International Journal of
Science, Architecture, Technology and Environment

# Extent of Waste Segregation Practices Among Households in Tungao, Butuan City

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*DOI: https://doi.org/10.63680/ijsate0326085.066*

## Abstract

This study examined household waste segregation practices in Tungao, Butuan City, utilizing a descriptive-correlational research design with 167 households from five puroks selected through cluster and convenience sampling. The investigation assessed demographic profiles and their influence on knowledge, attitudes, behaviors, and practices related to waste segregation. Results revealed a demographically stable community: 31% aged 45–59 years, 56% female, 59% with 4–6 family members, 29% high school graduates, and 77% residing for over 10 years. Knowledge levels varied, with 50% rated "High" and the remainder "Intermediate," indicating areas for improvement in recyclable identification and plastic handling. Attitudes demonstrated very high environmental responsibility (mean=4.24), with behavior (mean=4.29) and practices (mean=4.29) showing equally strong engagement in segregation routines. Statistical analysis using ANOVA revealed that age, educational attainment, and length of residency significantly influenced attitude, behavior, and practice variables ($p<0.05$), whereas sex and family size did not differ significantly. Despite high awareness, actual implementation varies, necessitating targeted demographic-specific interventions. This study recommends enhanced environmental education, particularly for children and new residents, alongside strengthened policy enforcement, infrastructural support, and sustained community programs. The findings provide policymakers and community organizations with evidence-based insights to improve compliance with household waste segregation and promote sustainable environmental stewardship in Tungao.

***Keywords:*** Butuan City, Community Sustainability, Demographic Factors, Environmental Behavior, Environmental Education, Waste Segregation, Philippines

## Introduction

Segregation of waste is the process of separating various types of waste at the source, usually into categories such as dry recyclable waste and moist organic waste. Effective waste management requires this

approach because it makes recycling easier, reduces landfill use, and helps turn organic waste into compost and other usable products. By reducing the quantity of mixed trash that contaminates land, water, and air, waste segregation also lowers environmental pollution and safeguards public health and ecosystems.

Improper solid waste disposal has long been a global concern and remains an unresolved problem. According to Manqele et al. (2021), improved technologies, rising standards of living, and rapid industrial growth are among the major factors contributing to increased waste generation. One of the underlying environmental problems many disregard is waste management at the community and household levels. When waste is not handled properly, it can contaminate soil, water, and air with hazardous substances. This pollution not only disrupts ecosystems but also contributes to greenhouse gas emissions. As a result, both marine life and wildlife will suffer. In addition, insufficient public engagement and the lack of awareness increase these issues.

Waste segregation and management programs are vital strategies in addressing increasing waste generation, environmental degradation, and public health concerns. Many countries emphasize ecological and sustainable waste management systems to reduce carbon footprints and conserve resources. The Philippines, in alignment with global environmental priorities, has institutionalized its Ecological Solid Waste Management Act of 2000 (Republic Act 9003), which mandates systematic segregation at the barangay level. The law emphasizes protecting public health and the environment through systematic strategies for waste reduction, segregation, collection, and disposal. It delegates local government units (LGUs) as the primary implementers of the program. However, enforcement challenges remain at various local levels, affecting the full realization of the program's benefits (Catiil & Daud, 2025).

According to Acting Secretary Sampulna (2022) of the Department of Environment and Natural Resources (DENR), the Philippines continues to face major challenges in solid waste management primarily due to inconsistent implementation and mismanagement of waste segregation policies at the local government unit (LGU) level, despite the mandates of Republic Act 9003 (DENR, 2022). DENR Undersecretary Benito Antonio de Leon further emphasizes that gaps in public awareness and actual practice hinder effective segregation, which, in turn, results in environmental harms, including pollution and damage to marine ecosystems. To combat these issues, the government promotes information campaigns, supports the establishment of material recovery facilities (MRFs), and provides color-coded bins to facilitate proper waste sorting. However, enforcement and resource constraints remain significant obstacles (DENR, 2022).

In the specific context of Butuan City's barangays, such as Tungao, understanding the extent of household waste segregation practices will provide valuable insights to inform local environmental management strategies. According to Tassie et al. (2024), examining current practices, challenges, and factors influencing segregation will help city officials and stakeholders tailor interventions to promote compliance and achieve sustainable waste management. Such efforts ultimately help reduce landfill volume, prevent pollution, improve public health, and support the city's ecological goals.

The researchers conducted this study to assess the extent of household waste segregation practices in Tungao, Butuan City. Initial observations revealed that waste was frequently left unattended and scattered in various locations, including the covered court, street sides, and residential areas within the community. This situation underscored the importance of understanding households' knowledge, practices, attitudes, and current behaviors in proper waste segregation.

## Related Studies

This section presents a review of related literature and studies on community-based waste segregation practices. This literary article provides valuable information towards a comprehensive understanding of this study.

For the past decades, Asia has faced growing problems in managing solid waste. Despite some improvements, many areas still depend on landfills and open dumps. Issues such as poor collection systems, food waste, open burning, and informal waste handling continue. Recycling is increasing, but challenges remain (Agamuthu & Babel, 2023).

Environmental pollution is a growing concern globally, especially in developing countries, driven by rapid urbanization and industrialization. This development has led to the overexploitation of natural resources, causing severe environmental challenges. The major pollution types, such as land/soil, water, air, noise, and plastic/microplastic, are recognized as significant public health issues, and their adverse effects on social progress and economic development place immense pressure on resources and ecosystems (Ajibade et al., 2021).

Similarly, waste management practices in developing nations encounter numerous challenges, including insufficient infrastructure, limited resources, and inadequate public awareness (Kumari & Raghubanshi, 2023). Nevertheless, opportunities exist through community-based strategies, enhanced education, and policy implementation to address these challenges. In addition, understanding the performance and challenges of solid waste management in emerging megacities offers insights from a developing-world perspective (Kwakye et al., 2024). The research examines how rapid urbanization affects waste management systems and the necessity for sustainable solutions.

Furthermore, separating waste at its point of origin, especially in residential settings, is a fundamental element of environmentally responsible solid waste management and a significant public health concern (Trushna et al., 2024). An extensive analysis of 82 research studies on intervention approaches showed that communication-based information campaigns are the predominant strategy. However, limited research examines household waste separation initiatives specifically in low- and middle-income nations.

In contrast, separating solid waste is an essential component of efficient waste management systems; however, its implementation remains limited in developing nations such as Ethiopia (Adefris et al., 2023). When waste is sorted at its source, the material remains less contaminated, facilitating more effective collection, transportation, and subsequent processing, while also optimizing treatment technologies and reducing reliance on new raw materials.

Moreover, inadequate waste separation practices may undermine recycling initiatives, leading to excessive resource consumption and exacerbating problems such as increased energy use and climate change, and undermining sustainable development objectives (Hassooni et al., 2024). Waste segregation is a vital stage in waste management, involving the classification of refuse by its characteristics and composition to enhance recycling efficiency, minimize environmental harm, and ensure the appropriate disposal of hazardous materials.

The Theory of Planned Behavior is one of the most prominent theoretical frameworks used to investigate factors influencing human behavior, particularly in environmental research contexts (Pan & Liu, 2024). Among adult populations, variables within the TPB model encompassing personal attitudes, social normative pressures, and perceptions of behavioral control, combined with environmental awareness, demonstrate significant positive correlations with individuals' intentions to engage in waste separation activities.

Moreover, the Theory of Planned Behavior originated from the concept of reasoned action, proposing that individual conduct is determined by behavioral intentions and self-perceived capacity to exercise control over that conduct (Sapawi et al., 2024). Behavioral intentions are influenced by three key elements: personal attitudes toward the action, perceptions of social pressures and expectations from others (subjective norms), and individuals' assessment of their capability to execute the behavior successfully.

Additionally, over the preceding three decades, scholarly investigation into the relationships between solid waste management practices and psychological theoretical frameworks has advanced considerably

(Jagadeshi & Raghu, 2020). Analysis of 80 scholarly articles revealed that the Theory of Planned Behavior was the most frequently tested framework (46% of studies), with the majority of research (59%) focusing on recycling behaviors and applying individual behavioral theories (90%).

