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ASEAN-NORWEGIAN COOPERATION PROJECT ON LOCAL CAPACITY BUILDING FOR REDUCING PLASTIC POLLUTION IN THE ASEAN REGION (ASEANO) 2020 – 2021

SUBPROJECT 1:

ASSESSING KNOWLEDGE, ATTITUDE, AND PRACTICES CONCERNING PLASTIC WASTE AND THE ABILITY AND WILLINGNESS TO PAY FOR MEASURES TACKLING PLASTIC POLLUTION OF THE IMUS RIVER, CAVITE, PHILIPPINES

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Acronyms/Abbreviations

4Ps – *Pantawid Pamilyang Pilipino* Program

ATP – Ability to pay

BOT – Build Operate and Transfer

CENRO – City Environment and Natural Resources Office

DENR – Department of Environment and Natural Resources

DLSU-D – De La Salle University-Dasmariñas

DTI – Department of Trade and Industry

ESWM – Ecological Solid Waste Management

IEC – Information, Education, Communication

ISWM – Integrated Solid Waste Management

KAP – Knowledge, Attitude, Practice

LGU – Local Government Unit

MBCRPP – Manila Bay Clean-Up, Rehabilitation and Preservation Program

MENRO – Municipal Environment and Natural Resources Office

MRF – Material Recovery Facility

MSWM – Municipal Solid Waste Management

NGO – Non-Government Organization

NIVA – Norwegian Institute for Water Research

PGENRO – Provincial Government Environment and Natural Resources Office

SEM – Structural Equation Modeling

SUP – Single-used plastics

SWM – Solid Waste Management

WTP – Willingness to pay

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Executive Summary

The Philippines, alongside China, Vietnam, and Indonesia, is frequently listed as one of the "world's worst offenders" in terms of marine plastic pollution. The utilization of single-use plastic in astonishing quantity is accompanied by problems in proper disposal, one of the major contributory factors in water pollution (Phys.Org, 2019). In fact, the Philippines has an annual plastic consumption at a volume of 60 billion sachets, 48 million shopping bags, and around 16.5 billion *labo* bags (a smaller, thinner, and often transparent plastic) according to the Global Alliance for Incinerator Alternatives (GAIA, 2019), which audited the utilization of single-use plastic. Meijer *et al*. (2021) found that 80 percent of riverine plastic waste is distributed in more than 1,000 rivers, and that most of that waste is carried by small rivers that flow through densely populated urban areas, rather than the largest rivers.

Cavite, where this study was undertaken, is a province south of Manila that has undergone rapid economic development and urbanization in the past 20 years. This development has brought new challenges regarding waste management. The Cavite local government (LGU) attributed waste problem in the province to the thoughtless garbage disposal in yards, open canals, riverbanks or tributaries, and rainwater canals and sewers which eventually lead to rivers and oceans. The province has noted that it has so far failed to establish its own sanitary landfill, due to land limitations, although one is currently being developed. In part due to the lack of adequate waste management facilities, approximately 2,000 tons of waste ends up in the river each day (DENR, 2021).

This study tackles the Imus River, one of the six major river systems in the province of Cavite. Its main course follows a 38.4-kilometer route from the north of Tagaytay City (upland), through the municipality of Silang and the cities of Dasmariñas, Imus, and Bacoor, and lastly through the lowland parts of Bacoor and Kawit where it empties into the Bacoor Bay. Within these cities/municipalities are barangays that find the river useful for domestic, tourism, and industrial purposes (CEP, 2020).

DLSU-D surveyed different stakeholders (households, LGUs, and households with small businesses) in 14 selected barangays in the five cities/municipalities (Silang, Dasmariñas City, Imus City, Bacoor City, and Kawit) located along the Imus River. This

study determined the stakeholders' knowledge, attitudes, and practices (KAP) related to plastic pollution problems including its impact, management, and their reasons for using plastic. It also assessed the economic value of the river to the community by identifying and analyzing economic benefits like employment, livelihood, goods, and services derived from the Imus River. Lastly, it determined the Ability to Pay (ATP) and Willingness to Pay (WTP) for better waste and pollution management of the selected communities dependent on the river for their day-to-day needs. Both quantitative and qualitative data were obtained for the study through surveys and interviews. Recommendations for a community-based plastic waste management program were made based on the collected data on KAP, ATP, and WTP of different stakeholders.

The following findings provide answers to the objectives of this study:

(1) The respondents were found knowledgeable about the negative effects of plastic pollution in the Imus River and their community as evidenced by a high knowledge level (x = 12.97) from 88% of respondents. They are aware that plastic waste makes the environment look unpleasant, that accumulated plastic wastes in canals/ waterways/rivers cause flooding, and plastic pollution in the river can be harmful to human health. They are also cognizant of various government programs like the plastic ban and river clean-ups. One notable finding is that barangay officials are recognized as the source of environmental information and as the implementers of river clean-ups.

(2) The respondents showed a high positive attitude with a mean of 4.18 with a standard deviation of 0.45. This means that the respondents have a high positive attitude regarding conservation and mitigation efforts on the Imus River. The respondents strongly agree that discipline is the solution to the waste problem, and that plastic pollution waste in the river is dangerous to the community.

(3) The respondents demonstrated 'good' practice scores (mean = 3.237, standard deviation = 0.652) for conservation and mitigation efforts regarding the Imus River. While they often use products in plastic sachets, pouches, and wrappers, especially for 3-in-1 coffee and candy, they seldom use plastic cutlery and plastic bottles. They also seldom buy home plastic-wrapped cooked foods from restaurants or cafeterias, or plastic-packed products in malls or supermarkets. Moreover, a majority have a trash can and claim that their waste is collected. However, some throw garbage into a pit, burn it , or take it to a temporary dump site. Respondents also seldom segregate biodegradable and non-biodegradable wastes. Despite some

contradicting practices, the overall waste segregation and disposal is considered good.

(4) Among the three domains of knowledge, attitude, and practice, a positive covariance was only observed with knowledge and attitude. A positive covariance means both variables decrease or increase together. This implies that as the respondents' knowledge increases, their attitude also increases and vice versa.

(5) On the economic value of the river, only 289 or 24.7% of the respondents claimed they benefit from the river. These respondents were fishermen from Kawit, Cavite who claimed that the river is beneficial to them in terms of agriculture, water source, and tourism. A large number of respondents do not find any economic value from the river. The river is polluted and unsafe for agricultural purposes, and domestic use. It is also too dangerous for the residents to access.

(6) The respondents' ATP range was PHP0 to PHP300,000.00, with a mean of PHP3,266.31 and standard deviation of PHP9,722.79. This indicates that the average ATP of the respondents amounts to PHP3,266.31 per month or PHP39,195.72 annually. There were only three variables studied that were significant predictors of ATP: elementary educational attainment, household income, and household expenditure.

(7) The respondents were directly asked in this survey how much they would be willing to pay for plastic waste management. The variables that were significantly correlated and significant in predicting the amount of WTP of the respondents were the amount of generated plastic waste and the practice score. Based on the amount of WTP regression model, it shows that for every unit increase in the amount of plastic waste generated, the amount that the respondent is willing to pay increases by PHP2.756, holding the other variable constant. Likewise, for every unit increase in the practice score, the respondents' willingness to pay a certain amount for plastic waste management increases by PHP7.235, holding the other variable constant.

