

Comprehensive analysis of ecological solid waste management strategies in Kalayaan, Laguna

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Abstract

This study explored the Ecological Solid Waste Management (ESWM) strategies of the Municipality of Kalayaan, Laguna, focusing on how both the local community and the government approach solid waste issues. It has used a descriptive research design, with a researcher-made questionnaire to gather data from 379 respondents/stakeholders. Descriptive and inferential statistics were used to analyze the data. Most of the people that answered were from Brgy. San Antonio. The majority of the respondents are aged between 41 and 50 years and most of the people who answered were women. Most of the people who answered the survey lived with 5 to 6 other people, and most of them lived fewer than 20 meters from garbage pick-up stations. Majority of the people who answered live in Kalayaan for more than nine years. The study also revealed that most of the participants completed high school, and the primary source of income was underemployment, with monthly earnings ranging from ten thousand to twenty thousand pesos, and weekly trash production between one and two kilos. Using test for difference, it came up with findings showing that while some progress has been made, there are still significant gaps—especially in waste segregation, enforcement, alternative technology, infrastructure, and public awareness. Limited funding, thus a problem of upgrading important facilities, and low public participation in recycling efforts were among the main issues identified. To address these challenges, the study proposes policy improvements focused on stricter enforcement, better community education, partnerships, and increased investment in sustainable waste management solutions.

Keywords: Alternative technology; ecological solid waste management; waste reduction; waste diversion

1. Introduction

Solid waste management is considered a pressing global issue calling for an immediate response from the government and its people. The Philippines has a continuously rising amount of waste and is expected to further increase in the succeeding years. As reviewed, associated problems with solid waste management in the country include an increasing amount of solid waste, weak law implementation, scarcity of sanitary landfills, and improper disposal. The ultimate solution existing in the country is the RA 9003 or the Ecological Solid Waste Management Act of 2000 which highlights the practices of segregation, proper disposal, and waste diversion (Coracero, E. *et al.* 2021) and Republic Act 11898 or the Extended Producers Act of 2022 is a law in the Philippines that holds companies responsible for the plastic packaging they use throughout the life of their products. The law was created to regulate the production, importation, and disposal of single-use plastics.

Solid waste management remains a major problem for the Philippines mostly due to the mismanagement of waste segregation at the local level (Sapulna, 2022). It is also a vital issue for environmental and human health, as increasing waste generation poses serious challenges to conventional methods of waste disposal. These methods are often associated with high costs, low efficiency, and negative impacts, such as greenhouse gas emissions, leachate, and odors. To address these challenges, emerging green

technologies have been developed to manage waste in a more effective and sustainable way, while reducing the environmental and social burdens of SWM.

Despite the enactment of the ESWM Act more than two decades ago, solid waste generation in the country steadily increased from 9.07 million metric tons in CY 2000 to 16.63 million metric tons in CY 2020. In 2023, the projected daily waste generation in the country reached 60,640 tons, indicating a rise from previous years. This problem worsened further due to the increased production of hazardous and infectious wastes caused by the COVID-19 pandemic. Due to this, stakeholders, including but not limited to legislators and non-governmental groups, have voiced the same concern and called for action regarding our increasing waste generation (COA, Performance Audit Report PAO 2023-01).

Many LGUs are seeking ways to manage the problems like introducing many technology-based solutions, such as Waste to Energy Concept among others. With continuous population growth, the problems on solid waste generation also are increasing.

Segregation plays a vital role in ensuring that the mandated waste diversion is achieved and that the landfills receive less waste than the actual waste generated. However, segregation was also a critical concern of LGUs, resulting in mixed waste collection, hazards to workers in landfills, and SLFs exceeding capacity levels (COA, Performance Audit Report PAO 2023-01).

Good and proper solid waste management reduces or eliminates impacts to the environment, human health and supports economic development leading to improved quality of life (Lettor, 2018).

1.1. Background of the Study

Key issues facing the Municipality are expensive operation and maintenance of the Category I Sanitary Landfill, compliance of the barangays to the Implementation of R.A. 9003 (Ecological Solid Waste Management Act of 2000), refusal to pay "Garbage Fee" by the community, public compliance to other SWM Ordinances and Policies, and waste segregation at sources / home. (10 Year SWP of Kalayaan 2014-2023).

In 2025, the projected population of the Municipality is 26,905 based on PSA 2020, a 1.68 percent average population growth rate, the Municipality's waste generation is 0.45 kilograms per capita waste generation based on 2023 WACS compared to results of WACS conducted in 2018, a per capita waste generation of 0.381 kilograms. (MENRO Kalayaan, 2024).

Based on Finance Committee of the LGU, the income from garbage collection is P1,095,648.05, with a P4,599,370.91 expenses on Environmental Management, which means Kalayaan Landfill operation is not income generating project.

Other program of the LGU is Waste Diversion, partnering with other agencies like Gardenia Philippines (Plastic collected to be turned to arm chairs for schools), CEMEX (Waste to Energy, Refuse Derived Fuel), Evergreen Labs Philippines (Manufacture of plastic boards and GNS Logistics (Recycling of Used Beverage Cartons and Tetrapak).

Currently, the LGU has 5 dump trucks used in garbage collections covering three barangays with a driver and 3 waste collectors per truck. They collect from Monday to Friday collecting bio-degradable and non bio-degradable waste. Landfill is also producing compost for sale and given for free to farmers and schools.

LGU is also conducting Information Education and Communication Campaign for ecological solid waste management, like IEC for schools, CSOs, Commercial Establishment and other sectors of the community. It also conduct weekly clean up drive.

Currently, the LGU has two Job Order Environmental Enforcer monitoring and enforcing national and local laws related to environment. The LGU now has a newly approved Ten-Year Solid Waste Management Plan (2024–2033), officially given by the NSWMC on April 29, 2025, to serve as a guide for the implementation of Ecological Solid Waste Management in the coming years.

Thus, the general purpose of this study was to examine the strategies of the LGU in the

implementation Ecological Solid Waste Management and the constituents' participation.

1.2. Theoretical Framework

The study is anchored on the Social Practices model for solid waste management by Spaargaren and van Vliet (2000). A social practices model for solid waste management emphasizes how social norms, behaviors, and interactions shape waste practices, advocating for community involvement and education to promote sustainable waste management.

The social practices model for solid waste management elucidates the ways of life households' and consumers' attitudes had an effect on how they stored things, how people keep waste in their homes, separation at the source is sorting rubbish into things that can and can't be broken down, collection is setting up the pickup or drop-off of waste at collection stations. Composting is households putting their organic waste in a compost pile. The implication is how people in a household act and think is highly crucial for starting to manage trash well. Also, in the systems of provision, providers must follow rules and use resources like infrastructure and services that help. Storage (bins, containers), separation (rules, training), collection (tools, schedules), composting (with incentives and places to do it) This means that citizens need help from institutions and systems of government to be able to take part. How the two places change each other, the middle actions (storage → separation → collection → composting) need people to make choices about how to live that work with the system. Make systems that will help and encourage healthy behavior. Finally the enabling environment (Bottom Box), this is the final effect of how people in a household act and how the system helps them. An atmosphere where policies support long-term behaviors. People who live in homes are well-informed and driven. It's easy to access to systems, they perform effectively, and they reply promptly.

A study by Dela Cruz, M. A. (2020) used this theoretical framework that investigates the household solid waste management (SWM) practices in Quezon City, focusing on residents' behavior, level of participation, and the support mechanisms provided by the local government. The analysis aligns closely with the Lifestyles and Systems of Provision Framework, highlighting the dynamic interaction between household practices and institutional structures.

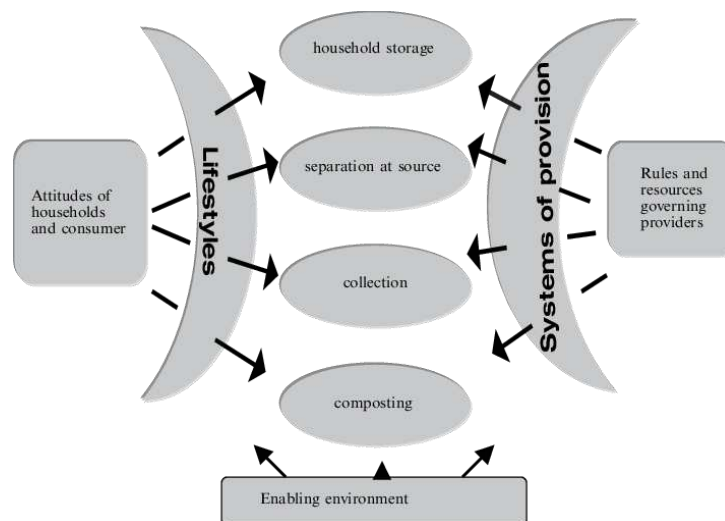


Figure 1. Theoretical Framework

1.3. Conceptual Framework

The conceptual framework for this study integrates key environmental, social, economic, and policy-related factors that influence the effectiveness of solid waste management practices.

Figure 2 illustrated the paradigm of the study where the demographic profile served as the Independent Variables. These include residence of the respondent, age, sex, household size and proximity to roads/garbage pick-up point, length of stay, education, source of income, monthly income and estimated waste generation of household. The Dependent Variables include waste management strategies and extent of implementation and challenges in terms of Ecological, Economic and Social.