While theoretical frameworks provide guidance, personal waste management behavior is shaped by both logical reasoning and altruistic motivations, as well as corresponding beliefs and attitudes (Wu et al., 2022). Research findings indicated that social normative expectations, perceived control, personal moral obligations, and environmental awareness were significant predictors of waste management conduct within the enhanced theoretical model. However, insufficient attention has been devoted to understanding the interactions among these components.

Furthermore, an expanded version of the Theory of Planned Behavior was employed to examine citizens' environmentally conscious behaviors related to waste minimization, focusing on three behavioral categories: waste prevention, recycling participation, and environmentally responsible consumption (Crespo & Rivas, 2024). External contextual factors moderate the relationship between ecological behavioral intentions and actual waste-reduction practices, underscoring the importance of targeting citizen attitudes and social expectations to encourage sustainable consumption, waste prevention, and recycling engagement.

Similarly, the Theory of Planned Behaviour provides a conceptual framework for understanding human behavior, particularly regarding food waste management (Etim et al., 2025). A systematic analysis of 42 studies across 17 countries reveals interconnections among TPB components in explaining household food waste behaviors, with 95% of the articles published between 2010 and 2024.

In addition, investigating the role of goals and motivation on waste separation behavior through the lens of the Theory of Reasoned Goal Pursuit provides alternative frameworks for understanding environmental behavior (Concari et al., 2023). Motivation plays a critical role in sustained waste segregation practices.

Moreover, understanding the factors that may influence citizens' willingness to adopt source separation practices is essential for achieving effective, efficient material recycling outcomes (Mukena et al., 2024). A survey of approximately 1,600 residents sought to identify these determinants using the Theory of Planned Behavior conceptual framework.

Demographic characteristics, including gender, age group, economic status, and academic background, substantially affect individual engagement in waste reduction, separation, and recycling activities (Konstantinidou et al., 2024). A comprehensive analysis of 27 studies found that female participants recycled more consistently than their male counterparts. That age was a particularly influential variable, with younger individuals demonstrating greater enthusiasm and active involvement in recycling than older age groups.

In addition, findings concerning factors influencing household waste separation and recycling behaviors provide important guidance for improving environmental education and promotional initiatives (Henao-Rodríguez et al., 2024). By examining the complex relationships among demographic, geographic, and attitudinal variables, this research illuminates the dynamics of waste separation behaviors, which are essential for developing tailored policy interventions.

Moreover, implementing effective waste-separation protocols in educational institutions is vital for advancing the principles of ecological civilization (Liu et al., 2024). Using the Knowledge, Attitude, and Practice theoretical framework, a study involving 1,282 university students found that inadequate infrastructure, scarce resources, and ineffective education on waste classification pose significant barriers to implementing practical waste-separation programs.

Similarly, environmental education, knowledge, and high school students' intentions regarding campus solid waste segregation illustrate the role of formal education in promoting waste segregation (Liao & Li, 2019). School-based interventions prove effective in building long-term environmental behaviors. Additionally, formal environmental education programs exert considerable influence on students'

understanding and perspectives regarding waste segregation practices (Erhabor, 2023). The research examined how environmental education affects university students' knowledge and attitudes, underscoring the importance of structured educational programs in advancing appropriate waste management behaviors.

The rapid urban expansion and escalating waste generation in India pose substantial challenges for sustainable waste management, and the Theory of Planned Behavior framework is being used to identify behavioral adaptation issues related to household waste segregation (Jampala & Shivnani, 2024). Social normative pressures emerged as the strongest predictor of segregation intentions, and the proposed theoretical model demonstrated an excellent statistical fit, with all three research hypotheses validated and substantial positive effects on waste-sorting intentions.

In addition, factors determining waste separation behavior at health facilities in Tabriz, Iran, were investigated using the Theory of Planned Behavior (Babazadeh et al., 2023). The research provides insights into how psychological factors influence waste segregation practices within institutional environments. Similarly, key informant perspectives in Iran indicated that inadequate organizational systems, combined with ineffective educational programs, can adversely affect waste management systems (Esmaeilizadeh et al., 2020). The research emphasizes the importance of institutional support for effective waste management.

Moreover, at-source segregation practices of household solid waste by youths in Nepal reveal important patterns in waste management behavior among younger demographic groups (Khanal et al., 2023). Understanding youth engagement in waste segregation is essential for sustainable waste management planning. Furthermore, indigenous knowledge systems for solid waste management in rural South African communities offer alternative approaches (Madonsela et al., 2024). The research highlights how traditional practices can be integrated with modern waste management systems.

Additionally, knowledge, attitudes, and behaviors regarding health and the environment within an Israeli community have implications for sustainable urban environments and public health (Dopelt et al., 2024). The research examines how community-level factors influence environmental behavior and waste management practices. In addition, managing waste continues to pose challenges, particularly in developing nations, where effective waste separation plays a vital role in reducing waste volumes and ensuring sustainable development (Vu, 2025). The research highlights that perceived ease of implementation and social pressures are critical factors affecting household waste-sorting behaviors in Vietnamese communities.

Also, behavioral transformation in source waste separation within an international community illustrates the application of the Theory of Planned Behavior framework (Hu et al., 2021). The research demonstrates how individual perceptions and social influences jointly shape environmental behaviors related to waste segregation. The collaborative relationship and unity between governmental authorities and community members are vital to achieving successful waste management outcomes (Kalra, 2020). Citizens' perspectives on waste and their understanding of the consequences of improper disposal significantly influence their willingness to participate in waste management programs, with documented successes across developed, developing, and underdeveloped nations.

Moreover, public participation in waste management systems has emerged as the optimal approach for such programs, particularly in developing countries (Sunarti et al., 2024). Involving diverse sectors and stakeholders, including civil society organizations, is essential for effective waste management through the implementation of community-of-practice frameworks. The influence of color preference and noticeability of trash bins on waste collection performance and waste-sorting behaviors demonstrates that visual cues significantly affect segregation practices (Leeabai et al., 2021). Appropriate bin design and placement constitute important factors in promoting effective waste segregation.

Furthermore, pay-as-you-throw trash collection programs emerged as the most substantial positive predictor of community recycling rates (Seacat & Boileau, 2018). Multiple regression analysis demonstrated that communities that charge for recycling services had significantly lower average recycling rates, with this

factor accounting for 30% of the variance in community recycling rates. Solid waste management has become one of the most pressing environmental issues facing many communities today, especially in rapidly growing urban areas (Balutan & Borja, 2025). According to Kanhai et al. (2021), research on household waste management is scarce, as it contributes to understanding perceptions of waste management and insights into health literacy.

On the other hand, open dumping and waste burning have been major sources of public health hazards, releasing toxic substances. They also stated that the adaptation of defensive behavior involves a cognitive process in which individuals' values, beliefs, attitudes, perceptions, personalities, motivations, aspirations, and community influences work together to minimize the harmful impacts of excessive waste disposal (Akmal & Jamil, 2021). In addition, the safe disposal of illegally dumped solid waste and litter from informal settlements is a priority for local governments in developing countries. However, the effective management of informal solid waste is a growing challenge for local authorities due to the inadequacy of conventional waste management practices in informal settlements (Geyer & Lille, 2024).

Meanwhile, in the Philippines, professionals ventured to improve their management of waste through the passage of RA 9003 or the Ecological Solid Waste Management Act, which provides for a systematic, comprehensive, and ecological waste management program to ensure the protection of public health and the environment (Department of Environment and Natural Resources, DENR, 2024). Another study stated that solid waste management remains a complex and evolving issue in the Philippines. Although Republic Act No. 9003 (Ecological Solid Waste Management Act of 2000) has served as the foundation for the country's waste management efforts for over twenty years, its implementation continues to face significant challenges at both national and local levels (Bueta et al., 2023).

Moreover, the rigorous implementation of RA 9003 has transformed Philippine barangays into clean, green materials recovery facilities featuring colorful gardens and eco-stores (MEF & GAIA, 2021). These examples demonstrate that achieving ecological waste management does not require expensive, high-tech, or harmful waste-disposal technologies, but rather community-based approaches supported by barangay leadership. Additionally, the EPR Act of 2022 (RA No. 11898) amended the Ecological Solid Waste Management Act (RA No. 9003) to combat plastic pollution by mandating that large enterprises assume responsibility for managing the plastic packaging waste they produce. The Philippine Action Plan for Sustainable Consumption and Production strengthen waste management through proper waste segregation and recycling, advancing toward zero waste by developing and adopting innovative technologies aligned with circular-economy principles.