(8) The recommended community-based plastic waste management program based on the collected data on KAP, ATP, and WTP of different stakeholders include interventions that focus on massive IEC drive, provision of incentives and strict implementation, enforcement of SWM laws, community involvement, and strong public-private partnership.

Based on the findings this study, the following recommendations are given:

(1) Massive Information, Education and Communication (IEC) drive. Develop innovative and creative means of engaging and motivating the households to increase pro-environmental practice. A critical review of the existing programs and projects on waste management must also be undertaken to determine if they are still appropriate or relevant in the present context of each barangay.

(2) Provision of incentives. Practical interventions like incentives or rewards may be instituted to achieve interest while promoting environmental sustainability. In particular, incentives may be given to households with small businesses that provide product refills, use alternative packaging, and are compliant with waste management policies.

(3) Strict implementation and enforcement of solid waste management laws. Barangay officials are mandated to strictly enforce ESWM policies, implementing sanctions on violators.

(4) Community involvement. This is hoped to be as a voluntary initiative as volunteer groups and individuals were observed to be active in river clean-ups. A strong volunteer program should be created to maintain and engage these volunteers for continuous involvement in the river clean-up and other possible environmental programs.

(5) Engage the private sector via Build Operate Transfer (BOT) also known as Public-Private Partnership that will invest using the Integrated Solid Waste Management System (ISWM). External partnerships should be sought for funding and technical assistance. Some projects may be linked to the government agencies like the Department of Trade and Industry (DTI), and the Department of Environment and Natural Resources (DENR).

Introduction

Plastic Pollution in the Philippines

Plastic pollution is a serious environmental concern around the globe, both in developed and developing countries. It is an emerging area of concern in the Philippines. Per a study by the World Bank Group (2021), the Philippines is the third-largest contributor with an estimated 0.75 million metric tons of mismanaged plastic entering the ocean every year. This threatens biodiversity in small bodies of water, rivers, lakes, and the ocean. Marine plastic pollution poses a danger to public health as well. Rivers and their tributaries, being the lifeline of any country, must be saved from further degradation.

According to GAIA (2019), which audited the utilization of single-use plastic (SUP), 48 million shopping bags, *labo* bags (a smaller, thinner, and often transparent plastic), and sachets used every day or around 17.5 billion pieces of plastics every year across the country. Phys.Org (2019) notes that the Philippines, alongside China, Viet Nam, and Indonesia, is frequently listed as one of the "world's worst offenders" in terms of marine plastic pollution. The utilization of large quantities of single-use plastic is accompanied by problems with waste management.

McKinsey (2015) estimated waste-leakage rates based on geographic proximity to rivers and the coast at the level of provinces, with the Philippines as one of the respondents. This study found that for every metric ton of uncollected waste near waterways, almost 18 kg of plastic entered the ocean. Meijer *et al*. (2021) found that 80 percent of plastic riverine waste is distributed by 1,656 rivers, rather than being concentrated in a small handful, and that most of that waste is carried by small rivers that flow through densely populated urban areas, rather than simply the largest rivers.

Cavite and the Waste Problem

Cavite, where this study is undertaken, is a province south of Manila (Figure 1). It is part of Region IV-A, also known as CALABARZON, which consists of the provinces of Cavite, Laguna, Batangas, Rizal, and Quezon. Cavite's topography can be classified

into upland, central or midland, and lowland areas. At present, the majority of its area has remained as farmland and rural, although rapid and consistent economic development for the past 20 years has seen certain places become sites for mass housing, subdivisions, schools and universities, commercial spaces, resorts, factories, and industrial parks. With urbanization, a ballooning population, and the growth in trade and industry, proper waste disposal has become a challenge. According to the report by the Provincial Government of Cavite (SEPP, 2014), there are three major sources of waste in the province of Cavite: residences, industrial areas, and markets. The volume of waste is generally affected by the growing population as well as the type of industries that flourish in the area. The highest volume of residential wastes was observed in the City of Bacoor, which produced 260 tons of waste daily. The City of Dasmariñas followed, producing 250 tons of residential waste per day. The third-largest residential waste producer is the City of Imus, with 130 tons. For market waste, the City of Bacoor also produces the highest volume, with 23.76 tons per day. The Municipality of Naic also produces a large volume of market wastes, at 4.12 tons, and is followed by Kawit with 3.96 tons. Bacoor is the locality producing the highest total volume of waste (283.76 tons/day). The second-largest producer of waste is the City of Dasmariñas (252 tons/day) and the City of Imus (133 tons/day). Plastic pollution impacts the ecosystems of bodies of water/rivers, as well as affecting the economic activity of communities that rely on them for support.

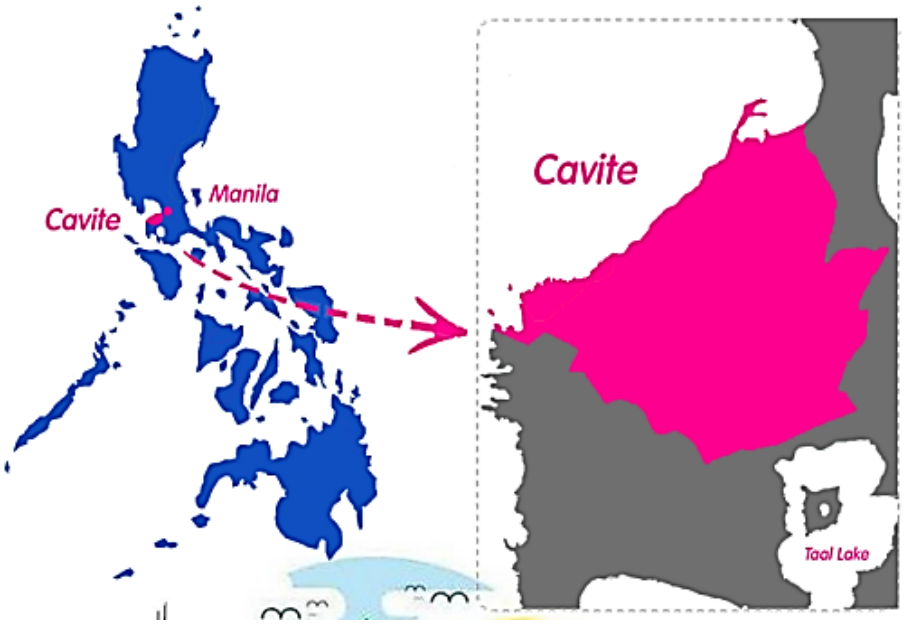

Figure 1. Cavite Province within the Philippines (Cavite Ecological Profile, 2016)

Garbage collection using trucks is the main means of waste collection in Cavite. Local Government Units (LGUs) independently manage their own waste disposal, many using open and controlled dumpsites in their locality as well as sanitary landfills in the neighboring provinces of Rizal and Laguna (SEPP, 2014).