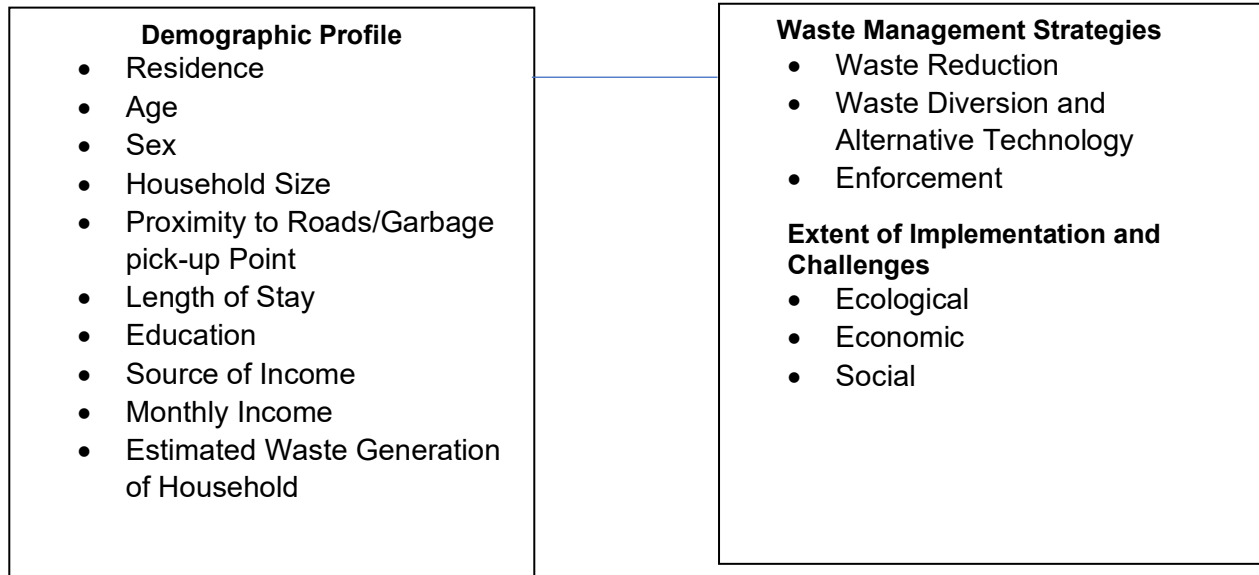


Figure 2. Conceptual Framework

1.4. Statement of the Problem

This study aimed to analyze the Ecological Solid Waste Management Strategies in Kalayaan, Laguna.

Specifically, it sought to answer the following questions:

1. What is the socio-economic and demographic profile of the respondents in terms of;
 - 1.1 place of residence;
 - 1.2 age;
 - 1.3 Sex;
 - 1.4 household size;
 - 1.5 proximity to roads/ garbage pick-up points;
 - 1.6 length of stay in Kalayaan;
 - 1.7 educational attainment;
 - 1.8 sources of income;
 - 1.9 estimated gross family monthly income; and
 - 1.10 estimated weekly solid waste generation by household.

2. What are the current strategies of the LGU on Ecological Solid Waste Management in terms of
 - 2.1 Waste Reduction,
 - 2.2 Waste Diversion and Alternative Technology, and
 - 2.3 Enforcement?
3. To what extent of implementation of Ecological Solid Waste of in terms of
 - 3.1 Ecological,
 - 3.2 Economic, and
 - 3.3 Social?
4. Is there a significant difference on the current Strategies of the LGU on Ecological Solid Waste Management when group according to profile?
5. Is there a significant difference in the extent of implementation of Ecological Solid Waste Management in terms of Ecological, Economic and Social when respondents are grouped according to their profile?
6. What challenges do the LGU encounters in implementing Ecological Solid Waste Management program?
7. What policy enhancement may be proposed to meet the challenges in implementation of Ecological Solid Waste Management.

1.5. Hypotheses

Ho 1. There is a no significant difference on the current strategies of the LGU on Ecological Solid Waste Management when group according to profile.

Ho 2. There is no significant difference in the extent of implementation of Ecological Solid Waste Management in terms of Ecological, Economic and Social when respondents are group according to their profile.

1.6. Significance of the Study

The researcher believed that the results of the study would be of great help to the following stakeholders:

Barangay officials. Findings from this study will help the barangay officials create and implement waste segregation programs leading to better waste management practices within their jurisdiction.

Community residents. Result from this study will benefit and improved public health and a cleaner environment, as well as a better understanding of how their own actions impact waste management. Proper waste management can prevent flooding, reduce garbage disposal issues, and contribute to a healthier environment.

Local governments. Findings from this study will inform the LGU the development of effective and sustainable waste management plans, which are essential for public health and environmental protection.

Businesses. The findings of this research aim to foster collaboration with the LGU in promoting resource efficiency and waste reduction, which can help businesses lower operational costs, lessen their environmental footprint, and unlock potential revenue opportunities through recycling and reuse initiatives.

Environmental organizations. Finding from this study provides the data and evidence needed to advocate for policies and practices that protect the environment.

Future Researchers. The result of the study will serve as a foundation for further studies and innovation in waste management.

1.7. Definition of Terms

The following terminologies found in this study were defined operationally.

Residence. Residence refers to a place where someone lives permanently or for a significant period.

Age. Age is the length of time that a person or thing has existed.

Educational Background. Refers to the highest level of formal education an individual has completed.

Estimated Weekly Household Solid Waste Generation. This refers to weekly volume of waste generated at the household level.

Gross Family Monthly Income. Monthly family income refers to the total amount of money earned by all members of a family or household from all sources such as salaries and business earnings.

Household Size. Refers to the total number of people living together in a single dwelling unit.

Length of Stay. Length of stay refers to the amount of time an individual or household has lived in Kalayaan, Laguna.

Place of Residence. Which Barangay in Kalayaan, Laguna the respondents reside.

Sex. Refers to the biological classification of individuals as male or female.

Solid Waste. Solid waste is any discarded material that is solid.

Ecological Solid Waste Management. Ecological Solid Waste Management refers to the systematic, environmentally responsible handling of solid waste, guided by ecological principles. It emphasizes reducing waste generation, reusing and recycling materials, composting organic waste, and disposing of residuals in a way that minimizes environmental impact.

Waste segregation. This describes the process of separating different types of waste materials into different categories for easier and more efficient handling, processing, and disposal.

Waste reduction. Refers to strategy focused on minimizing the amount of waste generated.

Scope and Limitations

This study's respondents considered residents from Barangays San Juan, San Antonio and Longos in the Municipality of Kalayaan, Laguna.

Since the data gathering utilized google forms for questionnaire, those without computers or cellular phone were not able to participate in the survey.

1.8. Review of Related Literature

This chapter presented the literature relevant to the current study's premise. It also included several studies and materials from various sources to provide adequate background and information for the success of this study.

Global solid waste management faces immense challenges due to rapid urbanization, population growth, and unsustainable consumption. Annual municipal solid waste generation is in the billions of tons globally, with projections showing a dramatic increase by 2050. Many regions, particularly in developing countries, lack adequate infrastructure (collection, processing, and sanitary landfills), resulting in open dumping, soil and water contamination, disease outbreaks, and air pollution.

In the Philippines, ecological solid waste management is hampered by insufficient infrastructure, weak enforcement of Republic Act No. 9003 (Ecological Solid Waste Management Act of 2000), and low public awareness. Inadequate collection and disposal, especially in rural areas, lead to illegal dumping and burning. Weak enforcement and lack of awareness hinder waste segregation, recycling, and proper disposal, further exacerbated by insufficient funding.

A study on urban versus rural residence, it was found out that it affects waste generation rates and patterns. UN-Habitat (2022) reported that urban populations produce significantly more municipal solid waste due to higher consumption of convenience products and limited space for composting or reuse. Demographic

factors such as age and gender intersect with these dynamics, influencing attitudes and behaviors toward waste disposal.

A study in 2022 shows that age was also a determinant factor in waste management practices in other studies with aging and married respondents, this could be highly related to the increasing sense of responsibility towards the environment and the importance of increasing the quality of life among household members. (Fadhullah, W. 2022)

Critical social reference groups of middle-aged adults, namely, the relation with the family or the inspiration, particularly, children, and/or refocusing the health condition of the entire family influenced their intention to behave in a more eco-friendly system (Taye. A. 2024).

An evaluation of the knowledge, attitude and practice (KAP) toward SWM of families in the Suyac Island, Sagay, Negros Occidental. The results indicated that, respondents who had low amount of education and older respondents produced high volumes of waste. Although the level of skills in SWM principles was significantly high, it was necessary to enhance the practices in the collection, storing, and dumping of wastes Tecson et al. (2024).

Also, Arga et al. (2024) examined the inclusion of the 3Rs (Reduce, Reuse, Recycle) in SWM in Sabang, Calabanga, Camarines Sur based on demographic, and psychographic factors. The outcome of the research, despite the positive feedback of the residents of all ages towards the waste management projects, there have been very few practical actions towards the sustainable methods, such as purchasing recycled products or composting. The analysis indicated that outreach and educational measures should be developed and applied in areas, which are specifically directed to the needs of the members of different demographic groups.

An economic survey to determine the awareness and practices applied on solid waste management in Mati City among the coastal barangays, adults of 35 and 44 years of age were more aware, possibly due to their ethnicity during this period of life where they have certain commitments in their families and in the society. In the research paper, there was a candid belief that a challenge of changing behaviors associated with SWM existed by stating how improved behaviors could not always be associated with increased awareness (Verzosa et al., 2024).

Going by the research of Castilla et al. (2024), it was determined that the waste disposal practices, attitudes, and knowledge around Brgy. Poblacion, Compostela, Cebu though the study did not particularly dwell on the age issue, it implied on how significant it is to understand the demographic factors in order to better manage the wastes and produce sustainable projects that are region specific.

Moreover, Jeremias and Fellizar (2020) examined the correlation between sociodemographic characteristics and solid waste management behavior in some barangays in the city. The study established that the practices of solid waste management had a significant correlation with age and size of households. This implies that the elderly and the families with many members may not manage the waste the way the lesser aged or smaller families do.

It was discovered that employment and gender were influencing factors that had a significant influence in the successfulness of compliance by a person with household waste disposal laws. Specifically, women were more compliant with the reuse and segregation whereas, men with disposal. The age of a person was also identified to significantly affect the reuse compliance one would have. These results indicate the importance of considering such demographic peculiarities during the development and implementation of interventions and campaigns to ensure that they are narrow and allow increasing the degree of compliance with the household waste disposal procedures by every household. Araune, P. et al., 2024).

Besides, as it was discovered in the research of Alimoradiyan et al. (2022), in the field of composting activities, gender plays an important role. Specifically, the paper discussed the socioeconomic determinants of the community involvement in the municipal solid waste management system and was conducted in the Tehran city in August 2022. This particular research was geared towards determining the effects of social economic features among citizens on their beliefs and actions towards composting, recycling and sorting of

waste. In the study, a sample size of 664 was used in face to face interviews employing a questionnaire. The survey was a combination of both qualitative and quantitative analysis of the waste management behaviour of the citizens. The study revealed that women had higher chances of engaging in composting related activities three times more than the men did. The results of the research particularly indicated that besides the use of composting, gender played an important role towards the implementation of 3Rs (Reduce, Reuse, Recycle). What was particularly observed was that, women excelled in waste management. This may imply that women were more enlightened or willing to assume controlling positions on issues relating to practices of sustainability.