Nevertheless, waste management is still a problem in many areas. Republic Act 9003 was made to protect people's health and the environment by promoting proper waste disposal and community participation. This study explored how the law is enforced across different places. Some areas did well, like Quezon City's cleanup of the Payatas dumpsite, Teresa, Rizal's shared waste services, and San Fernando, Pampanga's strong local partnerships. However, in many places, overreliance on local governments led to poor results. The study suggests faster action, more support, and better teamwork between the government and the people (Domingo & Manejar, 2021). Solid waste management awareness and, respectively, the effectiveness of current practices were assessed; the results showed that awareness of solid waste management is generally high. However, many respondents were less informed about the destination of collected waste. Regarding effectiveness, respondents felt that current practices work well but highlighted the need for better garbage collection coverage throughout the city (Inuguidan, 2025).

Apart from raising awareness, this study examined how people in Hugpa, Biliran, handle their waste and what the barangay council does to help. It focused on segregation, reduction, recycling, and waste disposal. A survey was conducted to get data from 30 people. The results showed that segregation, recycling, and reduction were sometimes practiced, whereas proper waste disposal and barangay programs were practiced

less often. The study showed that waste management needs improvement, and there should be greater support from the barangay and more community involvement (Cabias et al., 2024).

Along with Camarillo & Bellotindos (2021), they explored and assessed the compliance of selected barangays in Cebu City, Philippines, specifically with the integrated solid waste management plan based on the 3Rs (reduce, reuse, and recycle). A descriptive quantitative method was utilized in this study. 1,523 residents and 30 Barangay Environment Officials were identified as respondents using Slovin's sampling method at a 95% confidence level. The results revealed that compliance is less extensive across almost all SWM policies, including segregation, composting, recycling, incentives, and public information.

Furthermore, Sayson et al. (2024) highlighted that Barangay officials were involved in the study because they are responsible for leading waste management efforts. Their participation not only leads the community but also supports a cleaner and more sustainable community. Waste disposal involves deciding what to throw away and where to send it. Some consider waste to be items with no further use, while others view it as something that can still be given or sold to others. Proper waste management helps safeguard health, protect the environment, and conserve valuable resources (Valentin et al., 2024).

In addition, the common issues facing the community regarding solid waste management included awareness of the community's policies and regulations, actual community practices, and the challenges and opportunities the community faces. The assessment of the gap between awareness and actual practice showed that the community was highly aware of the impact of improper solid waste management and strongly agreed with the local barangay unit's actual practice regarding the programs and policies being implemented (Masanga et al., 2024).

Additionally, Valentin (2024) reinterprets classical waste management theory by emphasizing the crucial role of behavioral understanding in program success. The research shows that integrating factors such as attitudes, social norms, and perceived behavioral control enables waste management initiatives to achieve environmental goals more effectively. By applying an extended theory of reasoned action, Valentin demonstrates that strategic focus on improving community attitudes and shared responsibilities leads to more effective waste segregation and recycling behaviors, aligning with foundational concepts in waste management theory.

Moreover, Sunitha et al. (2023) highlighted their study, which determined whether people segregate waste, if so, into how many categories, whether they use proper disposal methods when disposing of sanitary waste, and how often they clean their dustbins. The primary objective of the study was to determine whether individuals are aware of the significance of segregating garbage and sanitary waste.

Furthermore, according to Beltran et al. (2023), improper waste segregation is a significant environmental challenge. Poor waste-disposal practices hinder the advancement of integrated solid waste management in households. The study aims to identify problems encountered during implementation and to provide specific solutions to improve the quality of life for residents and homeowners. Segregating waste into different types can make a huge difference. In 2020, the UK generated an estimated 40.4 million tons of commercial and industrial (C&I) waste, which is about one-fifth (21%) of the nation's total waste segregation (Waste Mission, WM, 2025).

The reviewed literature and studies provide essential foundations, empirical evidence, and contextual insights that directly support this investigation into household waste segregation practices in Tungao, Butuan City. The theoretical framework established by the Theory of Planned Behavior (Ajzen, 1991; Sapawi et al., 2024) offers a robust lens for understanding how attitudes, subjective norms, and perceived behavioral control shape residents' waste segregation intentions and actions, while demographic studies (Konstantinidou et al., 2024; Henao-Rodríguez et al., 2024) inform the examination of how age, gender, education, and residency duration influence environmental behaviors.

The Philippine-specific literature addressing RA 9003 implementation challenges (Bueta et al., 2023;

Domingo & Manejar, 2021; Camarillo & Bellotindos, 2021) provides critical context for understanding local policy frameworks and compliance gaps that persist in barangay-level waste management systems similar to Tungao. Furthermore, studies on community participation (Kalra, 2020; Sunarti et al., 2024), educational interventions (Liao & Li, 2019; Erhabor, 2023), and infrastructural considerations (Leeabai et al., 2021) collectively highlight the multifaceted nature of effective waste segregation programs. These works emphasize that sustainable outcomes require integrating knowledge enhancement, positive attitude development, behavioral reinforcement, and supportive physical infrastructure, all of which are critical dimensions examined in this study.

Synthesizing international best practices with Philippine-specific challenges and solutions, this literature review establishes a comprehensive knowledge base that guides the research methodology, informs data interpretation, and provides benchmarks for proposing evidence-based interventions tailored to the unique socio-demographic characteristics and waste management needs of Tungao's households.

## Theoretical/Conceptual Framework

The theoretical framework of this study was the Theory of Planned Behavior (TPB) developed by Ajzen (1985), which provides an understanding of human behavior in environmental studies, including household waste segregation. This theory posited that an individual's behavior is directly influenced by their behavioral intention, which is shaped by three components: attitude toward the behavior, subjective norms, and perceived behavioral control. In the context of waste segregation, attitude refers to the household's positive or negative evaluation of segregating waste; subjective norms involve the social pressure households feel from family, friends, or community to perform waste segregation; and perceived behavioral control reflects the ease or difficulty households perceive in carrying out segregation practices (Li et al., 2019).

Further enriching the TPB framework, environmental knowledge and environmental concern play critical roles in influencing waste segregation behavior. Environmental knowledge pertains to awareness and understanding of the benefits, methods, and consequences of waste segregation for environmental health. Meanwhile, environmental concern refers to the extent to which individuals are motivated by ecological issues, including altruistic, egoistic, and biospheric concerns. This integration is necessary because knowledge and concern can shape attitudes and perceived behavioral control, thereby reinforcing or diminishing intentions to segregate waste. For any household, exploring these factors clarifies whether education and awareness campaigns can effectively enhance waste segregation practices (Cheng et al., 2024).

Moreover, institutional factors, particularly local government policies and ordinances on waste segregation, significantly influence residents' behavior. Government interventions provide rules, incentives, and infrastructure (such as waste bins and collection systems) that enable or restrict waste segregation. The presence and enforcement of such policies affect residents' perceived behavioral control by making segregation either more convenient or more challenging. Understanding how municipal regulations influence households in Tungao situates environmental behavior within a policy context, highlighting opportunities to improve the implementation of the waste segregation ordinance and to develop supportive community programs (Tanjung, 2024).