Improper disposal and littering add to the burden facing LGUs regarding plastic pollution. Waste not secured in bins may be captured by the wind, and direct littering occurs in yards, open canals, riverbanks or tributaries, rainwater canals, and sewers. On June 24, 2021, during a Cavite Cluster Task Force meeting, Governor Jonvic Remulla stated that the province failed to establish its sanitary landfill due to land limitations. He also mentioned that around 2,000 tons of garbage a day ended up in the river due to a lack of solid waste management facilities (DENR, 2021).

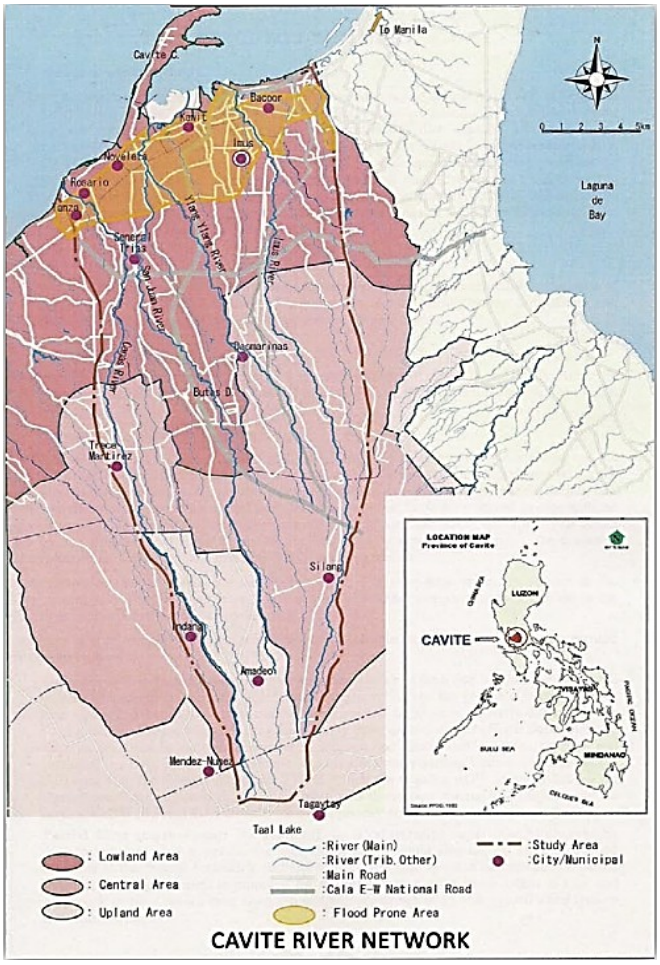

Figure 2. Parts of the river network in Cavite, with the Imus River on the right (National Irrigation Administration 2017)

Schmidt *et al.* (2017) found that the climate of a country is a factor in how plastic waste travels from canals and rivers to the ocean. During the rainy season more plastic waste is transported to the seas via the waterways, and large river systems act as super-highways.

This study tackles the Imus River, one of the six major river systems in the province of Cavite. The main river is 38.4 kilometers long and stretches from Tagaytay City in the northern upland region, through the municipality of Silang, the cities of Dasmariñas, Imus, and Bacoor, and lastly the lowland areas of Bacoor and the municipality of Kawit, where it empties into Bacoor Bay. Within these cities/municipalities are barangays that find the river useful for domestic, tourism, and industrial purposes (CEP, 2020).

Problem Statement

DLSU-D surveyed different stakeholders (households, LGUs, and households with small businesses) in 14 barangays in five cities/municipalities (Silang, Dasmariñas City, Imus City, Bacoor City, and Kawit) located along the Imus River.

Specifically, this study sought to address the following:

Knowledge, Attitude, and Practices (KAP)

1. Determine (a) the level of the respondents' knowledge on the problem and impact of plastic pollution in the Imus River and their community, and (b) the attitudes and practices of the respondents towards conservation and mitigation efforts (e.g. materials recovery facilities (MRF), use of 3Rs, ban on single-use plastic usage) to address the problem and impact of plastic pollution in the Imus River and their community;

2. Deepen the understanding of generally known environmental information, attitudes, and factors that influence practice;

Ability-to-Pay (ATP) and Willingness-to-Pay (WTP) on Plastic Waste Management

3. Assess the stakeholders' understanding of the link between plastic pollution and the economic value of the river, and of their ability and willingness to pay for plastic waste management;

4. Propose recommendations for a community-based plastic waste management program based on the collected data on KAP, ATP, and WTP of different stakeholders.

Methodology

Research Design and Methods

The research project determined the knowledge, attitude, and practice related to the plastic pollution problem including its impact, management, and reasons for using plastic in five selected communities along the Imus River. It also assessed the economic value of the river to local communities by identifying and analyzing economic benefits like employment, livelihood, goods, and services derived from the Imus River. Lastly, it determined the ATP and WTP of the selected communities dependent on the river for their day-to-day needs. Both quantitative and qualitative data were obtained. Mixed methods combining quantitative and qualitative approaches improved the depth and accuracy of the data and results, thereby providing a more comprehensive understanding of the problem (Creswell 2003).

Analytical Framework

This study tested the significant direct relationship between knowledge and practices, and attitude and practices regarding plastic pollution. The model used (Figure 3) is based on Bandura's Social Cognitive Theory and the structural equation model of Isa *et al*. (2013). According to Severin & Tankard (2001), Bandura's social cognitive theory shows that human learning develops by observing the environment and that other people exemplify various behaviors; thus, the environment influences the perception, knowledge, attitude, and practice of a person. In addition, this study sought to determine the significant predictors of the ability and willingness to pay of the respondents.

Based on the findings, this study provided recommendations for a community-based plastic waste management program.