Furthermore, recent findings indicate that sex-based behavioral differences influence the quantity and type of waste generated. Chintan Environmental Research and Action Group (2021) says that women are more likely to separate their trash and compost it, especially at home, because they are traditionally responsible for managing the household. Men, on the other hand, are less likely to be involved in getting rid of household waste, but they may be more involved in getting rid of waste from businesses or outside the home.

In a study of Treyes, A *et al.* (2023), findings reveal the significant contribution of women in household waste management responsibilities, highlighting their active participation in SWM initiatives. Analysis of short-term and long-term committed and accomplished actions demonstrated the willingness of the households to adopt sustainable waste management practices.

In one of the studies in India, Yadav and Pathak (2021) found that men and women express different consumption habits and therefore produce different waste materials. It is likely that women will become producers of organic and packaging waste since they prepare dishes and purchase or order goods. Men on the other hand had the tendency of producing more e-waste and non-biodegradable waste; this type of waste is usually attributed to personal gadgets and outdoor events.

According to a study conducted by Sarkodie and Owusu (2020), the researchers are able to find out that women are more conscious of the environment and are more willing to participate in recycling and sustainable waste management schemes. This trend is related to worldwide statistics that house-hold level environmental stewardship that is more in women where systemic factors often prevent equal engagement of women in formal methods of waste management.

Liu *et al.* (2021) highlighted that in the conditions of the COVID-19 pandemic, the trend in waste was altered, and a disproportionately high vulnerability of women to the increase in household waste due to the lockdown and home care responsibilities was observed. This highlights why gender-responsive waste policies should be rolled out, especially during a crisis.

In one case study conducted by Cimene *et al.* (2024) at the University of Science and Technology of Southern Philippines (USTP) system, the person (women) who responded to the survey knew and had better views towards management of solid waste as compared to men who responded to the survey. However, no major distinction was noted in their real practices implying that whilst the awareness and attitudes might differ with sex, they do not necessarily imply different behaviors.

Likewise, Cruzada Jr. and Benedictos (2022) conducted a study evaluating the participation of rural women in solid waste management practices in Laguna. The results showed that women were actively involved in separating and recycling waste because they were homemakers. The study stressed how important it is to include gender perspectives in efforts to fight climate change.

The World Wide Fund for Nature (WWF) Philippines, in partnership with the University of the Philippines Center for Women and Gender Studies, conducted a study in Barugo, Leyte, indicating that women are anticipated to assume greater responsibilities in waste reduction, segregation, and recycling. The study supports equal roles in waste management and the need for policies that include everyone. The size and makeup of a household affect how much and what kind of waste it makes. Wang *et al.* (2021) discovered that those households with more occupants are more likely to dispose of food, whereas small-size households in urban areas are more likely to discard single-use and packed products. Also, children or elderly persons could

influence the waste products (e.g. diapers, medical waste).

In a study by Jeremias and Fellizar (2020) an experiment was conducted to find out the socio-demographic factors that lead to a relationship between the population and solid waste management activity in urban barangays of Sorsogon City. The findings indicated that individuals were of the not-in-my-backyard (NIMBY) thinking which means they did not want to have the material recovery facilities and the waste collection points near their residences. As I can see, this perception influenced the manner in which they disposed their trash and this explains the need to consider the proximity of waste management facilities when planning and locating them.

Furthermore, Castilla et al. (2024) studied waste disposal-related knowledge, attitudes, and practices of Barangay Poblacion. The study was not based on particular analysis of the proximity to garbage collection points but highlighted the importance of understanding the demographical conditions to enhance waste disposal and design sustainable efforts that support the local challenges. The paper notes that the availability of technology related to waste disposal sites can influence how the residents handle the waste.

Besides, to assess the state of awareness and practices concerning solid waste management (SWM) Verzosa et al. (2024) conducted a study in coastal barangays of Mati City. In the research, the authors underlined that the level of awareness of SWM and its implementation is considerably influenced by socio-demographic variables, among which a time of living is the most significant. Though the study did not specifically look into the proximity of individuals to garbage collection points, it has indicated the relationship between proximity to garbage collection points, familiarity with the local waste management system, and the receptiveness of the residents to their local waste management structure.

Recent studies have shown that a greater distance to a collection point is associated with an added likelihood that the residents may not properly get rid of their waste. According to what Rana et al. (2021) stated, Dhaka residents in Bangladesh had a higher risk of burning or discarding their garbage illegally when they lived further than required concerning where the formally designated waste containers or stations were. The seemingly major reason is the convenience of separating trash and throwing away on time.

According to the study conducted by Alam and Ahmade (2020), it was observed that individuals with more than 100 meters between their residence and the trash cans keep the trash longer at home, increasing health and pest issues. This transport time lag in disposal because of distance may also lead to an increase in the accumulation of waste over a certain period, however, it does not indicate necessarily that more wastage is being generated per capita.

In accordance with the report of the research carried out by Otieno and Omondi (2022), an association between distance to waste collection infrastructure and the frequency of occurrence of illegal dumping was found in informal settlements of the Kenyan population. Residents claimed that they disposed of their wastes in open areas since transferring it a long distance was difficult and collection machinery was not always available.

In addition to this, Mwangi et al. (2023) examined how urban planning and spatial distribution of the location of waste collection spots impacts the behaviour towards household waste management among households in Nairobi. According to their study, locating waste disposal points near residential areas (at a distance more than 50 meters but less than 300 meters) drastically increases the chances of people engaging in appropriate means of disposing of it.

According to a study carried out by Bello and Yakubu (2020), the distance to waste collection sites has a greater impact on women, who are more suggestible to be responsible on the task of managing household wastage. Long distances make it hard to take out the trash often, especially when women have to do other household chores and can't move around easily because of safety or cultural reasons.

A study on upland Benguet, Philippines by Lunag and Elauria (2021), it focused on the generation of biodegradable waste among households. The results showed that households with 3 to 9 members produced biowaste per person ranging from 0.04 to 0.31 kg/day, with a weighted average of 0.1122 kg/day. A household with five people made an average of 0.55 kg of biowaste every day, which is interesting. The

research revealed that the more persons living in a household, the more household waste generated by the entire household increased. Nevertheless, the number of waste per household member reduced.

Jeremias and Fellizar (2021) conducted a study that revealed that the size of a household was considerably associated with the household waste management practices in the selected urban barangays of the city of Sorsogon.

Higher income earned households were more prone to segregate their wastes and sell the recyclable wastes since they had the desire to keep their homes clean and earn some additional income. But at least people continued to do things such as burning dried leaves and dumping trash in rivers. The research also emphasized on the need to improve information, education and communication programs to improve solid waste management practices among households of different size. Mahyari *et al.* (2021) conducted research on the effects of the COVID-19 pandemic on solid waste production in Serdang, Malaysia. The study found that family size significantly influenced domestic waste generation. Specifically, as family size increased, the per capita production of waste gradually declined. This aligns with previous studies indicating that smaller families produce more per capita waste than larger household.

A study focusing on Barangay Atate, Palayan City, Nueva Ecija, Philippines, examined the relationship between household size and waste generation. The study found that 65% of respondents had 4 to 6 household members, and larger households tended to produce more waste overall. The study concluded that larger household sizes drive higher consumption, which in turn influences waste generation patterns Ulloa, P. *et. al.* (2023).

A study estimating households' willingness to pay for improved SWM in Butuan City included an analysis of household size. The average household size was reported as 5.15 members. While the study primarily focused on economic aspects, it acknowledged that larger households might have different waste generation patterns and financial capacities, influencing their willingness to invest in better waste management services.

A study found that increased time at home during the pandemic, combined with larger household sizes, led to an increase in total household waste. However, per capita waste tended to normalize as people returned to work post-lockdowns (Singh, J. *et. al.* 2020).

Similarly, United Nations Environment Programme (UNEP, 2021) review stated that global analysis, household size is listed as a significant determinant of both the volume and type of waste generated. The review suggests that larger households are more efficient in waste production on a per capita basis due to shared resource use. The literature indicates the conclusion that larger household production higher total waste and less waste per person mainly because of the economies of scales and common consumption patterns. This information will ensure that the policymakers have a proper waste collection strategy and education programs depending on the ratio of demographics of the households.

A study conducted in Tampilisan, Zamboanga del Norte, assessed the house hold views towards the garbage collection care. The results indicated that locating all the Materials Recovery Facilities (MRFs) in one barangay rather than having it in every barangay was an issue. The perception of residents emphasized the relevance of closeness to receptacles of waste collection in order to have effective waste management (Jauculan, R. E., 2023).

The comparisons of social and economic factors to the amount of waste produced in people in the period between 2012 and 2016. The findings revealed that the per capita waste generated on daily basis varied between 300 to 700 grams per persons depending on the place, either rural or urban. The research revealed that the mean expenditure of a family is a great predictor of the number of waste per individual. Bautista, J. 2020).

Arga *et al.* (2024) examined demographic as well as psychographic aspects influencing the integration of the 3Rs (Reduce, Reuse, Recycle) into solid waste management. The study found that people of various age groups had positive inclination to waste management program, but the practice of maintaining sustainability like purchasing recycled materials or composting was highly limited. Although I could not find

the per se study of how long people live there, it would indicate that those who live there longer tend to have more entrenched behaviors and dispositions regarding practices of SWM.

In their work, Velasco et al. (2024) analyzed the perceived social outcomes of a community-based environmental project in Santa Cruz, Laguna. The program encouraged the beneficiary students and their households to collect and separate single-use plastics in exchange of educational incentives. The paper realized that the program was positive impacting the community, environment, economy and politics. This was the case when, as an example, it encourage more people to participate in the community, and it reinforced the social connections. The research did not have a direct focus on the length of stay but the study shows that a length of the time spent within the community program could positively affect the SWM behaviors in the long term.

A research anchored in Calauan, Laguna, Philippines, carried out an analysis of the concept of place attachment among those living in it and how it can affect community based solid waste management practices. The authors tested three aspects of place attachment which are place identity, nature connection, and community affiliation. The findings showed that the people with high degree of place attachment were more likely to engage in environmentally accountable behavior such as involvement in local waste management schemes. It means that the length of time during which a person has lived in a community is linked to stronger commitment in terms of retaining the environmental quality of it (Constantino, G. D. 2023).

Conversely, an analysis of recycling behavior in Greece revealed that the manner in which individuals dispose of their waste in the area where they have lived in the past has increasingly lost influence on the individuals as they adjust themselves to the manner of management of the region where they reside. In particular, the influence of the recycling norms of former regions on these people was low and represented their adaptation to the waste management culture of the new region, in which they had lived more than five years (Kountouris, Y. 2022).