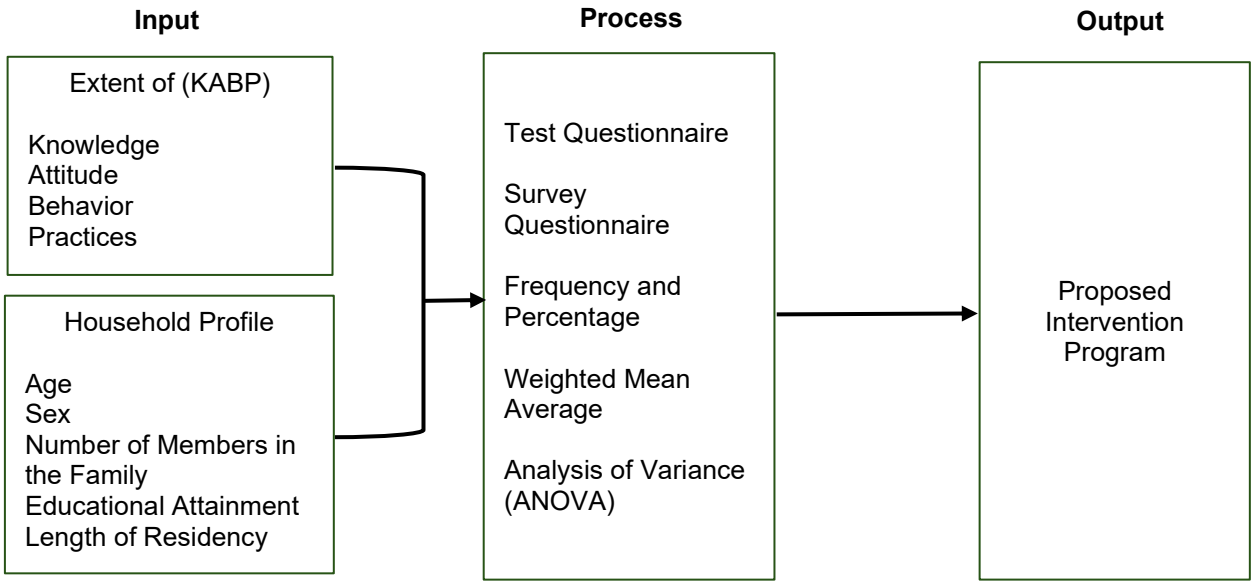
The combination of TPB with environmental knowledge, concern, and institutional factors presents a comprehensive theoretical framework for this research. It enables examination of how internal psychological determinants interact with external social and policy influences to shape the extent of household waste segregation practices in Tungao, Butuan City. This framework enables researchers to identify gaps between intention and actual behavior, inform strategies for behavioral change, and support the effective enforcement of local waste management policies to achieve a cleaner, healthier environment (Bekabil & Jayamohan, 2025).

TPB offered a refined understanding of how individual perceptions and social influences collectively

shape environmental behaviors. This theoretical model is particularly valuable in the context of waste segregation, where personal beliefs about the benefits and feasibility of the behavior, as well as social expectations and practical constraints, critically inform participation. TPB's flexibility enabled the incorporation of additional relevant factors, such as environmental knowledge, concern, and institutional policies, thereby enabling a holistic analysis of the multidimensional influences on waste segregation practices.

**Figure 1**

*Conceptual Framework of the Study*




**Objectives of the Study**

This study sought to address the following objectives: (1) determine the demographic profile of the households in terms of age, sex, number of members in the family, educational attainment, and length of residency; (2) evaluate the extent of knowledge of the residents on waste segregation practices; (3) assess the extent of waste segregation practices in terms of attitude, behavior, and practices; (4) determine the significant difference on the extent of waste segregation practices when they are grouped according to profile; (5) identify an intervention program may be proposed based on the results of the study.

**Methodology**

This study employed a descriptive-correlational research design. This study was conducted in Barangay Tungao, located in Butuan City. The respondents of this study were the 289 households from five selected puroks in Barangay Tungao, Butuan City. Two instruments were used in the study: a survey questionnaire and a test questionnaire. The researchers developed the test questionnaire to measure respondents' knowledge of proper waste segregation practices. An expert validated the questions before administration to ensure they were clear, relevant, and appropriate for the study. The Likert-scale survey questionnaire was used to assess the attitudes, behaviors, and practices of the respondents; this section of the

instrument was adapted from a published research study by Tecson et al. (2024). To systematically analyze and interpret the data gathered from the respondents, the following statistical tools were employed in this study, namely: Frequency and Percentage, Weighted Mean, Analysis of Variance (ANOVA), and t-Test.

## Results and Discussion

**Problem 1. What is the demographic profile of the household in terms of age, sex, number of members in the family, educational attainment, and length of residency?**

**Table 2**

*Distribution of Respondents in terms of Age*

| Age | Frequency (f) | Percentage (%) |
|---|---|---|
| 15-29 | 39 | 23 |
| 30-44 | 40 | 24 |
| 45-59 | 51 | 31 |
| 60-74 | 26 | 16 |
| 85-89 | 11 | 7 |
| **Total** | **167** | **100** |

Table 2 presents the demographic profile of respondents by age, in terms of frequency and percentage distributions, in Tungao, Butuan City. The data reveal that the 45-59 age group had the highest participation, accounting for about one-third of respondents. This concentration aligns with the demographic reality that middle-aged adults often manage households, making them more available and motivated to participate in community surveys. As Fadhullah et al. (2022) note, these individuals engage more in waste segregation due to their roles as household heads, familiarity with environmental practices, and family obligations that foster consistent habits.

In contrast, the 85-89 age group had the lowest participation rate at just 7%. This underrepresentation stems from smaller elderly populations in communities, compounded by health issues and mobility constraints that hinder participation in surveys. Soysa et al. (2023) similarly observe that adults over 65 participate less in waste segregation due to physical limitations and handling difficulties, despite their accumulated life experience. Age directly correlates with household roles and waste management engagement: high among 45-59-year-olds due to managerial responsibilities (Fadhullah et al., 2022), and low among the elderly due to physical constraints (Soysa et al., 2023).

**Table 3**

*Distribution of Respondents in terms of Sex*

| Sex | Frequency (f) | Percentage (%) |
|---|---|---|
| Male | 73 | 44 |
| Female | 94 | 56 |
| **Total** | **167** | **100** |

Table 3 displays the distribution of respondents by sex, presented as frequencies and percentages. Female respondents accounted for 56% of the sample, reflecting greater participation in the household survey

on waste management practices. This trend aligns with entrenched gender roles in Philippine households, where women, as primary homemakers, typically manage daily waste segregation and disposal, and show greater responsiveness to community-based environmental surveys (Dizon et al., 2025). Their central role underscores nurturing behaviors tied to family health and cleanliness.

On the other hand, males comprised 44% of respondents, indicating modestly lower engagement. While men often contribute less to routine household tasks due to work commitments or traditional divisions of labor, they play key roles in broader environmental decisions, such as infrastructure adoption and bulk waste handling (Smith & Rivera, 2024). For instance, males frequently influence decisions on composting pits or hauling non-recyclables to material recovery facilities (MRFs), leveraging physical labor or community leadership positions.

The gender distribution highlights women's pivotal influence on household waste practices alongside men's value in community-scale strategies. Women drive micro-level compliance through daily habits like source segregation, which directly impacts RA 9003 targets for 25-80% waste waste diversion. Men's involvement is crucial to macro-level execution, including advocacy for barangay-level MRFs and hauling schedules. This duality necessitates gender-sensitive approaches like tailored education campaigns, such as women-focused workshops on vermicomposting, and inclusive local ordinances that engage men in enforcement roles to boost overall segregation compliance under RA 9003 (Ramos et al., 2024). Prioritizing gender equity in waste management policies promises measurable gains in segregation rates and public health under RA 9003. These implications urge LGUs to integrate intersectional approaches, reducing vulnerabilities for marginalized women while amplifying community-wide sustainability (UN Women, 2022).

**Table 4**

*Distribution of Respondents in terms of Number of Members in the Family*

| Number of Members | Frequency (f) | Percentage *(%)* |
|---|---|---|
| 1 to 3 | 40 | 23 |
| 4 to 6 | 99 | 59 |
| 7 to 9 | 20 | 12 |
| 10 to 12 | 5 | 3 |
| 13 to 16 | 5 | 3 |
| **Total** | **167** | **100** |

Table 4 presents the household size distribution among respondents, expressed as frequencies and percentages. The data revealed that households with 4 to 6 members formed the largest group, accounting for 59% (n=99) of respondents and reflecting the typical nuclear-to-extended family structure in Philippine communities, where parents, children, and sometimes grandparents co-reside. From a waste management standpoint, these medium-sized households are pivotal, as they generate substantial, diverse volumes of waste from varied daily activities and consumption patterns. Agua et al. (2020) confirm that such households generate the highest quantities and varieties of waste, making them prime targets for segregation education and interventions. Their balance of sufficient members to create notable waste yet retain manageable dynamics positions them ideally to adopt sustainable practices.

