	.779**	.801**	.794**	.847**	1

*. Correlation is significant at the 0.05 level (2-tailed). **. Correlation is significant at the 0.01 level (2-tailed).

The correlation analysis between waste reduction practices and the composites of perceived effectiveness revealed significant positive relationships with all six factors: Reuse (r_{obt} = 0.656, $p < 0.01$, significant), Reduction (r_{obt} = 0.730, $p < 0.01$, significant), Collection (r_{obt} = 0.708, $p < 0.01$, significant), Recycling (r_{obt} = 0.761, $p < 0.01$, significant), Treatment (r_{obt} = 0.733, $p < 0.01$, significant), and Disposal (r_{obt} = 0.692, $p < 0.01$, significant). These findings indicate that waste reduction practices are strongly associated with the overall perceived effectiveness of waste management.

The correlation analysis of waste collection practices with the perceived effectiveness factors showed significant positive relationships with all six components: Reuse (r_{obt} = 0.566, $p < 0.01$, significant), Reduction (r_{obt} = 0.612, $p < 0.01$, significant), Collection (r_{obt} = 0.746, $p < 0.01$, significant), Recycling (r_{obt} = 0.700, $p < 0.01$, significant), Treatment (r_{obt} = 0.625, $p < 0.01$, significant), and Disposal (r_{obt} = 0.691, $p < 0.01$, significant). These results indicate that effective waste collection is closely linked to overall waste management efficiency.

The correlation analysis of waste recycling practices with perceived effectiveness factors revealed significant positive relationships with all six components: Reuse (r_{obt} = 0.600, $p < 0.01$, significant), Reduction (r_{obt} = 0.617, $p < 0.01$, significant), Collection (r_{obt} = 0.680, $p < 0.01$, significant), Recycling ($r_{o}bt$ = 0.657, $p < 0.01$, significant), Treatment (r_{obt} = 0.648, $p < 0.01$, significant), and Disposal

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(r_{obt} = 0.744, $p < 0.01$, significant). These results suggest that waste recycling is a critical component of overall waste management effectiveness.

The correlation analysis of waste treatment practices with perceived effectiveness factors revealed significant positive relationships with all six components: Reuse (r_{obt} = 0.533, $p < 0.01$, significant), Reduction (r_{obt} = 0.618, $p < 0.01$, significant), Collection (r_{obt} = 0.694, $p < 0.01$, significant), Recycling (r_{obt} = 0.653, $p < 0.01$, significant), Treatment (r_{obt} = 0.652, $p < 0.01$, significant), and Disposal (r_{obt} = 0.779, $p < 0.01$, significant). These results indicate that waste treatment plays a crucial role in the overall waste management system, with a particularly strong link to disposal practices.

The correlation analysis between waste disposal practices and the composites of perceived effectiveness showed significant positive relationships across all six factors: Reuse (r_{obt} = 0.541, $p < 0.01$, significant), Reduction (r_{obt} = 0.625, $p < 0.01$, significant), Collection (r_{obt} = 0.688, $p < 0.01$, significant), Recycling (r_{obt} = 0.656, $p < 0.01$, significant), Treatment (r_{obt} = 0.647, $p < 0.01$, significant), and Disposal (r_{obt} = 0.732, $p < 0.01$, significant). These results highlight that effective waste disposal practices are strongly associated with all aspects of the waste management process.

4. Discussion

Among community households in the province of Leyte, Philippines, waste management method was practiced in reusing materials as part of their waste management practices. This aligns with the principles of R.A. No. 9003 known as the Ecological Solid Waste Management Act of 2000 in the Philippines, which promote waste minimization strategies such as reuse to reduce environmental impact and conserve resources. Waste management practices in ten urban barangays of Sorsogon City, Philippines, and reported high levels of community participation. Approximately 82% of households' practices was segregation, while 85% engaged in selling recyclables such as plastics, paper, and metals [23]. Similarly, the community households recognize the importance of treating waste before disposal, which could be attributed to local government initiatives and awareness programs emphasizing proper waste handling. Even though, it received slightly lower mean score may indicate challenges in access to recycling facilities, limited incentives, or insufficient segregation at the household level. The best place to start making a difference is right in your own home. Learn to reduce, reuse, and recycle materials to decrease household waste [24].

On the other hand, waste reduction, waste disposal, and waste collection recorded the lowest mean scores, although they were still classified as "often practiced." The relatively lower scores may suggest that while households recognize the importance of minimizing waste generation, they may lack adequate knowledge, resources, or motivation to implement reduction strategies effectively. Similarly, the lower scores for waste disposal and collection may point to inefficiencies in waste management systems, such as irregular collection schedules or inadequate disposal infrastructure. Improper waste disposal remains a critical global environmental issue, particularly in low-income areas, where it contributes to the spread of infectious diseases such as cholera, typhoid, and smallpox due to contaminated water sources and poor sanitation [25]. Furthermore, it was emphasized that inadequate household waste disposal practices hinder the development of integrated solid waste management systems [26]. Emphasizing the importance of safe disposal for non-recyclable and non-reusable waste, these studies call for more cautious and structured waste handling [27].