A study done at the Mukono Town in Uganda considered how solid waste can be handled by the households depending on their characteristics. The research considered such factors as the level of education, income, and size of the family, and underlined the importance of community participation in waste management. This study did not examine directly the length of residence however it is implied that longer residents hold more occasions in order to participate and contribute towards locally generated waste management activities. The time one spends in a particular place can affect the behavior of the individual in terms of handling wastes by creating sense of attachment and enabling adjustment to environmental practices in that particular location. Perpetuated residency of the long-term often develops a deep bond with the community that leads to people being more involved in the upholding of the quality of the environment by regulated waste management (Majak, J. 2019).

A study in (Balaba *et al.* 2024) in Initao College aimed at asking questions that investigate awareness and practices on issues related to solid waste management (SWM) in students of different academic programs. The findings indicated that the students in Bachelor of Science in Business Administration (BSBA) and Bachelor of Elementary Education (BEED) were the most aware of all as they scored extremely aware on most of the questions. Students in the Bachelor of Science in Criminology (BSCRIM) and Hospitality Management (BSHM) Business programs on the other hand showed moderate level of awareness. This implies that level of awareness and practices relating to SWM are influenced by the educational background.

Education level also influences a great deal on the disposal of waste by people. As it was pointed out by Amoah and Okurut (2022), individuals who have attained higher education are probably more aware of the adverse impacts of poor waste management on the environment, and they have the tendency to perform activities such as recycling, waste separation, and composting. Not only is educational attainment linked to acquisition of knowledge, but also to modification of behavior, especially, in the urban regions.

Based on the findings of Molina and Catan (2021), a study with 332 Grade 12 students from various academic strands: Science, Technology, Engineering, and Mathematics (STEM); Technical Vocational Livelihood (TVL); and General Academic Strand (GAS). The results indicated that students possessed

adequate knowledge regarding solid waste management concepts, encompassing the definition of solid waste, the consequences of improper disposal, and prohibited activities. But people didn't know much about the laws that applied. The study underscores that although educational background establishes a basis for SWM awareness, deficiencies must be rectified through curriculum enhancement.

From the study of Anania *et al.* (2023), it examined the correlation between awareness and practices regarding solid waste management among sixth-grade students. The study showed a strong link between awareness and practices, which means that as students become more aware, their SWM practices get better. This finding underscores the necessity of incorporating SWM education at the elementary level to cultivate responsible behaviors from an early age. Jeremias and Fellizar (2020) undertook a study investigating the correlation between socio-demographic characteristics and solid waste management practices in specific urban barangays of Sorsogon City. The findings revealed that while 85% of respondents engaged in selling recyclables, citing additional income as a motivator, there was no significant relationship between total monthly household income and SWM practices. This suggests that the source of income may not directly influence waste management behaviors in this context.

Occupational status influences waste patterns through associated lifestyles. Ali and Sazali (2020) highlighted that professionals and business owners generate more office-related and packaging waste due to work-related consumption, while laborers and informal workers typically produce less waste per capita but may have limited access to formal waste collection systems.

The Philippine Institute for Development Studies (PIDS) highlighted the role of informal workers, such as scavengers and junk shop operators, in the country's waste management system. The study emphasized that these individuals, who often rely on waste collection and recycling as their primary source of income, are instrumental in bridging gaps in recyclables collection and market exchange. Recognizing and integrating their contributions can enhance the effectiveness of SWM programs.

A study focusing on France examined the causal relationship between waste tonnage and employment when waste collection is delegated to private operators. The study has used data on January 2015 to June 2017 and it was established that the volume of waste and employment had a negative relationship with industries like household waste, outdoor garbage, and miscellaneous waste. This signifies that the process of privatization of waste management services has a potential of hindering the creation of job opportunities within the waste collection industry hence the imperativeness of policies that balance efficiency with retention of employment levels (Zaied, Y. *et al.* 2018). Jeremias and Fellizar (2020) conducted a study to determine the relationship between socio-demographic characteristics and solid waste management activities in particular adjoining urban barangays of Sorsogon City. The findings showed that 85.4 per cent respondents were engaging in the selling of the recyclables due to an extra income, but there was no positive relationship established between the total monthly household income and the solid waste management practices. This is a sign that basic household income does not have direct relevance concerning the wellbeing of the management of waste in this picture.

Moreover, Porras *et al.* (2023) implemented a study in which they considered the willingness of households to pay the improved solid waste management in Butuan City. As the results of the study showed, the households with higher monthly income demonstrated a stronger disposition towards paying more to get better waste management services. This indicates that the level of earnings of a household can influence on the level they can and will spend in order to have a better system of trash treatment.

Increasing salaries means increasing access to formal waste service and more engagement in sustainable waste activity, e.g., recycling or composting. According to a study conducted by Awasthi *et al.* (2020) people in higher income groups were more ready and able to afford the cost of having a separate waste collection container and/or to have a waste reduction program. Conversely, low-salary people usually could not afford the resources or they had no motivation to practice sustainability especially in informal settlements or low-service cities.

In many developing countries, one should understand the effect of salaries on the waste production in

the context of the informal economies. To reduce the total waste produced, Tadesse and Mihret (2023) stressed that even weakly developed formal waste management systems might be compensated by short and informal reuse or recycling channels that are used by low-income earners.

The wage can easily be associated with the level of education that a person has, and hence the attitude towards the waste. Rahman et al. (2021) noted that the persons with higher salaries had a higher level of environmental awareness and tendencies to invest in environmental friendly goods or recyclable resources, which made an indirect impact on the production of waste.

In De Jesus et al. 2022 study, it analyzed good waste management in households of Barangay Atate, town of Palayan. It occurred to people that when there is less money in the household, people were quick to reduce their expenditure in order to manage its existence, and this may result in fewer wastes being produced. That implies that income levels could also influence spending as well as the amount of wastes produced.

Most evidence indicates that increasing salaries are associated with the increased production of solid garbage. Such association is associated with the fact that higher income earners are in a position to purchase goods, especially packaged and disposable commodities. Hafeez, and Memon (2021) revealed that households generating high incomes in Karachi, Pakistan had generated a significant amount of plastic items, food resources, and electronic waste compared to low-income households. The study attributed such a phenomenon to lifestyle differences and heightened reliance on convenience products.

The level of income is also always known to play a big role as it relates to generation of the solid waste. Bovill et al. (2021) found out that the households with higher levels of income are more likely to generate extra amounts of waste due to purchasing power, consumption of packaged foods, and dependence on disposable items. There is also a distribution of the wider range of waste, which includes more plastic waste, electronic waste, and food waste by the higher-income households. The reason is that they are not likely to reuse and recycle the materials efficiently.

Income does not only influence the quantity of waste but also the type of waste to be produced. According to Yusof et al. (2022), more affluent Malaysian households have been engaged in a higher recyclable material of paper, plastic, and electronic waste production compared with less relations households that have produced more organic and mixed waste. This finding has implications for the design of waste segregation and recycling programs, which must take into account the different types of waste produced by different income groups. The National Solid Waste Management Commission (NSWMC) has kept track of how much waste is made in each state. Nationwide, the per capita waste generation ranges from 0.10 to 0.79 kg per day, with a weighted average of 0.40 kg per day. In Metro Manila, the range is 0.27 to 1.00 kg per day, averaging 0.61 kg per day. (DENR-EMB 2022).

Approximately one-third of food produced globally, around 1.3 billion tons, is either lost or wasted across the food supply chain (Gustavsson *et al.*, 2011), with significant portions lost or wasted at various stages, including farming, post-harvest, processing, retail and consumption (UNEP, 2021; FAO, 2019).

The National Solid Waste Management Commission (NSWMC) and the Department of Environment and Natural Resources (DENR) consistently report that the most commonly recycled items in the Philippines are:

- Paper and cardboard (e.g., office paper, newspaper, carton)
- Plastics (e.g., PET bottles, HDPE containers, sachets in some cases)
- Metals (e.g., aluminum cans, tin cans)
- Glass bottles
- Used cooking oil (in small volumes, repurposed or processed into biodiesel) (DENR-EMB 2022)

The Philippines generates at least 61,000 metric tons of waste daily, with 24% comprising plastic waste. This statistic underscores the escalating waste management challenges in the country. (Philippine Star, 2023).

A meta-analytical review investigated factors influencing recycling behaviors within workplace settings. The study identified several determinants, including attitudes, availability of prompts or information,

convenience, education, and infrastructure. Notably, it emphasized that a combination of these factors is essential to enhance recycling practices among employees, indicating that workplace culture and environmental initiatives can significantly impact waste management outcomes (Oke, A. 2015).

According to one study on the awareness and practices of residents on ecological solid waste management, it is recommended that the LGUs, particularly at the barangay level, should conduct more information, education and communication campaign, trainings and seminars on proper waste management (Lantajo *et al.*, 2019).

The National Solid Waste Management Commission (NSWMC), chaired by the Department of Environment and Natural Resources (DENR), has approved a resolution imposing stricter law enforcement against the open burning of solid and agricultural wastes and providing alternative means of waste disposal across the country. "The open burning of solid wastes which includes agricultural wastes has long been prohibited by virtue of RA 9003. However, this has not been religiously adhered to, as open burning is still prevalent in communities, farming, and other agricultural activities especially in the rural areas of the country," (DENR Secretary R. Cimat, 2021).

The enforcement of selected provisions of the Philippine Ecological Solid Waste Management Act of 2000 (R.A. No. 9003) in relation to the functions of a local government unit is high which means that the provisions are often complied while the enforcement against prohibited acts is often indicating frequent enforcement.

2. Research Methods

This chapter explained the various methodologies that were used in gathering data and analysis. It described the techniques and procedures used to identify and analyze information regarding the topic.

2.1. Methodology

The study utilized a descriptive research design to evaluate comprehensively the ecological waste management practices in Kalayaan, Laguna. Descriptive research design was also used to summarize and present key features of a dataset. They provide a concise overview of the demographic profile and their responses on existing practices of the residents and challenges facing the LGU on Ecological Solid Waste Management to easier to understand and interpret. Instead of looking at raw data points, we use descriptive statistics to grasp the bigger picture.

Inferential approach was used to find out if there is a significant difference on the current strategies of LGU when group according to profile and significant difference on the extent of implementation in terms of Ecological, Economic and Social when grouped according to profile. Inferential statistics was used because it is powerful tool for making informed decisions based on data.