In comparison, the smallest segments are the households with 10 to 12 members and 13 to 16 members. Each comprised just 3% of the sample (n=5). Though less common, these larger households grapple with unique barriers to consistent waste segregation, including the challenge of aligning multiple members' differing levels of environmental awareness, routines, and disposal habits. Agua et al. (2020) highlight that such groups face coordination hurdles due to diverse behaviors and the ongoing collective effort required.

Without tailored support to address these organizational complexities, they risk ineffective segregation despite ample human resources.

Household size significantly shapes waste segregation dynamics in this context, with medium-sized families offering the greatest leverage for scalable interventions. In contrast, larger ones demand customized strategies to overcome coordination barriers (Menzel & Bekers, 2022). Prioritizing these demographics can enhance overall community-level waste management efficacy.

**Table 5**

*Distribution of Respondents in terms of Educational Attainment*

| Educational Attainment | Frequency (f) | Percentage *(%)* |
|---|---|---|
| No Formal Education | 3 | 2 |
| Elementary Level | 14 | 8 |
| Elementary Graduate | 17 | 10 |
| High School Level | 40 | 24 |
| High School Graduate | 48 | 29 |
| College Level | 26 | 16 |
| College Graduate | 17 | 10 |
| Master's Degree | 2 | 1 |
| Doctoral Degree | 0 | 0 |
| Others | 0 | 0 |
| **Total** | **167** | **100** |

Table 5 demonstrates the Educational Attainment of respondents in the following data. High school graduates made up the largest educational group at 29%, mirroring the typical profile in many Philippine barangays, where completing secondary education is a key milestone, yet access to tertiary education remains limited. This attainment level equips individuals with adequate literacy and comprehension to grasp waste segregation principles and participate effectively in environmental initiatives. As García et al. (2022) note, those with at least secondary education demonstrate superior understanding and sustained engagement in environmental practices.

On the other hand, respondents with master's degrees represented the smallest group at 1%, similar to the 2% with no formal education. This pattern underscores the rarity of advanced degrees in barangay settings, though their contributions offer unique depth despite their low numbers. Khan et al. (2021) highlight that individuals with low education often struggle with complex environmental concepts, whereas highly educated individuals offer distinctive viewpoints that are underrepresented in community samples. Thus, emphasizing the value of inclusive educational diversity in such surveys.

The predominance of high school graduates suggests that barangay residents possess baseline capacities for waste-segregation education. However, gaps in the higher- and no-education groups signal a need for tailored outreach to boost comprehension and participation. These findings imply that local government units should prioritize simplified, visually aided programs to bridge educational disparities and foster equitable environmental behavior change (García et al., 2022; Santos & Reyes, 2023).

**Table 6**

*Distribution of Respondents in terms of Length of Residency*

| Length of Residency | Frequency (f) | Percentage *(%)* |
|---|---|---|
| Less than 1 year | 12 | 7 |
| 1-5 years | 3 | 2 |
| 6-10 years | 23 | 14 |
| More than 10 years | 129 | 77 |
| **Total** | **167** | **100** |

Table 6 presents the respondents' demographic profile by length of residency in Barangay Tungao, Butuan City. A substantial majority of households (129 respondents, 77%) have resided in Tungao for over 10 years, reflecting exceptional community stability and deep-rooted local ties. This longevity fosters familiarity with waste management systems, robust social networks that promote pro-environmental behaviors, and prolonged exposure to norms favoring proper segregation. As Xu et al. (2017) note, long-term residents exhibit stronger waste segregation practices, driven by entrenched community norms, social cohesion, and ingrained environmental habits.

Conversely, the smallest group, consisting of households with 1-5 years of residency (3 respondents, 2%), faces adaptation hurdles, including limited awareness of local systems and underdeveloped social connections that typically bolster environmental compliance. Fadhullah et al. (2022) corroborate this, attributing lower engagement in segregation among newcomers to unfamiliarity, weak ties, and integration challenges, which call for targeted interventions.

These residency patterns underscore how tenure shapes the efficacy of waste segregation in Tungao, with long-term stability amplifying positive behaviors while short-term residency risks gaps in compliance. For local governments in Northern Mindanao, this implies prioritizing newcomer orientation programs, such as community workshops and informational campaigns, to bridge adaptation gaps and enhance overall solid waste management. As Agad et al. (2021) emphasize in their study of the Philippine context, such tailored strategies can boost household participation rates by up to 25% in similar barangay settings, aligning with Republic Act 9003's segregation mandates.

**Problem 2. What is the extent of waste segregation in terms of knowledge**

**Table 7**

*Distribution of Respondents in terms of Knowledge*

| Score Item | Frequency (f) | Percentage (%) | Interpretation |
|---|---|---|---|
| 1-4 | 0 | 0 | Beginning |
| 5-8 | 3 | 2 | Developing |
| 9-12 | 29 | 17 | Approaching Proficiency |
| 13-16 | 97 | 58 | Proficient |
| 17-20 | 38 | 23 | Advanced |
| **Total** | **167** | **100** | |

*Legend:1-4: Beginning, 5-8: Developing, 9-12: Approaching Proficiency, 13-16: Proficient, 17-20; Advanced*

Table 7 presents the extent of respondents' knowledge about waste segregation in Tungao, Butuan

City. The data reveal that most respondents exhibited proficient-level knowledge of waste segregation, with 58% (n=97) scoring 13-16 points and 23% (n=38) achieving advanced proficiency (17-20 points). This skew toward higher knowledge levels signals strong community awareness of waste segregation principles, likely driven by successful educational campaigns, media outreach on sustainable practices, and integration of waste management into local initiatives.

Such robust knowledge aligns with psychological models, in which positive attitudes and environmental awareness predict pro-environmental behaviors (Bamberg & Möser, 2007). In this context, greater knowledge equips community members to segregate waste, fostering readiness for effective sustainable practices.

In comparison, no respondents fell into the beginning knowledge level (0%), and only 2% (n=3) showed developing knowledge (5-8 points). While this rarity at lower levels indicates broad baseline familiarity, it underscores lingering educational gaps for a small subset, potentially due to limited access to information, resource constraints, or economic priorities that override environmental concerns. These individuals often lack the foundational attitudes needed to translate knowledge into action (Bamberg & Möser, 2007), underscoring the need for targeted interventions to address deficits and boost uniform participation.

Results show predominantly proficient and advanced knowledge levels, signaling successful awareness campaigns, though pockets of developing knowledge persist. This highlights the need for targeted strategies to engage all community segments and fully boost waste segregation. Local governments should focus education efforts on vulnerable groups to improve compliance and ease pressure on landfills. Steg and Vlek (2019) support this, noting that pairing knowledge gains with habit interventions drives sustained pro-environmental behavior, thereby enabling scalable policies.

**Problem 3. What is the extent of waste segregation in terms of attitude, behavior, and practices?**

**Table 8**

*Extent of Waste Segregation in terms of Attitude*

| | Statements | Mean | Description | Interpretation |
|---|---|---|---|---|
| 1 | I care about waste management | 4.39 | Always | Highly Practiced |
| 2 | Waste management is a personal responsibility | 4.18 | Often | Practiced |
| 3 | Waste disposal is the responsibility of the local authorities | 4.19 | Often | Practiced |
| 4 | I am responsible for the generation of waste | 4.20 | Often | Practiced |
| 5 | I believe I have a role in minimizing waste | 4.24 | Always | Highly Practiced |
| 6 | I am responsible for reminding other people of proper waste disposal | 4.09 | Often | Practiced |
| 7 | I read information on waste management with other people | 4.14 | Often | Practiced |
| 8 | I volunteer in municipality cleaning activities | 4.14 | Often | Practiced |
| 9 | I am concerned about the waste I saw in our municipality | 4.45 | Always | Highly Practiced |
| 10 | I put waste into the proper garbage container | 4.35 | Always | Highly Practiced |
| | **Overall Mean** | **4.24** | **Always** | **Highly Practiced** |

*Legend: Never: 1.00-1.80, Seldom: 1.81-2.61, Sometimes: 2.62-4.23, Often: 3.43-4.23, Always: 4.24-5.00*

Table 8 presents the respondents' attitudes toward waste segregation, with an overall mean of 4.24 (Always), indicating a strong positive disposition toward environmental responsibility and a high level of practice. The highest mean was observed for the statement "I am concerned about the waste I saw in our municipality" (M=4.45), indicating a high level of environmental concern among respondents. This suggests that individuals are highly aware of local waste issues and are emotionally engaged in environmental protection. This finding is consistent with Aprile and Fiorillo (2019), who emphasized that heightened environmental concern significantly increases participation in waste segregation and recycling behaviors.