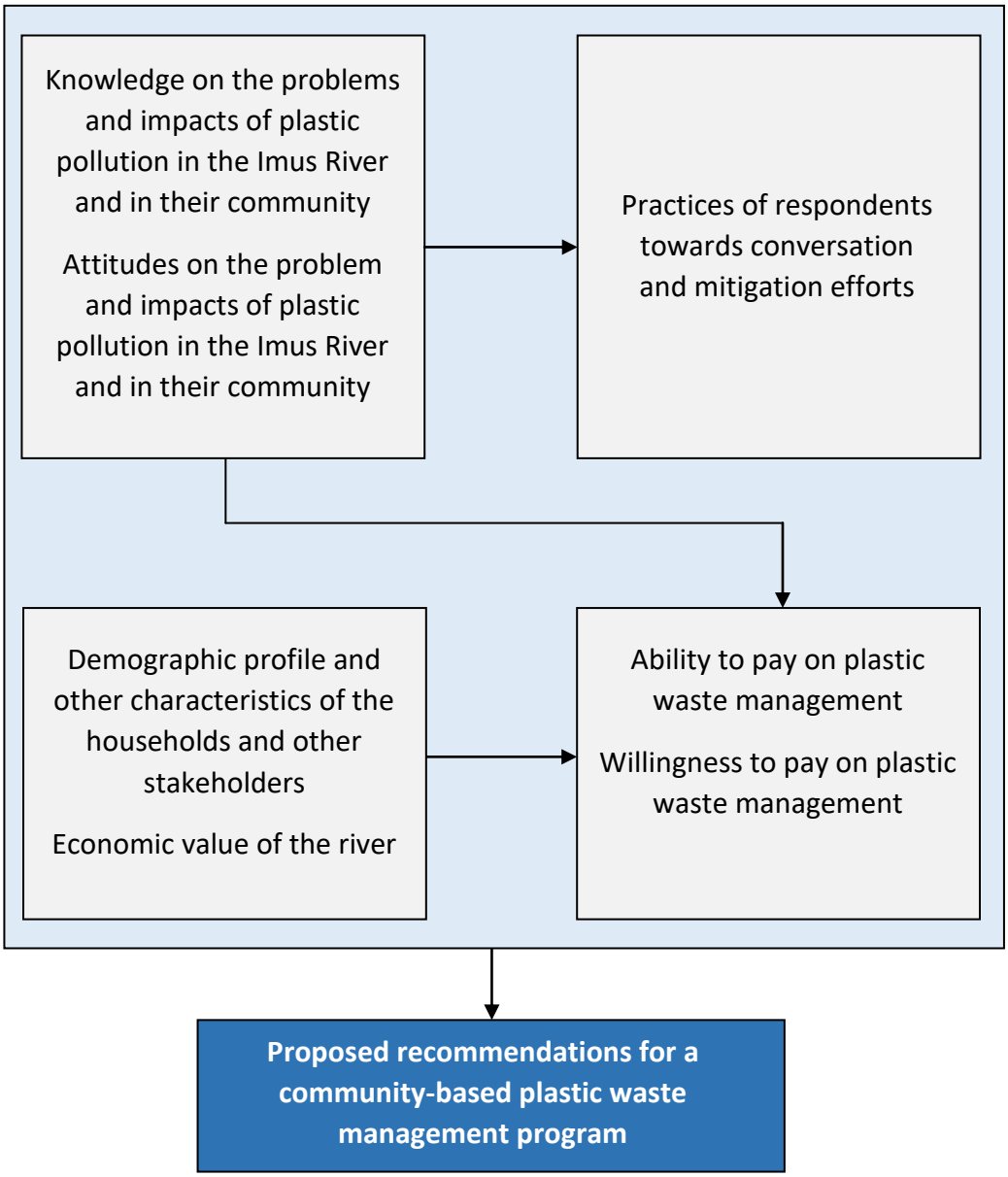

Figure 3. The analytical framework of the study

Locale of the Study

The river flows from Silang to Kawit. From Silang it runs through the cities of Dasmariñas, Imus, Bacoor, and ends in Kawit. Select barangays were identified through the assistance of the LGUs, particularly the MENROs and CENROs of these respective towns and cities. These offices identified barangays that are highly dependent on the river's ecosystem. 14 out of 15 target barangays participated in this study.

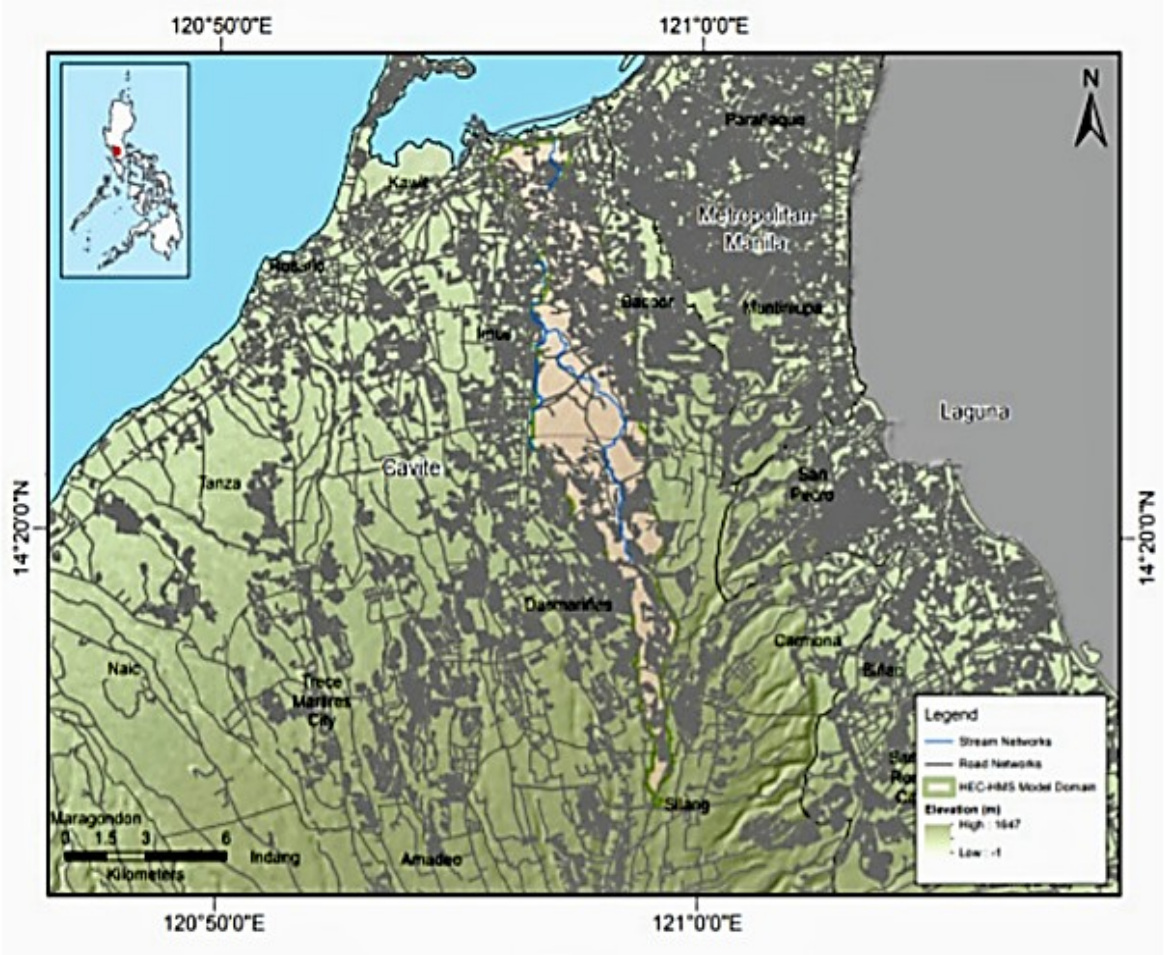

Figure 4. Map of the Imus River basin (UP Lidar Study of Imus River, 2017)

Population and Sample

The two main criteria for the selection of respondents are that the respondent is considered dependent on the river system, and that they, as main stakeholders, are involved in the preservation of the Imus River. The stakeholders considered in this study were barangays, households, and households with small businesses.

A three-stage sampling procedure (multi-stage sampling) was utilized to select respondents. Using purposive sampling, the first and the second stages were completed by the LGUs: the selection of the five municipalities and then the selection of three (3) barangays per municipality. The last stage was to take a simple random sample from each selected barangay. The number of samples per barangay was computed independently of other barangays using a sample size calculator or formula. In this case, each barangay was well represented with large enough sample

sizes to get accurate results (Table 1). Another purposive sampling was used to determine the respondents from households with small businesses.