2.2. Respondents of the Study

The study involved 379 residents from three barangays in Kalayaan, Laguna: Brgy. San Juan (102 respondents), Brgy. San Antonio (172 respondents), and Brgy. Longos (105 respondents). The respondents were current residents of Kalayaan and included both males and females. Various employment categories were represented, and only individuals aged 18 years and above were considered. Respondents of all educational backgrounds were included, along with information on their household size, proximity to garbage collection points, and length of residency in Kalayaan, regardless of their income level.

2.3. Sampling Technique

Stratified random sampling technique was employed creating subgroups in a dataset according to residence (105 respondents from Brgy. Longos, 102 respondents from Brgy. San Juan and 172 respondents from Brgy. San Antonio). Stratified sampling can be more efficient than simple random sampling, especially when dealing with geographically dispersed populations or when certain strata are more costly to sample. This is to ensure that there is a proportional representation from the residents of 3 barangays of Kalayaan, Laguna.

2.4. Research Instrument

The researcher utilized a researcher made questionnaire as the research instrument. It has 3 parts, the first part is Socio-Economic and Demographic profile of the respondents, the second part is the existing strategies of the LGU on ESWM and the last part is the extent of implementation and challenges facing the LGU on ESWM.

The questionnaire is in Google Form format, in English language with Filipino translation as needed. A face to face pilot testing of the questionnaire was conducted in the town of Paete, Laguna to ensure reliability of the instrument. A thirty residents of Paete was given a survey questionnaire mainly from the town proper of Paete, Laguna and with permission from the Municipal Environment and Natural Resources Office and from the Office of the Mayor. The face to face interview encountered challenges since its election campaign period and the respondents were somewhat adamant in answering the survey questionnaire.

After testing the reliability of the instrument and approval from experts, a stratified random sampling technique according to residence was employed to cover 105 respondents from Brgy. Longos, 102 respondents from Brgy. San Juan and 172 respondents from Brgy. San Antonio.

Cronbach alpha was used to test the internal validity, a value of .53 for waste reduction strategy, on waste diversion and alternative the result was .84. The strategy on enforcement, the Cronbach value was .71, on the extent of implementation and challenges facing the LGU on ecology, a value of .81 was obtained. On extent of implementation and challenges facing LGU on economic, .84 was observed, while on social, the Cronbach alpha was .88.

2.5. Data Gathering Procedure

The researcher developed a researcher made questionnaire and presented it to thesis adviser, language specialist, external and statistician for approval. After the approval and revisions, a letter to Hon. Sandy P. Laganapan and MENRO Reinlesa B. Corpuz was submitted for the permission to conduct the survey in the locality of Kalayaan, Laguna.

Data gathering was conducted during the months of April and May 2025. Respondents was chosen stratified from different residents of the community. Collected data was treated confidentially to protect the respondents' privacy.

Due to election period during the conduct of the study, and the researcher as an employee of the LGU to minimized the issue of electioneering, the researcher opted to conduct the survey via online utilizing google form. The data collected was tabulated and summarized then, submitted to the statistician for analysis and computation.

2.6. Statistical Treatment of Data

Descriptive statistics was used to find the frequency and percentage to describe the distribution of respondents according to variables such as residence, age, sex, household size, proximity, length of stay, educational background, source of income, estimated monthly income and estimated solid waste generation

by household. **Mean, standard deviation and Kruskal-Wallis test** were used in statistical analysis to test the difference of current strategies and extent of implementation by the LGU on ESWM.

3. Results and Discussions

This chapter presents and interprets the data gathered in relation to the research objectives and questions. The results are systematically organized and analyzed to highlight key findings. Tables and figures are used where necessary to clearly illustrate the outcomes.

The discussion that follows each set of results aims to provide a deeper understanding of the data by comparing them with findings from related literature, identifying patterns or trends, and explaining possible reasons behind observed phenomena. Where applicable, implications for theory, practice, and policy are also considered.

Overall, this chapter bridges the gap between raw data and meaningful conclusions, offering insights that support the broader aims of the study.

Table 1

Profile of the Respondents based on Place of Residence

Place of Residence	Count	Percentage
Brgy. San Juan	102	26.9%
Brgy. Longos	105	27.7%
Brgy. San Antonio	172	45.4%

Table 1 shows the profile of respondents based on place of residence. Brgy. San Antonio has the largest proportion of respondents, accounting for 45.4% of the total sample, Brgy. Longos has 27.7 % and Brgy. San Juan has the lowest percentage of respondent (26.9%). In stratified random sampling using the method of proportional allocation, a larger sample size was assigned to Brgy. San Antonio, as it has the highest population among the three barangays.

Table 2

Profile of the Respondents based on Age

Age	Count	Percentage
18 to 30 years old	49	12.9%
31 to 40 years old	112	29.6%
41 to 50 years old	137	36.1%
51 to 60 years old	64	16.9%
61 years old and above	17	4.5%

Table 2 shows majority of respondents fall within the 41 to 50 years old age group, accounting for 36.1% (137 respondents). However, the 61 years old and above group has only 4.5% (17 respondents), indicating that very few seniors participated in the survey. This may reflect a lack of accessibility or interest among older adults. The reason why maybe that ages between 41 to 50 years old answered the questionnaire was that time, they were the one not to busy and eager to participate and answer the questionnaire.

Age was a determinant factor in waste management practices in other studies with aging and married respondents, this could be highly related to the increasing sense of responsibility towards the environment and the importance of increasing the quality of life among household members. (Fadhullah, W. 2022).

Additionally, age was identified as a variable significantly impacting an individual's extent of compliance with reuse. These results underscore the importance of considering these demographic factors formulating and implementing interventions and campaigns, ensuring a targeted approach to enhance further

each household's extent of compliance with domestic waste disposal practices. (Araune, P. *et al.* 2024).

Table 3
Profile of the Respondents based on Sex

Sex	Count	Percentage
Female	326	86.0%
Male	53	14.0%

Table 3 indicates that majority of the respondents were female, representing 86.0 percent, while males only represents 14.0 percent of the total survey population.

In a study of assessing compliance with domestic waste disposal practices in Cagayan de Oro City., significant differences were found in compliance based on age and gender, with middle-aged individuals and females showing higher levels, especially in reuse (Araune, P. *et al.* 2024).

Table 4
Profile of the Respondents based on Household Size

Household Size	Count	Percentage
Less than 3 members	26	6.9%
3 to 4 members	108	28.5%
5 to 6 members	181	47.8%
7 to 8 members	39	10.3%
More than 8 members	25	6.6%

The largest group of respondents falls within the 5 to 6 members category, representing 47.8% (181 respondents). This indicates that a significant portion of the surveyed population lives in relatively larger households. Households with less than 3 members and those with more than 8 members are underrepresented, at 6.9% and 6.6% respectively. This indicates that very small and very large households are less common among the respondents, suggesting a trend towards medium-sized households.

According to Wang *et al.* (2021), larger households tend to generate more food waste, while smaller, urban-based households often produce more single-use and packaged product waste.

Table 5
Profile of the Respondents based on Proximity to Roads or Garbage Pick-up Points

Proximity	Count	Percentage
Less than 20 meters	137	36.1%
20 to 50 meters	93	24.5%
51 to 100 meters	96	25.3%
More than 100 meters	53	14.0%

Table 5 shows that 36.1 percent of the respondents live less than 20 meters from garbage pickup points and are easily accessible for garbage dump trucks to collect their garbage, while respondents with more 100 meters away from roads or pick up points represents 14.0 percent. On the study of Jauculan, R. E (2023), residents' perceptions highlighted the importance of proximity to waste collection points for effective waste management. Mwangi *et al.* (2023) studied the influence of urban planning and the spatial distribution of waste collection points on household waste management practices in Nairobi. Their research shows that putting waste collection points close to homes (less than 50 meters) makes people much more likely to follow proper disposal methods.

The proximity of respondents to garbage pickup points thought majority belongs to less than 20

meters, planning on routes of garbage collection is needed to ensure good collection service to the constituents.

Table 6

Profile of the Respondents based on Length of Stay in Kalayaan

Length of Stay	Count	Percentage
More than 9 years	337	89.2%
5 to 9 years	20	5.3%
1 to 4 years	10	2.6%
Less than a year	11	2.9%

A striking 89.2% (337 respondents) of participants have lived in their current location for more than 9 years. While categories from 1 to 4 years represents the lowest with only 2.6 percent, followed by less than a year residents with 2.9 percent. In a study of Constantino, G. D. (2023) revealed that residents with a high degree of place attachment were more likely to engage in environmentally responsible behaviors, such as participating in local waste management initiatives. This suggests that the longer individuals reside in a community, the more invested they become in maintaining its environmental quality.

On the other hand, a study of recycling habits in Greece found that the way people manage their waste in their home region has less and less of an effect on them as they get used to the way things are done in their new home. Specifically, individuals who had migrated and resided in a new region for over five years exhibited a diminished influence of their previous region's recycling norms, signifying an adaptation to the local waste management culture (Kountouris, Y. 2022).

Table 7

Profile of the Respondents based on Educational Attainment

Educational Attainment	Count	Percentage
College	78	20.6%
High School	194	51.2%
Elementary	89	23.5%
No Formal Education	18	4.7%

The largest group of respondents holds a High School education, comprising 51.2 percent (194 respondents). This indicates that over half of the surveyed population has completed high school-level education, while those with no formal education comprises only of 4.7 percent or 18 respondents. Amoah and Okurut (2022) observed that individuals with higher levels of education are more likely to be aware of the environmental impacts of poor waste management and are more engaged in practices like recycling, waste segregation, and composting.

Table 8

Profile of the Respondents based on Source of Income

Source of Income	Count	Percentage
Formal Employment	82	21.6%
Business/Self-Employed	87	23.0%
Daily Wage Labor	90	23.7%
Under-Employed	120	31.7%

The most prevalent income source is Under-employment, at 31.7% (120 respondents). Formal employment only accounts for 21.6% (82 respondents). Business/Self-Employed (23%) and Daily Wage

Labor (23.7%) represent substantial portions of the population's income sources.

In a study of assessing compliance with domestic waste disposal practices in Cagayan de Oro City employment status significantly influenced compliance, with retirees and the unemployed exhibiting higher levels compared to employed (Araune, P. *et al.* 2024).