Households prioritize the proper disposal of waste as a key component of their solid waste management practices. It attributes the availability of waste disposal facilities and the implementation of local waste management policies under R.A. No. 9003, which mandates proper waste disposal to maintain environmental sustainability. The enactment of the Republic Act No. 9003, known as the ***Ecological Solid Waste Management Act of 2000***, has significantly impacted waste disposal practices in the Philippines. Enforcement of R.A. No. 9003 by local government has improved household waste segregation in urban areas. This progress is attributed to the provision of local waste infrastructure and educational efforts. The law requires waste to be categorized as biodegradable, non-biodegradable, or recyclable to minimize landfill use [28].

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Likewise, waste reuse is considered an integral aspect of waste management among community members. Frequently, waste reuse was practiced as it stems from economic motivations, where households repurpose materials to minimize expenses, as well as awareness campaigns promoting sustainable consumption. Economic constraints drive urban households to repurpose items like furniture, clothing, and electronics to reduce costs. In communities where reuse is already common, environmental awareness campaigns further strengthen these practices. While financial savings are the primary motivator, sustainability education helps reduce and expand reuse behaviors [29]. Systematic disposal of waste was also observed by the community members as the Local Government Units (LGUs) ensures regular waste collection services. It implies active participation of the waste generators and waste collectors to regularly maintain the cleanliness and its public health.

However, waste reduction was the least prioritized practice among households as waste generators have limited knowledge of waste reduction techniques, inadequate access to alternative eco-friendly products and a lack of strict enforcement mechanisms hinders the widespread adoption of this practice. Households recognize the importance of waste reduction, many struggles due to limited knowledge of practical methods like composting and food waste minimization. Economic barriers, such as the high cost or inaccessibility of eco-friendly products, further hinder efforts, especially among lower-income households. Additionally, weak enforcement of waste reduction policies reduces motivation to adopt sustainable practices [30]. Older individuals are more likely to engage in waste reuse practices among the community households as it attributed to their greater awareness of sustainable habits, experience in resource conservation, or adherence to traditional reuse methods. Older individuals are more likely to practice waste reuse due to their experiences with resource conservation during times of scarcity. These habits, rooted in traditional and economic values, reflect a cultural understanding of the importance of repurposing items [31]. However, sex, civil status, educational attainment, and household size showed no significant correlations, suggesting that reuse behavior is influenced more by personal habits than demographic factors. Waste reduction and waste recycling practices exhibited no significant correlation with any demographic variables. It implies that waste reduction and recycling among community households has no significant correlation with demographic factors. Demographic factors like sex, civil status, and education had little impact on household waste management behaviors. Instead, personal attitudes, cultural habits, and economic factors played a more significant role in shaping practices such as recycling, waste reduction, and reuse [32]. It appears that waste collection exhibited educational attainment has significant negative correlation, suggesting that individuals with higher education levels may be less engaged in waste collection. This could be due to a greater reliance on waste management services or a preference for institutionalized waste collection programs. Individuals with higher education levels tend to prefer formal waste management services over manual waste handling [33]. Other demographic factors, including age, sex, civil status, and household size, did not show significant correlations. While age and sex slightly influenced specific waste behaviors like recycling, they had limited impact on overall waste collection practices. Instead, attitudes and awareness – often shaped by education – were more significant predictors of household waste management behavior [34].

The correlation analysis presented in Table 5 reveals that waste reuse practices are significantly linked to all six waste management effectiveness factors. It inferred that households and communities actively engaged in waste reuse are also more likely to participate in other key waste management activities, including waste reduction, collection, recycling, treatment, and disposal. Communities with structured disposal systems are more inclined to adopt reuse strategies, likely due to greater awareness of waste management policies or the presence of established waste segregation and recovery programs. Community engagement is crucial in effective waste management and recycling, as it promotes responsibility, awareness, and active participation. Hence, community involvement is very important to significantly improve waste reduction, recycling rates, and environmental sustainability [35]. Additionally, waste reuse, recycling, and treatment reinforce the notion that individuals and households practicing reuse are more inclined to engage in other sustainable waste

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management activities. The vital role of informed and socially connected communities in solid waste management enhanced community recycling and reduction efforts, contributing to more effective and sustainable environmental practices [36]. Lastly, waste reuse and waste collection underscores the role of efficient collection systems in encouraging reuse practices. When collection processes are organized and accessible, households are more likely to segregate reusable materials, contributing to improved waste management outcomes. Effective waste collection systems are essential for improving recycling and resource recovery. Structured processes facilitate source segregation, allowing households to separate reusable materials efficiently. Organized and accessible waste management enhances community sustainability and resources utilization [37].