Table 1. Distribution of respondents

City/Municipality	Barangay	Frequency	Percent
Bacoor	Mabolo 3	100	8.5
	Mabolo 2	57	4.9
Kawit	Aplaya	100	8.5
	Pulvorista	100	8.5
	Congbalay	94	8
Imus	Anabu 1 G	100	8.5
	Tanzang Luma1	100	8.5
	Toclong 2 B	100	8.5
Dasmariñas	San Luis 2	100	8.5
	Zone 3	93	7.9
	San Agustin 3	83	7.1
Silang	Biga 1	50	4.3
	Sabutan	50	4.3
	Tubuan 3	44	3.8
	Total	**1,171**	**100**

Kawit, Imus, and Dasmariñas had the highest numbers of respondents with almost a hundred participants from their respective barangays. These areas have the most residents who live near the river, and, in the case of Kawit, many respondents remain highly dependent on the river's ecosystem.

In Bacoor, only a handful of people remain dependent on the river, which it is already highly polluted and silted within the LGU. In Silang, the river is smaller and in a deep ravine, limiting access and the proximity of housing. Given these factors, respondents from these LGUs were fewer than in other LGUs.

In total 835 or 71.31% of respondents belong to simple households, while 336 or 28.69% are in households which have businesses attached to the home (Table 2).

Table 2. Types of respondents

Sector/Institution	Frequency	Percent
Household	835	71.31
Household with Business	336	28.69
Total	**1,171**	**100.0**

Table 3. Nature of business

Nature of Business	Frequency	Percent
No response	835	71.31
Food	283	24.17
Non-food	37	3.16
Services	16	1.37
Total	**1,171**	**100.0**

835 respondents (71.31%) do not have a business, and rely on their day-to-day jobs for their income. 283 (24.17%) have food businesses in their homes as a main or additional source of income for the family. A small percent of the respondents, 3.16% and 1.37%, are engaged in non-food businesses i.e. selling clothes, plastic products, etc., and service businesses, respectively (Table 3).

Sources of Data

Primary data. Primary data were collected from the communities identified by MENROs/CENROs. Socio-demographic and economic data were obtained from stakeholders i.e. households and households with small businesses. Responses to certain issues related to plastic waste management were also requested.

Secondary data. Data coming from the national government, LGUs, and NGOs were obtained. Secondary data included official records like statistics, maps, and other such information. These supplement the data taken from the field work.

Data Collection Procedures and Management

This study followed the following procedure:

Courtesy call to LGU through CENRO/MENRO. An appointment was secured with relevant CENROs and MENROs to discuss the details of the research and ask their assistance in identifying the barangays that meet the research criteria. Inquiries about the waste management programs of each LGU were also undertaken.

Courtesy call to barangay officials. Before the conduct of this study, the researchers conducted a formal visit to the officials of selected barangays wherein the following were discussed: approval of the barangay officials to conduct the research, objectives of the research, target respondents, and the survey schedule. Barangay officials were also asked about their waste management programs.

Establishment of face validity of the questionnaire. The questionnaire was formulated by the researchers and validated by experts from the ASEAN-Norwegian cooperation project on local capacity building for reducing plastic pollution in the ASEAN region (ASEANO). The statistician also checked if the questions were fit for statistical analysis while the DLSU-D Ethics Review Committee validated the questionnaire's adherence to research ethical standards.

Pre-testing of the questionnaire. Pre-testing was conducted in Barangay Burol and Barangay San Manuel I, barangays in the City of Dasmariñas along the Imus River. 40 individuals participated, verifying if the questions were relevant and comprehensible.

Revision of questionnaire. Minor revision of the questionnaire occurred following pre-testing.

Recruitment and training of enumerators. Enumerators were hired from each barangay to administer the survey. They were oriented about the contents of the questionnaire, proper ways to conduct the interview, their roles as enumerators, and the schedule.

Administration of questionnaire. The questionnaire was administered to respondents from the selected barangays. Through the enumerators, the respondents were oriented about the objectives of the research. Consent was sought from the respondents before they answered the questionnaire.

Data cleaning. Researchers thoroughly checked the collected data to ensure that there were no duplicate or missing entries, and that the information was as accurate and complete as possible, and usable for statistical analysis.

Application of statistical treatment to collected data. The collected data were statistically analyzed using different statistical treatments such as Structural Equation Modeling (SEM), Linear Regression, and Chi-square tests.

Data Collection

For data collection, semi-structured survey questionnaires were distributed among the selected respondents coming from the locale of this study. A total of 1,117 respondents from 14 barangays participated in the survey. Statistical data and qualitative responses were also obtained.

Interviews were conducted with barangay officials, mostly barangay captains, and heads and staff of CENRO/MENRO from five (5) municipalities/cities.

The following data were collected:

Level of knowledge. In this study, the level of knowledge was defined as the understanding about problems and impact of plastic pollution in the Imus River. This variable was measured using a set of questionnaires wherein a score of 1 was given to every correct answer and 0 if otherwise. The total score per respondent was obtained and was classified into 3 levels: High, Moderate, and Low.

Attitude. This refers to the feeling and beliefs of the respondents about the problems and impact of plastic pollution in the Imus River. In this context, attitude is considered a latent variable, one that cannot be measured directly. A set of indicators were constructed to measure this variable indirectly, using a Likert scale. The result was converted to a score for analysis and classified as very low positive, low positive, positive, high positive, or very high positive.

Practices. Practices in this context refer to the actions and behavior of the respondents to prevent further problems in plastic pollution. Here, practices were measured using ratio scale variables through a checklist. The total score was classified as poor, fair, good, very good, or excellent.

Economic value. The amount of goods and services derived from the river. The economic value of water extraction was computed by multiplying the average number of gallons taken per day by the amount in pesos of water per gallon, and multiplied by the number of days in a month. The price is based on prevailing market price of water sold by private water suppliers in the area.

Economic value of river	=	*Average number of gallons of water from river*	*x*	*Amount in pesos per gallon*	*x*	*Number of days in a month*

To determine the peso value of the agricultural products (vegetables and fish) harvested from the river, the amount of goods (in kg) harvested was multiplied by the current market price, and then multiplied by the number harvest days.

Peso value of agricultural products	=	*Average weight (kg) of harvest*	*x*	*Current price in the market*	*x*	*Number of days of harvest in a month*

Ability to pay. ATP is determined by subtracting the total monthly expenses from the monthly combined income of the household.

ATP = total income – total expenses

Willingness to pay. WTP is determined by asking respondents whether they are willing to pay for the project or not, in which they were required to answer yes or no. In this case, dichotomous data were obtained and used to determine the factors affecting the respondent's WTP.

Demographic profile. Some characteristics of the households and households with small businesses were collected. These were used to describe respondents and determine significant factors/predictors of their ATP and WTP.