Table 9

Profile of the Respondents based on Monthly Income

Monthly Income	Count	Percentage
Less than P 10,000	44	11.6%
Between P 10,000 and P 20,000	151	39.8%
Between P 20,000 and P 30,000	120	31.7%
More than P 30,000	64	16.9%

The largest group of respondents falls within the between P 10,000 and P 20,000 category, comprising 39.8% (151 respondents). A smaller percentage (11.6%) earns less than ₱10,000, while another notable portion (16.9%) earns more than ₱30,000. Hafeez and Memon (2021) found that households with higher salaries in Karachi, Pakistan, generated significantly more plastic, food, and electronic waste compared to lower-income households. The study attributed this to lifestyle differences and a greater reliance on convenience products.

Jeremias and Fellizar (2020) undertook a study investigating the correlation between socio-demographic characteristics and solid waste management practices in specific urban barangays of Sorsogon City. The findings revealed that while 85% of respondents engaged in selling recyclables, citing additional income as a motivator, there was no significant relationship between total monthly household income and SWM practices. This suggests that the source of income may not directly influence waste management behaviors in this context.

Table 10

Profile of the Respondents based on Solid Waste Generated

Solid Waste Generated per Week	Count	Percentage
Below 1 kg	44	11.6%
1 to 2 kg	151	39.8%
3 to 4 kg	120	31.7%
More than 4 kg	64	16.9%

The majority of the respondents (39.8%) generate between 1 and 2 kg of solid waste. A substantial portion (31.7%) generate between 3 and 4 kg. Relatively smaller percentages generate less than 1 kg (11.6%) or more than 4 kg (16.9%). A study in Baguio City found out that the average per capita waste generation for domestic sources is 0.4193 kg per day (Lunag M. N. *et al.* 2019). The LGU's Waste Analysis Characterization Study of 2023, revealed that the per capita waste generation of Kalayaan, Laguna is .45kgs.

From 2012 to 2016, the amount of waste produced per person in relation to social and economic factors. The results showed that the amount of waste produced per person each day ranged from 300 to 700 grams, depending on whether the area was rural or urban. The study found that the average amount of money a family spends is a strong indicator of how much waste each person makes. (Bautista, J. 2020).

Table 11*Current Strategies of the LGU On Ecological Solid Waste Management in terms of Waste Reduction*

Materials	Mean	Standard Deviation	Verbal Interpretation
As a resident of Kalayaan, Laguna, I...			
1. limit my use of single-use plastic bag and Styrofoam.	3.29	0.699	Strongly Agree
2. use eco-bag whenever I go shopping/going to market.	3.71	0.492	Strongly Agree
3. practice composting biodegradable waste such as kitchen and backyard waste.	3.44	0.744	Strongly Agree
4. consistently segregate waste (non-biodegradable, biodegradable waste and recyclable)	3.81	0.461	Strongly Agree
5. regularly recycle items like bottles, tetra pack, cartons, cans, metals etc.	3.61	0.596	Strongly Agree
Overall	3.57	0.359	Strongly Agree

Legend 4 – Strongly Agree (SA) 3 – Agree (A) 2 – Disagree (D) 1 – Strongly Disagree (SD)

The residents of Kalayaan exhibit a strong commitment to eco-friendly practices, as indicated by the "Strongly Agree" interpretation across all items. The highest mean score (3.81) for consistently segregating waste suggests that this is a particularly strong practice among residents. The second-highest mean score (3.71) reflects a positive inclination towards using eco-bags, indicating a shift away from single-use plastics.

In the study of Camarillo *et al.* (2020), there is less extent of compliance among residents in almost all of the SWM policies such as segregation, composting, recycling, incentives, and public information.

This implies that the LGUs strategies on ESWM in terms of waste reduction has a positive impact on the community.

Table 12*Current Strategies of the LGU On Ecological Solid Waste Management in terms of Waste Diversion and Alternative Technology*

Indicators	Mean	Standard Deviation	Verbal Interpretation
As a member of the community, I participate in...			
1. "Basuraffle Program" of the Municipality (wherein 1 kilo of dry and clean plastic waste can be redeemed with 1 raffle ticket).	2.63	1.070	Agree
2. "Plastic Palit Bigas" Program of the LGU (3 1.5L PET Bottle with 600 grams each weight can be redeemed with 1 kilo of rice and 3 raffle ticket.)	2.51	1.067	Agree
3. Gardenia Plastic Collection Program of Gardenia and LGU (5 kilos of dry and clean plastic can be redeemed with 1 loaf of Gardenia Bread)	2.37	1.111	Disagree
4. proper plastic waste disposal to be delivered to CEMEX Philippines intended as Waste to Energy Technology (Refuse-Derived Fuel.)	3.00	1.027	Agree

5. proper plastic waste segregation to be delivered to Evergreen Labs Phil. and transform to home construction materials like plastic boards.	3.10	0.942	Agree
Overall	2.72	0.816	Agree
<i>Legend 4 – Strongly Agree (SA) 3 – Agree (A) 2 – Disagree (D) 1 – Strongly Disagree (SD)</i>			

The means for the “Basuraffle Program” (2.63) and “Plastic Palit Bigas” Program (2.51) indicate a moderate level of agreement, suggesting some participation but also a significant number of residents who may not be actively involved. The “Gardenia Plastic Collection Program” received the lowest mean score (2.37), indicating a general disagreement or lack of participation in this particular program. Proper plastic waste disposal (mean of 3.00) and segregation (mean of 3.10) show a higher level of agreement, indicating that residents are more likely to engage in these practices compared to specific recycling programs.

In a study by Xueliang *et al.* (2019) in Shandong China, respondents had an overall positive attitude towards waste-to-energy, but it varied according to the demographic details of residents, such as age, education, and income.

While all other programs surveyed received positive feedback, the Gardenia Plastic Collection Program, launched only in January 2025, was the only one to receive negative feedback. This implies that this may be attributed as it is being a newly implemented strategy of the LGU.

Table 13

Current Strategies of the LGU On Ecological Solid Waste Management in terms of Enforcement

Indicators	Mean	Standard Deviation	Verbal Interpretation
As a responsible member of the community, I...			
1. Support laws and ordinances on anti-illegal dumping of waste, ban on plastics and styrofoam (RA 9003, Kapasiyan Blg. 38 T. 2009 (Ban on Plastics and Styrofoam, Kautusang Bayan Blg. 1 S. 2009 or the Ecological Solid Waste Management Ordinance of Kalayaan, Laguna)	3.83	0.440	Strongly Agree
2. Support the LGU's Information Education and Communication Campaign for Ecological Solid Waste Management.	3.53	0.569	Strongly Agree
3. Support laws against open burning of waste and adhere to the implementation of RA 9003 and Kautusang Bayan Blg. 1 S. 2009 or the Ecological Solid Waste Management Ordinance of Kalayaan, Laguna.	3.56	0.528	Strongly Agree
4. Am aware that environmental officers are overseeing proper waste management practices in both households and commercial establishments.	3.54	0.509	Strongly Agree
5. Comply with the garbage collection schedule.	3.58	0.521	Strongly Agree
Overall	3.61	0.394	Strongly Agree
<i>Legend 4 – Strongly Agree (SA) 3 – Agree (A) 2 – Disagree (D) 1 – Strongly Disagree (SD)</i>			

Support for Waste Management Laws and Ordinances: The overwhelming support (mean 3.83) for anti-illegal dumping laws, plastic and styrofoam bans (referencing RA 9003 and local ordinances), showcases a strong community commitment to environmental protection. Support for IEC Campaigns: The high mean score (3.53) for supporting the LGU's information, education, and communication campaign demonstrates the effectiveness of these campaigns in raising awareness and fostering community engagement. Support for Laws Against Open Burning: The strong agreement (mean 3.56) regarding laws against open burning, coupled with adherence to RA 9003 and local ordinances, highlights the community's understanding of the environmental and health risks associated with this practice. Awareness of Environmental Oversight: The high mean (3.54) reflecting awareness of environmental officers overseeing waste management practices indicates a perceived level of accountability and enforcement. Compliance with Garbage Collection Schedule: The strong agreement (mean 3.58) with complying with the garbage collection schedule demonstrates responsible civic behavior and cooperation with local waste management services.

In a study in Esperanza, Agusan Del Sur, Apdohan, J. D. (2021), cited that enforcement of RA 9003 at a local level is critical in safeguarding human health and environment and realizing sustainable development. Involvement of enforcement mechanism in implementing and institutionalizing solid waste management entails political will and is an approach to discipline and change community behaviors towards proper solid waste management.

This implies that current strategies of the LGU on ecological solid waste management in terms of enforcement is effective.

Table 14

Extent of Implementation and Challenges on LGU's Solid Waste Management in terms of Ecological

Indicators	Mean	Standard Deviation	Verbal Interpretation
I am aware that...			
1. Waste segregation is not consistently practiced in most areas.	2.85	0.786	Agree
2. Illegal dumping of waste continues to be a major ecological concern.	3.31	0.771	Strongly Agree
3. Open burning of solid waste still occurs in the community.	2.80	0.824	Agree
4. The LGU struggles with managing hazardous and special wastes effectively.	2.51	0.834	Agree
5. Flooding in some areas is worsened by unmanaged solid waste.	3.03	0.769	Agree
Overall	2.90	0.604	Agree

Legend 4 – Strongly Agree (SA) 3 – Agree (A) 2 – Disagree (D) 1 – Strongly Disagree (SD)

The overall mean score indicates a general awareness of the solid waste management problems within the community. The relatively low standard deviation suggests a somewhat consistent level of awareness across the community, although the individual indicator scores reveal significant variations in the severity and impact of each issue.

In a study of Hoang and Fogarassy (2020) highlighted that inadequate ESWM has given rise to a range of unexpected consequences, including the contamination of oceans and drains, the occurrence of floods, and the transmission of infections through the breeding of vectors.

The respondents agreed that there were still ecological problem existing in the community that need to be addressed.