Waste reduction and recycling suggests that minimizing waste at the source often leads to increased recycling efforts, reinforcing sustainable resource conservation practices. Waste reduction and both treatment and collection further emphasize the role of organized waste systems in supporting reduction efforts. Households that actively reduce waste are more likely to participate in structured collection programs and adopt proper treatment practices, enhancing overall waste management outcomes. Organized waste collection services are vital for supporting household waste prevention. Such systems enable proper source segregation, improving recycling and treatment of specific waste types, which in turn promotes resource conservation and reduces reliance on landfills [38]. Waste reduction and reuse further reflects the tendency of environmentally conscious households to repurpose materials, demonstrating a comprehensive commitment to minimizing waste. Social factors like environmental awareness and community engagement significantly influence household waste separation and reuse. It suggests that promoting community involvement and a sense of environmental responsibility can boost participation in waste reduction efforts [39].

Waste collection ensures the overall effectiveness of waste management systems as it highlights its function as a foundational component that facilitates recycling, reduction, treatment, and disposal efforts. Notably, efficient collection systems can improve household participation in recycling by promoting proper segregation of recyclable materials. Waste collection and disposal further reinforces the importance of structured collection systems in preventing waste accumulation in households and public spaces, reducing potential environmental and health risks. Additionally, waste collection and reduction indicate that well-organized collection services may encourage households to adopt sustainable practices, such as minimizing waste at the source. Communities with well-organized waste collection systems experience higher recycling rates and lower waste-related costs. These systems encourage households to adopt sustainable practices, such as minimizing waste at the source [40]. Waste collection and treatment underscores the role of effective collection systems in ensuring that waste reaches designated treatment facilities, preventing the disruption of treatment processes. Effective waste collection systems are crucial for ensuring waste is properly transported to treatment facilities, protecting environmental and public health. Proper operation and maintenance are essential to handle expected waste loads and prevent system failures, which could disrupt treatment processes [41].

Waste recycling and disposal suggests that increased recycling efforts contribute to improved waste disposal outcomes by diverting recyclable materials from landfills. This finding underscores the importance of recycling in minimizing landfill waste and promoting sustainable disposal practices. Intensified recycling efforts greatly improve waste disposal results by redirecting recyclable materials away from landfills, which helps reduce environmental harm and supports sustainability. The U.S. Environmental Protection Agency (EPA) highlights that recycling lowers the amount of waste sent to landfills and incinerators, conserves natural resources, and reduces pollution by decreasing the need for raw material extraction and processing [42].

Waste recycling and collection highlights that efficient waste collection systems play a vital role in supporting recycling efforts. Households with access to organized collection services are better equipped to segregate and dispose of recyclable materials effectively. Efficient waste collection systems are essential for promoting household recycling by providing the infrastructure needed for effective waste segregation [39]. Community households that actively recycle are also more inclined

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to repurpose materials, reinforcing sustainable consumption patterns and fostering a circular economy mindset. Cost–benefit models can be used to assess the economic feasibility of reuse and repurposing strategies, providing a structured way to compare them with recycling while identifying the most cost-effective and environmentally beneficial approaches [43]. Effective recycling ensures that segregated materials are directed to appropriate treatment processes, reducing the strain on disposal systems. Recycling helps reduce environmental harm by keeping waste out of landfills, thereby preventing soil and water pollution and lowering greenhouse gas emissions [44]. Additionally, waste recycling and reduction suggests that households engaged in recycling are also adopting waste minimization strategies, further promoting sustainable habits. Increasing awareness about the impacts of waste and the benefits of reduction strategies can lead households to adopt more sustainable waste minimization practices alongside recycling [45].

Waste treatment and disposal suggests that effective treatment processes significantly improve disposal practices by reducing the volume of waste sent to landfills. Combining recycling and composting with traditional landfilling significantly decreased the amount of waste ending up in landfills, resulting in better environmental benefits [46]. Waste treatment and collection highlights the importance of well-structured collection systems in ensuring successful treatment processes. Efficient waste collection facilitates the segregation of biodegradable, non-biodegradable, and hazardous materials, improving treatment outcomes. This finding reinforces the need for strengthened collection programs and active public participation in waste segregation efforts. Efficient waste collection systems, when supported by public awareness initiatives, enhance household-level waste segregation—an essential step for the effectiveness of later waste treatment methods [47]. Waste treatment and recycling suggests that communities engaged in recycling are also likely to support waste treatment initiatives. This may reflect heightened environmental awareness and an understanding that waste treatment effectively manages non-recyclable waste, complementing recycling efforts. Community participation plays a vital role in creating effective waste management policies. The research emphasizes that active engagement in recycling programs boosts public support for adaptable municipal solid waste management solutions, including both recycling and efficient waste treatment methods [48]. Furthermore, waste treatment and reduction indicate that communities practicing waste reduction strategies, such as composting or minimizing single-use plastics, contribute positively to waste treatment efficiency. This emphasizes the value of educational campaigns promoting waste reduction behaviors to improve overall treatment outcomes. A community-based program in Santa Cruz, Laguna, Philippines, motivated students and their families to collect and separate single-use plastics in return for financial rewards. This initiative fostered environmental conservation, enhanced community involvement, and helped lower household education costs [49]. Lastly, waste reuse implies that households involved in reuse practices may also recognize the importance of waste treatment. Encouraging reuse behaviors alongside formal treatment initiatives may further enhance comprehensive waste management systems. Household waste sorting promotes resource recycling, reduces the amount of waste needing treatment, and enhances the effectiveness of waste treatment facilities. This practice helps conserve landfill space and lowers greenhouse gas emissions from waste decomposition [50].