Other attitude indicators, such as "I care about waste management" (M=4.39) and "I put waste into a proper garbage container" (M=4.35), also fall into the highly practiced category, indicating that respondents not only value waste management but also translate this concern into consistent personal actions. Meanwhile, statements related to responsibility, such as "I believe I have a role in minimizing waste" (M=4.24) and "I am responsible for the generation of waste" (M=4.20), further reinforce a strong sense of personal accountability. These results suggest that respondents possess both awareness and internalized responsibility toward waste management. This supports Liu et al. (2022), who found that strong pro-environmental attitudes are closely linked to sustained environmental behaviors.

However, the lowest mean was observed for "I am responsible for reminding other people on proper waste disposal" (M=4.09), although it was still interpreted as practiced, indicating relatively lower engagement in influencing others. This suggests that while respondents are personally committed, they are less inclined to enforce or promote proper practices within their social circles. Such reluctance may be influenced by social and cultural factors, particularly the avoidance of interpersonal conflict. This aligns with Steentjes et al. (2017), who identified social norms and fear of negative social consequences as barriers to engaging others in pro-environmental actions.

The gap between high personal concern (M=4.45) and lower peer enforcement (M=4.09) highlights a behavioral disconnect between individual responsibility and collective action. This indicates that while respondents are environmentally conscious, social dynamics may limit their willingness to promote proper waste practices among others actively. In the Philippine context, cultural values such as hiya and pakikisama may further explain this hesitation, reinforcing indirect rather than confrontational approaches. These findings suggest that strengthening community-based and norm-focused interventions, as emphasized by the Environmental Management Bureau (2020), can help bridge this gap and enhance collective compliance with Republic Act 9003.

**Table 9**

*Distribution of Respondents in terms of Behavior*

| | Statements | Mean | Description | Interpretation |
|---|---|---|---|---|
| 1 | I segregate my household waste into biodegradable, recyclable, and residual | 4.29 | Always | Highly Practiced |
| 2 | I make sure to rinse recyclables before disposal to avoid contamination | 4.20 | Often | Practiced |
| 3 | I participate in community clean-up and waste segregation programs | 4.23 | Often | Practiced |
| 4 | I educate my family members to practice proper waste segregation | 4.12 | Often | Practiced |
| 5 | I use color-coded waste bins for different types of waste | 4.15 | Often | Practiced |

| | | | | |
|---|---|---|---|---|
| 6 | I reduce waste generation by avoiding single-use plastics | 4.13 | Often | Practiced |
| 7 | I compost biodegradable waste whenever possible | 4.19 | Often | Practiced |
| 8 | I avoid mixing hazardous or special waste with my household waste | 4.04 | Often | Practiced |
| 9 | I dispose of segregated waste on scheduled collection days | 4.07 | Often | Practiced |
| 10 | I motivate others in my community to practice waste segregation | 4.22 | Often | Practiced |
| | **Overall Mean** | **4.16** | **Often** | **Practiced** |

*Legend: Never: 1.00-1.80, Seldom: 1.81-2.61, Sometimes: 2.62-4.23, Often: 3.43-4.23, Always: 4.24-5.00*

Table 9 presents the extent of waste segregation in terms of behavior, with an overall mean of 4.16 (Often), indicating that respondents generally practice consistent waste management actions. The highest mean was observed in "I segregate my household waste into biodegradable, recyclable, and residual" (M=4.29), suggesting that source separation is already an established routine among households. This reflects strong compliance with Republic Act 9003, which mandates waste segregation at source, and indicates that such practices have become habitual through continuous community exposure. Yusof et al. (2014) support this, explaining that repeated environmental actions can develop into automatic habits over time.

Other behavioral indicators, such as rinsing recyclables (M=4.20), participating in community programs (M=4.23), and composting biodegradable waste (M=4.19), are all interpreted as practiced, showing that respondents actively engage in multiple waste management strategies. Similarly, behaviors like using color-coded bins (M=4.15) and reducing single-use plastics (M=4.13) indicate awareness translated into daily action. These findings suggest that both household-level and community-level practices are well integrated into respondents' routines. This aligns with the Philippine Statistics Authority (2023), which emphasized that consistent community engagement and accessible systems significantly improve segregation behaviors.

However, the lowest mean was recorded in "I avoid mixing hazardous or special waste with my household waste" (M=4.04), indicating a relative gap in handling specialized waste types. This suggests that respondents may lack sufficient knowledge or access to proper disposal systems for hazardous materials such as batteries or e-waste. Infrastructure limitations and unclear guidelines may contribute to this inconsistency, leading to improper disposal practices. This is supported by Yusof et al. (2014), who identified knowledge gaps and limited facilities as key barriers to effective waste segregation.

Overall, the results indicate that while general waste segregation behaviors are well practiced, specific areas such as hazardous waste management require improvement. The high level of participation in routine practices demonstrates the effectiveness of existing policies and programs under RA 9003. However, addressing identified gaps through clearer guidelines, improved facilities, and targeted education can further enhance behavioral compliance. Strengthening these aspects will help local governments sustain progress, reduce environmental risks, and improve overall waste management outcomes.

**Table 10**

*Distribution of Respondents in terms of Practices*

| | Statements | Mean | Description | Interpretation |
|---|---|---|---|---|
| 1 | Control of waste in our house is done on a regular basis | 4.26 | Always | Highly Practiced |
| 2 | Separation of waste at household is ensured to help in waste management of the municipality | 4.16 | Often | Practiced |
| 3 | Waste collection method observed in the municipality | 4.22 | Often | Practiced |
| 4 | At home, I separate the waste of plastic, paper, glass, etc. before their disposal | 4.28 | Always | Highly Practiced |
| 5 | I dispose solid waste everywhere | 4.03 | Often | Practiced |
| 6 | I burn unsegregated solid wastes | 4.02 | Often | Practiced |
| 7 | I burry unsegregated solid wastes | 3.97 | Often | Practiced |
| 8 | I participate in programs regarding solid wastes | 4.13 | Often | Practiced |
| 9 | I volunteer or join in activity, like clean up | 4.34 | Always | Highly Practiced |
| 10 | I obey the laws covering waste management | 4.78 | Always | Highly Practiced |
| | **Overall Mean** | **4.21** | **Often** | **Practiced** |

*Legend: Never: 1.00-1.80, Seldom: 1.81-2.61, Sometimes: 2.62-4.23, Often: 3.43-4.23, Always: 4.24-5.00*

Table 10 presents the respondents' waste segregation practices, with an overall mean of 4.21 (Often), indicating a generally consistent application of proper waste management practices. The highest mean was recorded in "I obey the laws covering waste management" (M=4.78), reflecting very strong compliance with existing regulations such as Republic Act 9003. This suggests that respondents have internalized legal requirements, likely influenced by barangay enforcement, monitoring, and community-based programs. Lalamonan and Comighud (2020) support this, noting that combined efforts of household training, school initiatives, and local government reinforcement often drive high compliance.

Other highly practiced behaviors include "I volunteer or join in activities like clean-up" (M=4.34) and "At home, I separate waste before disposal" (M=4.28), indicating active participation in both household and community-level waste management. Practices such as regular waste control (M=4.26) and the practice of segregation (M=4.16) further demonstrate that proper waste handling is embedded in daily routines. These results suggest that respondents not only comply with policies but also actively engage in sustainability efforts. This aligns with Lalamonan and Comighud (2020), who emphasized that sustained practices are strengthened through awareness, participation, and supportive local systems.

However, the lowest means were observed for "I bury unsegregated solid wastes" (M=3.97) and "I burn unsegregated solid wastes" (M=4.02), although they are still considered practiced, indicating the persistence of improper disposal methods. These behaviors suggest that some respondents may resort to convenient but environmentally harmful practices, possibly due to limited access to proper facilities or inconsistent waste collection. Ong and Madlas (2021) identified similar issues in Philippine communities, where burning and burying remain common due to infrastructure and awareness gaps. This indicates that, despite strong compliance, certain traditional or convenience-based practices persist.