Statistical Analysis

To analyze the collected data, the following statistical tools were utilized:

For the knowledge, attitude and practices of the respondents:

Structural Equation Modeling (SEM) was used to determine whether or not knowledge and attitude affect the practices of the respondents. SEM is a multivariate statistical framework used to model complex relationships between, directly and indirectly, observed (latent) variables. It is a general framework that involves simultaneously solving systems of linear equations and encompasses other techniques such as regression, factor analysis, path analysis, and latent growth curve modeling. Its two goals are to understand the patterns of correlation or covariance

among a set of variables and to explain as much of their variance as possible with the model specified (Suhr, 2016).

SEM explicitly specifies error and provides no straightforward tests to determine model fit. The best strategy to evaluate model fit is to examine multiple tests such as Chi-square, Comparative Fit Index (CFI), and Root Mean Squared Error of Approximation (RMSEA). The goodness of fit indices are used as indicators of model fit. Chi-square tests are used as an index of the significance of the discrepancy between the original (sample) correlation matrix and the (population) correlation matrix estimated from the model. CFI and RMSEA must be considered because the significance of chi-square tests depends on the number of subjects. CFI values are derived from the comparison of the hypothesized model with the independence model. RMSEA values help to answer the question of how well the model with unknown but optimally chosen parameter values would fit the population covariance matrix if it were available. The acceptable values for CFI are greater than 0.90 and RMSEA are less than 0.08 (Isa *et al*., 2013).

A graphical language provides a convenient and powerful way to present complex relationships in SEM. Model specification involves formulating statements about a set of variables. Then, a diagram or a pictorial representation of a model is transformed into a set of equations. The set of equations are solved simultaneously to test model fit and estimate parameters. The general structural equation model consists of two parts: (a) the structural part linking latent variables to each other via systems of simultaneous equations, and (b) the measurement part which links latent variables to observed variables via a restricted (confirmatory) factor model. The structural part of the model can be written as:

$$\eta = B\eta + \Gamma\xi + \zeta \quad (1)$$

Where η is a vector of endogenous (criterion) latent variables, ξ is a vector of exogenous (predictor) latent variables, B is a matrix of regression coefficients relating the latent endogenous variables to each other, Γ is a matrix of regression coefficients relating endogenous variables to exogenous variables, and ζ is a vector of disturbance terms.

The latent variables are linked to observable variables via measurement equations for the endogenous variables and exogenous variables. These equations are defined as:

$$y = \Lambda y\eta + \varepsilon \quad (2) \quad \text{and} \quad x = \Lambda x\xi + \delta \quad (3)$$

Where Λy and Λx are matrices of factor loadings, respectively, and ε and δ are vectors of uniqueness, respectively.

For the economic value of the river:

Economic value of the river was computed as follows:

EV = amount of water taken from the river (in gal/day) x price of water/gal x no. of days in a month

EV= Average weight (kg) of harvest x current price in the market x no. of days of harvest in a month

For the ability to pay (ATP):

Since ATP was measured on a ratio scale for each respondent in terms of amount, this was described using the mean as follows:

$$Average\ ATP = \frac{\sum ATP_i}{n}$$

Where Average ATP is the average amount the respondent is willing to pay for waste management, ATP_i is the amount per respondent *(i)* and *n* is the total number of samples.

For significant predictors/ factors affecting the ATP of the respondents:

To determine the significant predictors of the respondents' ATP, multiple linear regression (MLR) was utilized. MLR is used to determine the relationship of one dependent variable (*Y*) to two or more independent variables (*Xs)* by fitting a linear equation to observed data measured in a ratio scale. In this study, the dependent variable is the respondents' ATP and the independent variables are some characteristics of the respondents taken from the instrument through the survey. The equation is given by:

$$ATP_i = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \cdots . + \beta_p X_{ip} + \varepsilon_i$$

Where ATP_i = the amount per respondent *(i)*, β_i is the parameter estimates of the population regression line, X_{ij} is the value of the independent variables associated with the value of the dependent variable, and ε_i = residuals.

For the willingness to pay (WTP):

The data for WTP is dichotomous, with its question answerable by *yes* or *no* only. Thus, to determine the factors/predictors of the respondents' WTP, logistic regression was utilized. Mathematically, logistic regression estimates the multiple linear regression function defined as:

$$Log\left[\frac{p(WTP)}{1-WTP}\right] = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \cdots . + \beta_p X_{ip} + \varepsilon_i$$

Where WTP = willingness to pay for the waste management, β_i = the parameter estimates of the population regression line, X_{ij} = the value of the independent variables associated with the value of the dependent variable, and ε_i = residuals.

Results and Discussion

Socio-demographic Profile of Respondents

Table 4. Demographic profile of the respondents

Demographic Variable	Category	Frequency	Percentage (%)
Age	18 - 34	419	35.8
	35- 44	259	22.1
	45 – 64	432	36.9
	65 and older	61	5.2
Sex	Male	349	29.8
	Female	822	70.2
Education Attainment	No Formal Education	12	1.0
	Elementary Level	135	11.5
	Elementary Graduate	85	7.3
	High School Level	255	21.8
	High School Graduate	417	35.6
	College Level	124	10.6
	College Graduate	94	8.0
	Post-Graduate	6	0.5
	Vocational Course	43	3.7
Civil Status	Single	169	14.4
	Married	615	52.2
	Separated	49	4.2
	Widowed	80	6.8
	Common-Law Spouse	258	22.0
No. of Family Members	1-5	884	75.5
	6-10	272	23.2
	11-15	15	1.3

Table 4. The demographic profile of the respondents *(cont.)*

Demographic Variable	Category	Frequency	Percentage (%)
Land Ownership	Owned	335	28.6
	Not Owned	836	71.4
Business/House Structure	Owned	739	63.1
	Not Owned	432	36.9
Length of Stay	1-10	338	28.9
	11-20	231	19.7
	21-30	262	22.4
	31 and up	340	29.0

The respondents are mostly females (70.2%), married (52.2%), and whose ages range 45 to 64 years old (36.89%). Most of the respondents were high school graduates (35.6%). The average family size is 1 to 5 members. In terms of residency, the majority (29.04%) of the respondents have been staying in the barangay for 31 years and up wherein 71% of them do not own their land. The house or business structure, however, is owned by majority (63.1%) of the participants (Table 4).

Table 5. Profile on waste generation by the households

Profile	No business	With business
Number of households	835	336
Number of household members	3,798	1,513
Mixed waste (kg) per week	17,746.00	9,698.00
Plastic waste (kg) per week	1,872.20	1,023.14
Mixed waste (kg) per capita per day	0.67	0.92
Plastic waste (kg) per capita per day	0.07	0.10

For those households with no business, out of 835 surveyed and with 3,798 household members combined, a total of 17,746 kg of mixed wastes were generated per week. That is equivalent to a total of 0.67 kg of mixed waste per person per day.

From the mixed waste produced by the households per week, it is estimated that 1,872.20 kg were plastic waste which was computed as 0.07 kg per person per day (Table 5).

While out of 336 households with small businesses and with 1,513 household members combined, a total of 9,698 kg of mixed wastes were generated per week. That is a total of 0.92 kg of mixed waste per person per day. From the mixed waste produced by the households per week, it is estimated that 1,023.14 kg was plastic waste which was computed as 0.10 kg per person per day.