Table 15*Extent of Implementation and Challenges on LGU's Solid Waste Management in terms of Economic*

Indicators	Mean	Standard Deviation	Verbal Interpretation
The LGU has...			
1. Limited funding for ecological solid waste management programs.	2.74	0.749	Agree
2. Difficulty upgrading waste management infrastructure and equipment.	2.67	0.755	Agree
3. Limited economic incentives for waste reduction and recycling at the household level.	2.79	0.760	Agree
4. A financial constraint implementing ecological solid waste management.	2.85	0.666	Agree
5. Limited private partnerships to help in the solution to ecological solid waste management problems.	2.96	0.635	Agree
Overall	2.80	0.564	Agree

Legend 4 – Strongly Agree (SA) 3 – Agree (A) 2 – Disagree (D) 1 – Strongly Disagree (SD)

The LGU's financial limitations (mean 2.74) directly impact its ability to implement and maintain effective waste management programs. Insufficient funding restricts the scope and quality of initiatives. The difficulty in upgrading infrastructure and equipment (mean 2.67) is a direct consequence of limited funding. Outdated or insufficient equipment hinders efficient waste collection, processing, and disposal. The lack of economic incentives (mean 2.79) for household waste reduction and recycling discourages active participation from residents. The financial constraint on implementing ecological solid waste management (mean 2.85) is a recurring theme, highlighting the pervasive impact of limited resources on the overall program's effectiveness.

Limited Private Partnerships: The scarcity of private partnerships (mean 2.96) further restricts the LGU's capacity. Collaboration with private entities can provide additional funding, expertise, and resources to enhance waste management initiatives.

Many LGUs face challenges in securing adequate funding for SWM initiatives. LOCAL government units (LGUs) will need to look into public-private partnerships (PPPs) for urban services like solid waste management due to the government's limited resources (Philippine Institute for Development Studies, 2023). Financial constraints emerge as a primary challenge faced by Local Government Units (LGUs) in implementing solid waste management programs (Toledo, TC 2024).

This result implies that the respondents agree to the extent of implementation and challenges on LGU's ecological solid waste management in terms of economic, this means the respondents saw that there are problems and challenges in the implementation of ecological solid waste management

Table 16*Extent of Implementation and Challenges on LGU's Solid Waste Management in terms of Social*

Indicators	Mean	Standard Deviation	Verbal Interpretation
1. Community participation in ecological solid waste management programs is limited.	2.79	0.727	Agree
2. Public awareness on proper waste disposal needs improvement.	2.78	0.749	Agree
3. Residents still prioritize convenience over	2.87	0.719	Agree

compliance with waste policies.			
4. There is resistance from some business establishments in following ecological solid waste management regulation.	2.87	0.709	Agree
5. The LGU faces difficulty in mobilizing volunteer groups for environmental activities.	2.76	0.726	Agree
Overall	2.82	0.597	Agree
<i>Legend 4 – Strongly Agree (SA) 3 – Agree (A) 2 – Disagree (D) 1 – Strongly Disagree (SD)</i>			

The level of participation in the ecological solid waste management programs is limited, which is indicated by the mean score of the perceptions among the community members. This shows that there is necessity to have better engagement strategies that will make residents active participants. The deal on the lack of awareness among the population underlines the need to raise the level of educational activities. The community may also have a better way of comprehending its role in effective waste management by improving on their waste disposal methods. This observation implies that most inhabitants are so conscious of convenience that they do not even follow the waste policies. Such a behavior not only highlights the need to make compliance simpler and more convenient, but perhaps with better infrastructure or incentives. The fact that some business establishments are perceived to resist in sticking to the waste management regulations means that there is need to have an improved enforcement and business support in sticking to ecological regulations. Difficulty in getting groups of volunteers to carry out environmental actions is an indication that people are not involved or have no reason to engage in the process. This reflects the need to provide the strategies that would support volunteerism as well as community-based activism on environmental projects. The average mean of 2.82, accompanied by a fairly small standard deviation of 0.597, signifies homogeneous agreement concerning the difficulties experienced in relation to participating in communities and adherence to waste management

Many communities remain unaware or misinformed about the requirements of Republic Act 9003, also known as the Ecological Solid Waste Management Act of 2000. This lack of awareness results in poor segregation at source and low participation in recycling and composting activities (DENR, 2021)

The finding implies that the respondents agreed that there are challenges facing the LGU on social aspect and that needs to be addressed.

Table 17

Test of Difference in the Current Strategies of the LGU On Ecological Solid Waste Management in terms of Waste Reduction when Grouped According to Profile

Profile	χ^2	p-value	Verbal Interpretation
Place of Residence	0.771	0.680	Not Significant
Age	7.74	0.101	Not Significant
Sex	0.106	0.744	Not Significant
Household Size	10.53	0.032	Significant
Proximity	1.43	0.698	Not Significant
Length of Stay	4.07	0.254	Not Significant
Educational Attainment	2.103	0.551	Not Significant
Source of Income	3.85	0.278	Not Significant
Monthly Income	0.356	0.949	Not Significant
Solid Waste Generated	8.73	0.033	Significant

The other demographic factors (place of residence, age, sex, proximity, length of stay, educational attainment, source of income, and monthly income) do not show significant difference with the outcomes. This suggests that interventions targeting these variables may not be as impactful.

Research in an upland city of Benguet found that households with 3–9 members generate biodegradable waste ranging from 0.04 to 0.31 kg per person per day, averaging 0.1122 kg/day. Notably, as household size increases, total waste generation rises, but per capita waste generation tends to decrease (Lunag, M. N. *et al.* 2021).

Household size and the amount of solid waste generated are significant factors that warrant further examination. The implications may include targeted educational programs or resource allocation based on household size and the specific waste management needs associated with different levels of waste generation.

Table 18

Test of Difference in the Current Strategies of the LGU On Ecological Solid Waste Management in terms of Waste Diversion and Alternative Technology when Grouped According to Profile

Profile	χ^2	p-value	Verbal Interpretation
Place of Residence	10.114	0.006	Significant
Age	6.89	0.142	Not Significant
Sex	0.707	0.400	Not Significant
Household Size	5.34	0.255	Not Significant
Proximity	8.67	0.034	Significant
Length of Stay	8.05	0.045	Significant
Educational Attainment	0.130	0.988	Not Significant
Source of Income	8.29	0.040	Significant
Monthly Income	2.971	0.396	Not Significant
Solid Waste Generated	7.69	0.053	Not Significant

The analysis reveals significant difference between place of residence, proximity to a relevant factor, length of stay, and source of income with the outcome variable(s). However, some unexpected results (household size and solid waste generated) require additional investigation to determine the underlying reasons for the lack of significance. Further analysis, possibly including qualitative data or more detailed questionnaires, could provide a richer understanding of the findings observed.

Table 19

Test of Difference in the Current Strategies of the LGU On Ecological Solid Waste Management in terms of Enforcement when Grouped According to Profile

Profile	χ^2	p-value	Verbal Interpretation
Place of Residence	29.748	<0.001	Significant
Age	6.06	0.195	Not Significant
Sex	3.432	0.064	Not Significant
Household Size	4.13	0.388	Not Significant
Proximity	3.47	0.325	Not Significant
Length of Stay	3.35	0.341	Not Significant
Educational Attainment	30.372	<0.001	Significant
Source of Income	4.12	0.249	Not Significant

Monthly Income	16.443	<0.001	Significant
Solid Waste Generated	6.02	0.111	Not Significant

The analysis reveals significant difference between place of residence, educational attainment, and monthly income. The analysis clearly shows that where people live, how educated they are, and how much they earn significantly affect enforcement of ecological waste laws—while other characteristics do not. Practical strategies should prioritize these areas for targeted interventions.

Table 20

Test of Difference in the Extent of Implementation and Challenges on LGU's Solid Waste Management in terms of Ecological when Grouped According to Profile

Profile	χ^2	p-value	Verbal Interpretation
Place of Residence	0.477	0.788	Not Significant
Age	4.670	0.323	Not Significant
Sex	0.924	0.337	Not Significant
Household Size	1.894	0.755	Not Significant
Proximity	3.540	0.315	Not Significant
Length of Stay	1.480	0.687	Not Significant
Educational Attainment	1.340	0.720	Not Significant
Source of Income	1.320	0.725	Not Significant
Monthly Income	0.835	0.841	Not Significant
Solid Waste Generated	0.719	0.869	Not Significant

The overall results indicate that none of the demographic or socioeconomic factors assessed show a statistically significant difference with the outcome variable. This could imply that the behaviors or attitudes related to waste management are relatively uniform across different demographic groups in the study area.

In the study of Sagodaquil, Jr. A.T. *et al.* (2023), shows no significant difference in the implementation when communities are grouped according to population. However, a significant difference was found when communities were grouped according to location, land area, and income.

Table 21

Test of Difference in the Extent of Implementation and Challenges on LGU's Solid Waste Management in terms of Economic when Grouped According to Profile

Profile	χ^2	p-value	Verbal Interpretation
Place of Residence	3.715	0.156	Not Significant
Age	3.500	0.478	Not Significant
Sex	1.868	0.172	Not Significant
Household Size	1.393	0.845	Not Significant
Proximity	3.730	0.292	Not Significant
Length of Stay	4.500	0.212	Not Significant
Educational Attainment	7.620	0.054	Not Significant
Source of Income	3.510	0.320	Not Significant

Monthly Income	11.838	0.008	Significant
Solid Waste Generated	3.841	0.279	Not Significant

The chi-square test showed a statistically significant difference between monthly income and solid waste generation ($\chi^2 = 11.838$, $p = 0.008$). This indicates that there is a statistically significant difference between income level and the amount of waste produced. The remaining factors—place of residence, age, sex, household size, proximity, length of stay, educational attainment, source of income, and the amount of solid waste generated—showed no statistically significant association with waste generation at the 0.05 significance level. The p-values for these variables were all greater than 0.05, indicating that any observed differences could be due to chance. Therefore, based on this analysis, these factors do not appear to significantly influence the amount of solid waste produced.

Better access to formal waste disposal and more involvement in sustainable behavior, including recycling and composting is linked to higher salaries. One of the studies, conducted by Awasthi et al.(2020), concluded that people with higher incomes were more likely and capable of affordability to pay for a private waste collection or waste minimization program. Conversely, low-wage earners did not usually have the means or motivation to practice sustainable lifestyles especially in the case of informal settlements or rural unserved urban centers.

This means that higher monthly income respondents felt that there are difficulties as far as economic aspect of ESWM implementation by LGU is concerned.