Overall, the findings show that while waste segregation practices are generally well established and supported by policy compliance, specific gaps remain in the proper disposal of waste. The high level of compliance with waste management laws reflects the effectiveness of RA 9003's implementation, yet the

presence of burning and burying practices highlights areas for improvement. Strengthening infrastructure, such as Materials Recovery Facilities, and enforcing anti-burning regulations can address these gaps. As emphasized by the Department of Environment and Natural Resources (2022), improving facilities and enforcement are essential to achieving sustainable, environmentally sound waste management.

Table 11 presents an overall summary of waste segregation in terms of attitude, behavior, and practices, with a total mean of 4.20 (Often), indicating a consistently high level of engagement among respondents. Among the dimensions, attitude had the highest mean (M=4.24), followed by practices (M=4.21) and behavior (M=4.16), indicating that respondents have strong positive perceptions that support their waste management actions. This suggests that awareness and personal responsibility are well established, serving as a foundation for consistent environmental behavior. This finding aligns with Liu et al. (2022), who emphasized that strong pro-environmental attitudes significantly influence behavioral intentions and actual practices.

Behavior, although slightly lower than the other dimensions, still reflects practiced engagement, indicating that respondents can translate their attitudes into actual waste segregation activities. The relatively close mean values across all dimensions suggest a balanced relationship between what respondents believe, how they act, and what they routinely practice. This consistency implies that community waste management efforts are holistic and reinforced through both knowledge and action. This supports Yusof et al. (2014), who highlighted that repeated environmental behaviors become habitual when supported by positive attitudes and enabling conditions.

Practices also demonstrate a high level of implementation, reflecting compliance with waste management systems and participation in related activities. The alignment of practices, attitudes, and behaviors indicates that respondents are not only aware but also actively engaged in proper waste handling. This may be attributed to effective policy implementation and community-based programs under Republic Act 9003. Lalamonan and Comighud (2020) noted that integrated efforts from local governments, schools, and households contribute to sustained waste management practices.

Overall, the findings indicate that respondents exhibit a coherent pattern of attitudes, behaviors, and practices regarding waste segregation, with all dimensions consistently reported as practiced. This suggests that waste management awareness is not only present but is actively translated into daily actions. The close alignment among the three dimensions reflects the effectiveness of community education and policy enforcement in promoting environmental responsibility. Strengthening these existing efforts can further enhance compliance and support long-term sustainability goals in line with national waste management frameworks.

**Problem 4. Is there a significant difference in the extent of waste segregation practices when they are grouped**

**Table 12**

*Extent of Waste Segregation Practices and Demographic Profile*

| Profile | Variable | F-value | P-value | Decision | Conclusion |
|---|---|---|---|---|---|
| Age | Knowledge | 0.364 | 0.833 | Accepted $H_0$ | Not Significant |
| | Attitude | 5.249 | 0.001 | Rejected $H_0$ | Significant |
| | Behavior | 6.813 | <.001 | Rejected $H_0$ | Significant |
| | Practices | 3.358 | 0.016 | Rejected $H_0$ | Significant |
| Sex | Knowledge | -1.072 | 0.285 | Accepted $H_0$ | Not Significant |
| | Attitude | 0.762 | 0.447 | Accepted $H_0$ | Not Significant |
| | Behavior | 0.654 | 0.514 | Accepted $H_0$ | Not Significant |
| | Practices | 0.422 | 0.673 | Accepted $H_0$ | Not Significant |
| Educational Attainment | Knowledge | 0.777 | 0.463 | Accepted $H_0$ | Not Significant |
| | Attitude | 7.866 | <.001 | Rejected $H_0$ | Significant |
| | Behavior | 4.935 | 0.010 | Rejected $H_0$ | Significant |
| | Practices | 4.063 | 0.021 | Rejected $H_0$ | Significant |
| Number of Member in the Family | Knowledge | 0.777 | 0.887 | Accepted $H_0$ | Not Significant |
| | Attitude | 7.866 | 0.826 | Accepted $H_0$ | Not Significant |
| | Behavior | 4.935 | 0.719 | Accepted $H_0$ | Not Significant |
| | Practices | 4.063 | 0.378 | Accepted $H_0$ | Not Significant |
| Length of Residency | Knowledge | 2.600 | 0.110 | Accepted $H_0$ | Not Significant |
| | Attitude | 0.592 | 0.636 | Accepted $H_0$ | Not Significant |
| | Behavior | 5.294 | 0.018 | Rejected $H_0$ | Significant |
| | Practices | 0.171 | 0.913 | Accepted $H_0$ | Not Significant |

*Legend: * p<.05, ** p> .01, *** p<.001*

Table 12 displays the test of the Difference between the extent of Waste Segregation and the profile variables. The results show that age significantly influences attitude (F=5.249, p=0.001), behavior (F=6.813, p<0.001), and practices (F=3.358, p=0.016), with behavior showing the highest F-value, indicating greater variation in actual waste segregation across age groups. This suggests that older individuals demonstrate better compliance due to accumulated experience and habitual environmental practices. In contrast, knowledge (F=0.364, p=0.833) is not significant, indicating uniform awareness across ages due to widespread dissemination of waste management information. This finding supports Pan et al. (2024), who emphasized age-related behavioral differences, and Fernando et al. (2022), who noted consistent knowledge levels across demographic groups in the Philippines.

Sex does not significantly influence waste segregation across all variables, as reflected in knowledge (t = -1.072, p = 0.285), attitude (t = 0.762, p = 0.447), behavior (t = 0.654, p = 0.514), and practices (t = 0.422, p = 0.673). The low absolute t-values indicate minimal variation between males and females, suggesting that waste segregation behaviors are gender-neutral. This implies that both sexes are equally exposed to environmental education and community practices, leading to similar levels of compliance. These results align with Addas et al. (2023) and Fernando et al. (2022), who reported that gender differences in waste management are often insignificant due to inclusive policies and shared community norms.

Educational attainment shows significant differences in attitude ($F=7.866$, $p<0.001$), behavior ($F=4.935$, $p=0.010$), and practices ($F=4.063$, $p=0.021$), with attitude having the highest F-value, indicating that education strongly shapes environmental perspectives and actions. However, knowledge ($F=0.777$, $p=0.463$) remains non-significant, suggesting that basic awareness is evenly distributed across educational levels. This implies that while information is accessible to all, higher education enhances critical thinking and strengthens the application of pro-environmental behaviors. This finding is supported by González-Herrera et al. (2022), who highlighted the role of education in fostering environmental responsibility through deeper understanding and cognitive development.

The number of family members does not significantly affect knowledge ($F=0.777$, $p=0.887$), attitude ($F=7.866$, $p=0.826$), behavior ($F=4.935$, $p=0.719$), or practices ($F=4.063$, $p=0.378$), indicating that household size has minimal influence on waste segregation. Although some variation is observed in behavior and practices, the high p-values suggest that these differences are not statistically meaningful. This implies that waste segregation is more influenced by individual attitudes and environmental awareness rather than household composition. This finding is consistent with Addas et al. (2023), who emphasized that psychological and behavioral factors outweigh demographic variables such as family size.

Residency length significantly affects behavior ($F=5.294$, $p=0.018$), indicating that longer-term residents are more likely to practice proper waste segregation due to familiarity with local systems and community norms. However, knowledge ($F=2.600$, $p=0.110$), attitude ($F=0.592$, $p=0.636$), and practices ($F=0.171$, $p=0.913$) are not significant, suggesting uniformity in awareness and execution across residency durations. This pattern implies that while systems and policies ensure consistent practices, behavioral adoption improves with prolonged exposure. This finding supports Guo et al. (2022), who noted that longer residency strengthens environmental behavior through place attachment and social integration.