Measurement of mixed waste generated by each household and household with business was done by asking the respondents about how many plastic *sando* bags or sacks of waste their households produce every week. For the actual recording, a garbage collector was asked to weigh in separately three (3) different sacks full of mixed waste and the results revealed that each sack weighed around 16 kg while a plastic sando bag full of mixed waste weighed around 2 kg.

10.55% of the mixed waste is plastic. An adopted and standard computation used by the National Solid Waste Management Survey (2018). The findings regarding mixed waste and plastic waste here show slightly higher generation than the projection for the year 2020, which was 0.62 kg per capita per day total, and 0.059 kg per capita per day for plastic (CENRO Bacoor, 2020)

Level of Knowledge on the Problem and Impacts of Plastic Pollution

A high knowledge level (mean = 12.97, SD = 1.94) on the problem and impacts of plastic pollution in the Imus River and their community was observed from 88% of the respondents (Table 6).

Table 6. Knowledge level of respondents

Knowledge level	Frequency	Percentage (%)
High (11-15)	1,030	88.0
Moderate (6-10)	137	11.7
Low (0-5)	4	0.3

Respondents appeared to be knowledgeable about the negative effects of plastic pollution. 99.8% believe that plastic waste makes the environment look unpleasant (item 5), 99.1% know that accumulated plastic wastes in canals/waterways/rivers cause flooding (item 7), and 98.6% claim that plastic pollution in the river can be harmful to human health (item 3) (Table 7).

Table 7. Knowledge on plastic pollution and waste management

Knowledge Items	Frequency (%)	
	No	Yes
1. Do you notice plastic wastes in the river?	153 (13.1%)	1018 (86.9%)
2. Do you notice anyone throwing garbage in canals/ waterways/rivers?	465 (39.7%)	706 (60.3%)
3. Do you know that plastic pollution in the river can be harmful to human health?	16 (1.4%)	1155 (98.6%)
4. Do you know that plastic pollution in the river can harm the animals that depend on the river?	33 (2.8%)	1138 (97.2%)
5. Do you think plastic waste makes the environment look unpleasant?	2 (0.2%)	1169 (99.8%)
6. Do you know that plastic pollution in the river can harm people's livelihood?	18 (1.5%)	1153 (98.5%)
7. Do you know that accumulated plastic wastes in canals/ waterways/rivers caused flooding?	1 (0.1%)	1170 (99.1%)
8. Do you know that there are alternatives or replacements to plastic such as *bayong* and eco-bags?	23 (2%)	1148 (98%)
9. Do you know that there are alternatives or replacements to plastic such as reusable water tumblers o reusable water bottles	90 (7.7%)	1081 (92.3%)
10. Do you know that there are alternatives or replacements to plastic such as household things that are made of wood and metal?	229 (19.6%)	942 (80.4%)
11. Do you know that there is a Materials Recovery Facility (MRF) in your barangay?	449 (38.3%)	722 (61.7%)
12. Do you know that there is an economic program that the government provides for observing proper waste management?	280 (23.9%)	891 (76.1%)
13. Do you know that the government has a program on the plastic ban?	114 (9.7%)	1057 (90.3%)
14. Are there any groups or groups in your community that clean up plastic waste in the River?	96 (8.2%)	1075 (91.8%)
15. Do you know that the local government (barangay or municipality) has allocated funds for plastic waste management programs?	404 (34.5%)	767 (65.5%)

60.3% of respondents are aware of people who are throwing garbage in canals/waterways/rivers of their community (item 2, Table 7). SUPs that are brought from establishments like supermarkets or wet markets, when not properly managed, end up in waste streams and waterways (GAIA, 2019).

Almost 1/3 of the respondents (61.7%) are also aware of the presence of an MRF in their barangay (item 11, Table 7). Under the Ecological Solid Waste Management Act of 2000, LGUs are mandated to set up an MRF which includes a solid waste transfer station or sorting station, a drop-off center, a composting facility, and a recycling facility. Section 32 of the said law states that all recyclable wastes materials should be taken to MRFs in every barangay or cluster of barangays, where they are received, sorted, processed, and stored efficiently in an environmentally sound manner. Based on the Cavite Ecological Profile (2020), all cities and municipalities in the province have a centralized MRF.

90.3% of the respondents know that the municipality/city government has a plastic ban program (item 13, Table 7). This program is supported by the Cavite Provincial Ordinance No. 007-2021, also known as the Selective Plastic Ban and the Use of Eco Bag Ordinance of the Province of Cavite. This ordinance was created to minimize, if not eliminate, activities, products, and services that generate residual wastes, and promote practices that will support avoidance or reduction of residual waste generation in Cavite. The said ordinance was adapted by cities and municipalities involved in this research. The respondents learned this from various sources of information (Table 8).

Table 8. Sources of information about the municipality/city plastic ban program. The percentage of cases refers to the percentage of respondents who chose a particular option.

Sources of Information	Frequency*	Percent of responses	Percent of cases
Social Media	705	31.63	60.20
Barangay Officials	665	29.83	56.79
House campaign	397	17.81	33.90
Reading materials	261	11.71	22.29
Billboards	191	8.57	16.31
Others	10	0.45	0.85

**multiple responses*

Social media is the primary source of information, as identified by 60.20% of the total number of respondents. Social media has become the most popular platform for environmental education and the delivery of content from environmental groups (Chung *et al.*, 2020; Terracina-Hartman *et al.*, 2014). Barangay officials are also a key source of information, as evidenced by 56.79% of respondents. Another key information source for communities is house campaigns, as claimed by 33.90% of respondents.

91.8% of the respondents are aware that there are groups in their community that conduct clean-up operations for plastic wastes in the river (item 14, Table 7). Barangay officials top the groups who conduct river clean-ups (Table 9) as identified by 82.15% of respondents. Volunteer groups and individuals are also active in river clean-ups as noted by 65.24% of respondents. Among the different volunteer groups and individuals, the *Pantawid Pamilyang Pilipino* Program (4Ps) beneficiaries are the most noticeable individuals who participate in river clean-up activities.

Aside from the groups mentioned above, river rangers are also outsourced by the City or Municipal Environment and Natural Resources Office (CENRO/MENRO) for river clean-up activities. River clean-ups are continuously done as part of the Manila Bay Clean-Up, Rehabilitation and Preservation Program (MBCRPP) of the Province of Cavite.

Table 9. Groups that conduct river clean-ups

River Clean-up Groups	Frequency*	Percent of responses	Percent of cases
Barangay Officials	962	39.95	82.15
Volunteer Groups and individuals	764	31.73	65.24
Municipal Officials	329	13.66	28.10
NGOs	272	11.30	23.23
Business Owners	81	3.36	6.92

**multiple responses*

Barangay officials are recognized as a source of environmental information and as the implementers of river clean-ups. This role is part of the policy-setting and service-delivery functions of barangay officials (Guzman & Reyes, 2003; Navarro, 2003; Rebudilla, 2002). Section 10 of Republic Act 9003 or the Ecological Solid Waste Management Act and Section 17 of the 1991 Local Government Code of the Philippines mandate barangay officials to prepare and enforce a solid waste management program and other environmental-related functions.