Proper collection systems streamline disposal processes, reducing the likelihood of waste accumulation and enhancing environmental safety. Well-organized waste collection systems improve the retrieval of recyclable materials, which in turn reduces landfill waste and supports environmental sustainability. It highlights the need to incorporate effective waste collection strategies to optimize resource recovery results [51]. Communities that actively reduce waste through strategies like minimizing packaging and opting for sustainable materials contribute to improved disposal outcomes by limiting the volume of waste requiring disposal. Community-based waste management systems have been effective in tackling waste disposal issues. These systems promote active community involvement, household waste segregation, organic waste composting, and the collection and transportation of waste to treatment facilities. These initiatives have successfully reduced environmental pollution and fostered resource efficiency [52]. Effective recycling practices reduce

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disposal burdens and promote environmental sustainability. Hence, waste disposal and treatment indicates that communities utilizing composting, waste-to-energy technologies, or other treatment methods can minimize the negative environmental impacts of waste disposal. Effective recycling practices, like composting and waste-to-energy (WtE) technologies, help reduce waste disposal and support environmental sustainability. Composting lowers methane emissions, enriches soil with organic nutrients, and reduces the need for chemical fertilizers, while WtE technologies transform non-recyclable waste into energy, reducing landfill waste and reliance on fossil fuels [53]. The community households actively engaged in reusing materials are also more likely to adopt proper disposal habits. Thus, potential waste reuse initiatives to indirectly support effective disposal practices by reducing the total waste volume. Household solid waste management practices and attitudes were examined in the study, which found that households engaging in waste separation and reuse displayed a stronger commitment to responsible waste disposal, underscoring the connection between reuse efforts and effective waste management [54].

5. Conclusions

The study underscores the multifaceted nature of waste management practices among community households in Leyte, Philippines, revealing that an integrated approach is crucial for enhancing overall waste management outcomes. While waste disposal emerged as the most frequently practiced activity, its effectiveness is amplified when combined with strategies such as waste reuse, reduction, recycling, treatment, and collection. The interconnectedness of these practices highlights the need for comprehensive policies that address the entire waste management cycle.

Households' engagement in reuse practices, often motivated by economic and environmental awareness, demonstrates a proactive effort to minimize waste and conserve resources. However, lower adoption rates in waste reduction suggest the necessity for enhanced education and community support to promote source reduction techniques effectively. Moreover, the study reveals that demographic factors, such as educational attainment, influence waste practices differently, reinforcing the importance of tailoring interventions to address specific community dynamics.

To achieve sustainable waste management, Local Government Units (LGUs) should implement integrated strategies that align with the principles of R.A. No. 9003. This includes strengthening waste collection infrastructure, promoting awareness campaigns on reduction and reuse, and enhancing recycling facilities. Investing in education, incentives, and stricter enforcement mechanisms will further encourage public participation and improve overall waste management efficiency. By adopting these comprehensive approaches, communities can better address environmental challenges and contribute to sustainable development.

6. Patents

This section is not mandatory but may be added if there are patents resulting from the work reported in this manuscript.

Supplementary Materials: The following supporting information can be downloaded at: www.mdpi.com/xxx/s1, Figure S1: title; Table S1: title; Video S1: title.

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Data Availability Statement: We encourage all authors of articles published in MDPI journals to share their research data. In this section, please provide details regarding where data supporting reported results can be found, including links to publicly archived datasets analyzed or generated during the study. Where no new data were created, or where data is unavailable due to privacy or ethical restrictions, a statement is still required. Suggested Data Availability Statements are available in section "MDPI Research Data Policies" at https://www.mdpi.com/ethics.

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Abbreviations

The following abbreviations are used in this manuscript:

MDPI	Multidisciplinary Digital Publishing Institute
DOAJ	Directory of open access journals
TLA	Three letter acronym
LD	Linear dichroism

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