**Problem 5. Based on the findings of the study, what intervention program may be proposed?**

**Rationale.** The proposed intervention program addresses critical gaps identified in the study through a coordinated approach combining education, infrastructure development, enforcement, community engagement, and monitoring. The Awareness and Education Campaign targets knowledge deficiencies in plastic preparation and color-coded bin identification, ensuring residents gain the understanding needed for effective segregation. The Waste Segregation Infrastructure component removes physical barriers by providing accessible bins and establishing Material Recovery Facilities. At the same time, the Incentives and Enforcement strategy bridges the gap between high attitudes (4.24) and behaviors (4.29) and the 2% actual compliance rate through positive reinforcement and ordinance enforcement. The Community Participation mechanism leverages peer influence to support newer residents and those with lower educational attainment, and the Monitoring and Evaluation component employs surveys and waste audits to address persistent practices such as burning (4.02) and burying (3.97), enabling continuous program improvement.

| Findings | Activities | Objectives | Time Frame | Person involved | Fund Source | Expected Outcomes |
|---|---|---|---|---|---|---|
| Awareness and Education Campaign (43% lack knowledge on preparing plastics for recycling; 57% cannot identify recyclable bin colors) | Community seminars and workshops<br><br>Distribution of flyers and posters<br><br>Use of local media for messages | Increase knowledge and positive attitudes toward waste segregation | All Year Round | Local government units, NGOs, community leaders | LGU Environmental Office / DENR; The Researchers | 85% demonstrate proper segregation knowledge |
| Waste Segregation Infrastructure (Waste scattered in covered courts, streets, and homes; no infrastructure for proper segregation) | Distribution of color-coded bins Establish Material Recovery Facilities (MRFs) in barangay | Facilitate ease of segregating waste at source | All Year Round | City waste management office | City Government / DILG; The Researchers | 85% have access to bins and MRFs |
| Incentives and Enforcement (2% compliance despite high attitudes (4.24) and behaviors (4.29); gap between intention and action) | Incentive programs for households with good practices-<br><br>Monitoring and enforcement of local ordinances | Encourage consistent segregation behavior | All Year Round | Barangay officials, City enforcers | Barangay LGU / City Government; The Researchers | 85% compliance; 50% fewer violations |
| Community Participation and Feedback | Regular community meetings | Enhance ownership and | All Year Round | Community leaders, LGU | Barangay Council / NGOs; The | 85% active participation across all groups |

| | | | | | | |
|---|---|---|---|---|---|---|
| (77% long-term residents show stronger practices; newer residents and lower education need support) | Feedback channels (hotlines, suggestion boxes) | continuous improvement | | | Researchers | |
| Monitoring and Evaluation (High law compliance (4.78) but improper disposal persists: burning (4.02) and burying (3.97) waste) | Household surveys<br><br>Waste audits<br><br>Reporting to stakeholders | Measure effectiveness and identify areas for improvement | All Year Round | The Researchers LGU | Research Team / LGU / DENR; The Researchers | 85% reduction in burning/burying; Quarterly progress reports |

## Conclusions

Based on the findings of the study, the following conclusions are drawn:

1. Barangay Tungao is characterized by a stable, mature, and predominantly long-term community, with an established demographic profile that provides a strong foundation for implementing and sustaining effective waste management programs.
2. While most residents possess a generally strong understanding of waste segregation, critical knowledge gaps remain in specific technical areas, particularly in bin color identification and proper plastic preparation, which must be addressed through focused educational interventions.
3. Residents of Barangay Tungao have developed a strong cultural foundation of environmental responsibility, consistently demonstrating high levels of positive attitudes, behaviors, and practices toward waste segregation, which must be continuously reinforced.
4. Educational attainment, age, and length of residency are significant determinants of waste segregation performance. At the same time, sex and household size show no meaningful influence, underscoring the need for targeted rather than uniform intervention approaches.
5. A comprehensive, integrated intervention program that combines education, infrastructure development, enforcement, community participation, and monitoring is essential to eliminate improper disposal practices and ensure the long-term environmental health of Barangay Tungao.

## Recommendations

Based on the given findings and conclusions, the following recommendations are made.

**Local Government Units (LGUs).** They can provide technical and infrastructural support by ensuring the availability of waste segregation facilities, upgrading dumpsites, and closely monitoring compliance with ecological solid waste management laws. Capacity-building initiatives for community leaders and integrative programs that address the needs of varied demographic groups are recommended.

**Non-Government Organizations (NGOs).** They can design targeted programs to address identified knowledge gaps in bin color identification and plastic preparation for recycling, leveraging local champions among long-term residents to facilitate peer education. These organizations are recommended to collaborate with local government units to establish community monitoring groups, organize educational clean-up initiatives, and create accessible platforms for resident participation that complement government-led waste management interventions.

**Barangay Officials**. They shall implement and communicate clear sanctions for violations of waste segregation policies while fostering open dialogue and support programs to encourage compliance. This balanced approach will build accountability and community cooperation for a healthier living environment.

**Commercial Sectors.** They shall develop corporate social responsibility programs to support waste segregation infrastructure by providing color-coded bins for public spaces and sponsoring educational materials and community seminars. Commercial establishments are encouraged to implement internal segregation systems as demonstration models, offer customer incentives for proper waste-disposal practices, and establish partnerships with Material Recovery Facilities to create viable markets for recyclable materials, thereby promoting circular-economy initiatives beneficial to both business operations and community environmental health.

**Community Organizations.** They shall deliver targeted educational workshops and seminars focusing on identified knowledge gaps, especially for children and newly settled residents. Utilize schools and community centers as hubs for continuous environmental education and practice reinforcement.

**Waste Collectors**. They may optimize collection routes and schedules based on the community's segregation patterns identified in this study and provide specialized training for personnel to handle segregated waste properly, preventing contamination during transport. Service providers are encouraged to establish feedback mechanisms with households to reinforce correct segregation techniques and report areas requiring additional support, thereby strengthening the waste management chain from source to disposal.

**Future Researchers.** They can conduct longitudinal studies to evaluate the long-term effectiveness of intervention programs on waste segregation practices. Further research on the socio-cultural factors influencing behavior changes within similar communities is also encouraged to refine intervention designs and policymaking.

**Acknowledgments**

The successful completion of this research is thanks to the invaluable support, guidance, and expertise provided by many individuals. The researchers sincerely appreciate everyone who helped shape this study and inspired us toward academic excellence.

**Hipolito C. Rosolada Jr.**, the respected School Principal. The researchers express sincere gratitude for his outstanding leadership, guidance, and continuous support to students. His dedication to quality education and academic excellence inspired the successful completion of this research.

**Rodelio B. Pasion, PhDM.,** the Senior High School Assistant Principal. Heartfelt gratitude is extended for his unwavering support, encouragement, and guidance during the research. His suggestions and insights helped the researchers meet their expectations and strive for academic excellence.

**Chelsea Rose D. Tero,** sincere thanks are given for her support and valuable recommendations on

the research data, ensuring accuracy and clarity. Appreciation is also expressed for her patience in being approachable despite frequent consultations. Her motivational words helped complete the study.

**Robert T. Torres,** the researchers express their deepest gratitude for his invaluable insights, thoughtful recommendations, and constant guidance. His clear and meaningful responses, despite a busy schedule, greatly contributed to the study's organized and successful completion.

**Yumico M. Supangan** is appreciated for her support, patience, and constructive feedback, which strengthened the study. Her encouraging words and positivity inspired confidence and focus throughout the process.

**Bless A. Racho,** warm thanks are given for her guidance, constructive criticism, and motivation. Her dedication and attention to detail helped refine the research and elevate its quality.

**Menchie P. Azucenas,** the research adviser. The researchers are sincerely thankful for her patience, understanding, and continuous support throughout the study. Her guidance and wisdom served as a strong foundation for the successful completion of the research.

**Ivy B. Rivas,** warmest thanks are extended for her kindness and generosity in providing printing assistance and materials. Her meaningful support greatly contributed to the efficient completion of the study.

**The** researchers sincerely acknowledge Ronald B. Cadavez for his invaluable guidance, encouragement, and support throughout the study. His expertise, patience, and constructive feedback significantly strengthened the quality of the research and contributed to its successful completion.

**Don D. Atienza,** the researchers express sincere gratitude for his support and constructive feedback. His expertise was instrumental in completing the research.

## Declaration of Conflicting Interests

The authors declare no potential conflicts of interest with respect to the research, authorship and publication of this article.

## Funding

The author received no financial support for the research, authorship and publication of this article.

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