Table 22

Test of Difference in the Extent of Implementation and Challenges on LGU's Solid Waste Management in terms of Social when Grouped According to Profile

Profile	χ^2	p-value	Verbal Interpretation
Place of Residence	2.211	0.331	Not Significant
Age	4.510	0.342	Not Significant
Sex	1.012	0.314	Not Significant
Household Size	0.583	0.965	Not Significant
Proximity	4.390	0.222	Not Significant
Length of Stay	3.890	0.273	Not Significant
Educational Attainment	4.410	0.220	Not Significant
Source of Income	6.780	0.079	Not Significant
Monthly Income	5.509	0.138	Not Significant
Solid Waste Generated	0.527	0.913	Not Significant

Legend 4 – Strongly Agree (SA) 3 – Agree (A) 2 – Disagree (D) 1 – Strongly Disagree (SD)

There is no considerable disparity among these demographics meaning that age, sex, education level, income, and household size might not have any impact in how the communities experience or practice solid waste management procedures. This may imply homogenous implementation of SWM in various groups of the population in the LGUs under investigation.

In enhancing the adoption of a more effective Ecological Solid Waste Management(ESWM), as well as encouraging the concept of sustainability in Kalayaan, Laguna, the LGU has outlined a series of action plan.

First, periodical Information, Education, and Communication (IEC) campaign shall be carried out to address different segments in the community. This will create awareness on waste diversion efforts of the

LGU and the WTE programs. Its leader will be Municipal Environment and Natural Resources Office (MENRO) with collaboration of the Province of Environment and Natural Resources Office (PG-ENRO), Department of Environment and Natural Resources (DENR), and with the help of the private sectors like CEMEX, Gardenia, GNS, and Evergreen Labs. Considering that this campaign will be implemented quarterly and all the assets required including funds and a venue is put on place, it should lead to the formation of an informed society and improved relationship with stakeholders in waste management industry.

Second, the residential and commercial facilities will be inspected in regular intervals on a semestral basis. The aim is to make sure that the laws put across by the environment are adhered to, especially in the way they practice proper waste management. Such inspections by MENRO, PG-ENRO, DENR, in partnership with home owners and businesses will involve the use of financial and transport resources. It is projected that the results will be an improvement in environmental infractions in the municipality.

The other significant step is to make the environmental enforcers more visible to scare away illegal dumping and open garbage burning. Proper monitoring will be carried out daily by MENRO, PG-ENRO, DENR, and authorized environmental enforcers. It will also require enough finances and transportation to realize a cleaner and more upright environment.

The LGU also intends to establish partnerships with Obligated Enterprises also known as OE (RA 11898) which has the Extended Producer Responsibility Law of 2022. The collaborations will sustain a circular economy because they will require producers to retrieve and divert plastic wrapping trash. This is a quarterly project initiated by MENRO, PG-ENRO, DENR, and OEs to tap assistance of the private produce organizations in fund and implementation in accordance to the EPR Act.

In order to control these programs in a sustainable way; the LGU will need to enhance its financial capability. MENRO will advocate through government financial institutions to have budget allocations in order to improve manpower, equipment and facilities needed to implement ESWM. This will be an annual undertaking that will improve the ability of the LGU in managing the present and future problems of solid waste.

In addition, the focus will be to increase the composting efforts. The LGU will maximize the activities of vermicomposting through partnership with the Department of Agriculture - Bureau of Soils and Water Management (DA-BSWM) and MENRO and obtain more bio-reactors. Due to its yearly implementation and provision of obligatory finances, this measure will lead to the increase of production of compostable waste as well as a drop in the quantity of biodegradable waste.

Finally, the LGU will sustain and develop the biogas system in the Kalayaan Sanitary Landfill. This project is under the management of MENRO and it seeks to exploit biodegradable waste to serve as an alternative source of power. The biogas plant is also going to cost millions of dollars per year, yet even with improvements, the facility will not only ensure cleaner waste disposal but also will produce eco-friendly fuel, becoming an example of an innovative way to convert waste to energy.

To conclude, these are seven interlaying steps indicating a strategic, resource based and multisectoral approach to solid waste management in Kalayaan. The comprehensive plan complies with national legislations like RA 9003 and the RA 11898 laws and is expected to maximize in the long-run protection and preservation of the environment, resource management, and social cooperation.

4. Summary of Findings, Conclusions, and Recommendations

This chapter will present the summary of findings, conclusions and recommendations based on the data gathered and its analysis.

4.1. Summary of Findings

The following findings were observed from the data and its analysis:

1. Majority of the respondents were from Brgy. San Antonio. Most of the respondents belongs to ages between 41 and 50 years old. A significant majority of respondents were female. Most of the respondents belong to 5 to 6 household members, while most of the respondents lived less than 20 meters from garbage pick-up points. Large majority of the respondents resides in Kalayaan for more than 9 years. The research also found out that majority of the respondents finished high school, and the prevalent source of income was under employment with monthly income between ten thousand and twenty thousand pesos and the weekly waste generated is between one and two kilos.
2. In current strategies of the LGU on ecological solid waste management in terms of waste reduction, the respondents strongly agreed on the strategies of the LGUs on waste reduction, while strategies of the LGU on waste diversion and alternative technology, the respondent agree of implemetation that they participated in strategies of the LGU but except on Gardenia's Plastic Collection Program in which they disagreed, while the strategies on enforcement, the program received a strongly agree response.
3. In the extent of implementation of ecological solid waste in terms of ecological, the respondents agree that they are aware that problems and challenges still exist in terms of ecological, while the extent of implementation in terms of ecological, the respondents agree that there is a problem in economic, and in terms of social, the respondents also agreed that there are problems and challenges.
4. In the test of difference in the current strategies of the LGU on ESWM in terms of waste reduction when group according to profile, the result was partially not significant since proximity and solid waste generated by household was significant, while on the test of difference in the current strategies of the LGU on ESWM in terms of waste diversion and alternative technology when group according to profile, again the result is partially not significant since place of residence, proximity, length of stay and source of income was significant. In the test of difference in the current strategies of the LGU on ESWM in terms of enforcement when grouped according to profile, the result is partially not significant, since place of residence, educational attainment and monthly income show significant result.
5. The test of difference in the extent of implementation and challenges on LGU's ESWM in terms of ecological when grouped according to profile, the result was not significant, on the test of difference in the extent of implementation and challenges on LGU's ESWM in terms of economic when grouped according to profile, the result was not significant except on the variable monthly income, and on the test of difference in the extent of implementation and challenges on LGU's ESWM in terms of social when grouped according to profile, the result show a not significant findings.
6. This study found out challenges the LGU is facing in terms of strategies on waste diversion and alternative technology, specially on the newer program like Gardenia Plastic Collection, since number of respondents do not participate in this program of the LGU. In the extent of implementation and challenges, it was found out that illegal dumping of garbage is still a problem in the community. The open burning, segregation, managing hazardous and special waste needs a more stricter enforcement. In terms of economic challenges of the LGU on the implementation of ESWM, funding and financial constraints, infrastructure and equipment, incentives on ESWM programs and limited private partnership need to be address, in terms of social, it was found out that awareness on ESWM, community and business establishment participation and mobilization of volunteer groups need to be included for further enhancement in LGU's ESWM programs and approach.
7. The following policy enhancement is proposed based on the result of this study:
To improve Ecological Solid Waste Management (ESWM) and promote sustainability in Kalayaan, Laguna, the LGU has developed a clear and practical action plan.

First, the LGU will hold regular Information, Education, and Communication (IEC) campaigns to raise awareness about waste diversion and WTE programs. This will be led by MENRO, PG-ENRO,

DENR, and private partners like CEMEX and Gardenia. Held quarterly, these activities aim to build community knowledge and strengthen partnerships.

Second, regular inspections of homes and businesses will be conducted every six months to ensure compliance with waste regulations. This is expected to reduce violations and promote proper waste practices.

To address illegal dumping and burning, the LGU will ensure daily presence of environmental enforcers. This ongoing monitoring will help keep the environment clean and instill discipline in the community.

The LGU also plans to work with Obligated Enterprises under the EPR Law (RA 11898). These quarterly partnerships will help recover and recycle plastic packaging, promoting a circular economy and accessing private sector support.

To support all these programs, the LGU aims to boost its financial capacity. By working with financial institutions, it seeks annual funding to improve manpower, equipment, and facilities for effective ESWM.

In addition, the LGU will expand composting efforts through vermicomposting and more bio-reactors, in partnership with DA-BSWM. This will help manage biodegradable waste and produce more compost.

Finally, the biogas project at the sanitary landfill will be upgraded to produce cleaner energy from waste. This will reduce landfill waste and support energy sustainability.

In summary, these seven steps reflect a focused, well-supported plan that follows national laws like RA 9003 and RA 11898, aiming to protect the environment and involve the whole community in proper waste management.

4.2. Conclusions

Based on the stated hypothesis, there is no significant difference in the current LGU strategies on solid waste reduction when grouped according to profile—except for house proximity and amount of solid waste generated, which show a significant difference, this means that the hypothesis is partially rejected.

For the LGU's strategies on waste diversion and alternative technologies, significant differences were observed when grouped by place of residence, length of stay, educational attainment, and source of income. In terms of enforcement strategies, significant differences emerged based on place of residence, educational attainment, and monthly income, this means that the stated hypothesis is partially rejected.

However, when assessing the extent of implementation and challenges of the LGU in terms of ecological management, no significant differences were found across demographic profiles. Only monthly income showed a significant difference in the extent of implementation and challenges related to the economic aspect of solid waste management. This means that the stated hypothesis is partially rejected.

There was no significant difference in the extent of implementation and challenges in terms of the social aspect of solid waste management when grouped according to profile, thus the hypothesis is accepted. Additionally, respondents expressed the belief that illegal waste dumping remains prevalent and needs urgent attention and action.

4.3. Recommendations

Based on the research findings, the following recommendations are proposed to improve ESWM in Kalayaan, Laguna:

Enhance Public Awareness and Participation: Implement comprehensive public education campaigns to promote proper waste segregation, reduce waste generation, and encourage active community participation in ESWM initiatives. This could involve educational materials, workshops, and community engagement

activities, and the IEC on LGU's initiatives on Waste Diversion and Alternative Technology (Waste to Energy).

Enforce Regulations: Strengthen existing regulations related to waste management and enforcement mechanisms to ensure compliance. This could involve stricter penalties for illegal dumping and improper waste disposal. Regular monitoring and evaluation of compliance are essential.

Regular Monitoring and Evaluation: Establish a robust monitoring and evaluation framework to track the progress of ESWM initiatives and identify areas for improvement. Regular data collection and analysis will inform decision-making and ensure the effectiveness of interventions.

Formulate financial mechanism to generate funds to support the ESWM strategies of the LGU.

By implementing these recommendations, Kalayaan, Laguna can significantly improve its ESWM strategies, leading to a cleaner, healthier, and more sustainable environment.

Further researches are needed to find out gaps of this research.

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