Attitudes towards Conservation and Mitigation Efforts

Table 10. Attitude towards conservation and mitigation efforts

Statements	Mean	Standard Deviation	Interpretation
1. People can easily throw plastic wastes into the river because the river is close to their homes.	3.49	1.27	Slightly Agree
2. People throw plastic wastes into the river because of the lack of other waste disposal options.	3.20	1.25	Slightly Agree
3. People throw plastic wastes into the river due to a lack of awareness/ knowledge on proper waste disposal.	3.39	1.24	Slightly Agree
4. Strict enforcement of the law will prevent people from dumping garbage in the river.	4.35	0.78	Agree
5. Providing good alternatives to plastics will prevent people from dumping plastic waste in the river.	4.37	0.70	Agree
6. A proper waste management facility will keep people from improperly disposing of waste plastic.	4.43	0.69	Agree
7. Self-discipline is the solution to the waste problem.	4.73	0.54	Strongly Agree
8. People will be encouraged to recycle plastic waste if it has incentives like money or food.	3.99	1.02	Agree
9. People will be encouraged to recycle plastic waste if the waste management law is strictly enforced	4.41	0.65	Agree
10. People will be encouraged to recycle plastic waste if there is a proper waste collection system and management facility.	4.46	0.63	Agree
11. The river and its tributaries are important in our daily life.	4.35	0.79	Agree
12. Plastic pollution waste in the river is dangerous to the community	4.55	0.65	Strongly Agree
13. The river can still be rehabilitated.	4.52	0.67	Strongly Agree
14. Prohibiting the use of single-use plastic (SUP) is the way to reduce river pollution caused by waste plastic.	4.41	0.67	Agree
15. The efforts of various groups to clean up the river are helping to reduce plastic pollution in the river.	4.52	0.62	Strongly Agree
16. The plastic manufacturing industry should pay for plastic waste management programs	3.95	0.94	Agree
17. The business owners who sell and use plastics should pay for plastic waste management programs.	3.89	1.01	Agree
Over-all Attitude	**4.18**	**0.45**	**High Positive**

Means were converted into attitudes as such:

- 1.00-1.49: Very Low Positive Attitude
- 1.50-2.49: Low Positive Attitude
- 2.50-3.49: Positive Attitude
- 3.50-4.49: High Positive Attitude
- 4.50-5.00: Very High Positive Attitude

The respondents show a high positive attitude (mean = 4.18, SD = 0.45) regarding conservation and mitigation efforts on the Imus River (Table 10). This result corroborates the respondents' high knowledge of the problem and impacts of plastic pollution in the Imus River and their community.

The item with the highest mean response, 4.73, is item 7 (Table 10). This means that the respondents strongly agree that discipline is the solution to the waste problem. This is followed by item 17 which states that *plastic pollution waste in the river is dangerous to the community*; the mean response is 4.55 meaning that the respondents also strongly agree with this statement. On the other hand, the item with the lowest mean response is item number 2 with a mean of 3.20. This implies that the respondents generally slightly agree that people throw plastic wastes into the river because of the lack of other waste disposal options. Looking at the standard deviations, item 1 obtained the highest value of 1.27. This means that the respondents have varied opinions about the statement that *People can easily throw plastic wastes into the river because the river is close to their homes*.

On the other hand, the item with the lowest standard deviation of 0.54 is item 7 on self-discipline as the solution to the waste problem. This means that the respondents have a consistent opinion about the statement. It is also notable that the respondents strongly agree on item 7 which yielded a mean response of 4.73.

Overall, the mean attitude is 4.18, with a standard deviation of 0.45. This means that respondents have a high positive attitude regarding conservation and mitigation efforts for the Imus River.

Practices towards Conservation and Mitigation Efforts

Table 11. Practices towards conservation and mitigation efforts

Statements	Mean	Standard Deviation	Interpretation
1. How often do you use plastic bags (shirt bags, plastic labo)?	4.03	0.99	Often
2. How often do you use plastic cutleries (such as plastic spoons and forks)?	2.53	1.04	Seldom
3. How often do you use plastic bottles (bottles of mineral water and soft drinks)?	2.85	1.12	Seldom
4. How often do you use styrofoam or other plastic food containers?	2.16	0.95	Rarely
5. How often do you use products in plastic sachets, pouches, wrappers (example: shampoo sachet, 3-in-1 coffee, candy, etc.)?	4.37	1.01	Often
6. How often do you buy plastic packaged products at sari-sari store convenience store?	3.97	1.10	Often
7. How often do you buy plastic-packed products at the talipapa or town market?	3.53	1.08	Often
8. How often do you take home plastic-wrapped cooked foods from a restaurant or cafeteria?	2.87	1.05	Seldom
9. How often do you buy plastic-packed products in malls or supermarkets?	2.40	0.86	Rarely
10. How often do you buy plastic-packed products from ambulant or street vendors or sidewalk vendors?	2.76	1.02	Seldom
11. How often do you dispose of plastic waste?	4.08	0.89	Often
12. How often do you separate biodegradable and non-biodegradable waste?	3.11	1.23	Seldom
13. How often does the waste picker come to your home/ business establishment to buy your plastic waste?	3.08	1.02	Seldom
14. How often is garbage collected in your household/ business establishment?	3.72	0.88	Often
15. How often do you try to recycle or reuse plastics in your household/ business establishment?	3.11	1.21	Seldom
Overall Practice	**3.237**	**0.652**	**Good**

The interpretation was converted into a qualitative response value as such:

1	Never	Poor
1.5	Rarely	Fair
2.5	Seldom	Good
3.5	Often	Very Good
4.5	Always	Excellent

The respondents were found to have 'good' practice scores (mean = 3.24, SD = 0.65) on practices relating to waste (Table 11).

The item with the highest mean response of 4.37 is item 5. This means that the respondents often use products in plastic pouches, wrappers, and sachets for shampoo, 3-in-1 coffee, candy, etc. Notably, almost 164 million pieces of sachets daily, and around 59.7 billion pieces of sachets are disposed of yearly in the Philippines alone (GAIA, 2019). The respondents also often use plastic bags (item 1, Table 7) with a mean of 4.026. Moreover, the respondents often buy plastic-packed products at *sari-sari* stores or convenience stores (item 6, Table 11) with a mean of 3.92, and they often buy plastic-packed products at the *talipapa* or town market (item 7, Table 11) with a mean of 3.53.

Respondents claimed that they buy plastic-wrapped products because the plastic wrapping is free or that it comes with the product, a reason presented by 62.51% of respondents (Table 12). Respondents also prefer plastic-wrapped products because they are accessible, as reported by 43.89% of respondents. Packaging is the most frequent modality of plastic use (Filho *et al.*, 2021). SUPs are considered "strong, cheap and hygienic ways to transport goods" (UNEP, 2018, p. 12), and this results in increasing plastic generation (Paul *et al.*, 2016). These characteristics also make SUPs environmentally unsound and difficult to recycle when not properly managed (Filho *et al.*, 2021; UNEP, 2018).

Table 12. Reasons for buying plastic-wrapped products

Reasons for buying plastic-wrapped products	Frequency*	Percent of responses	Percent of cases
It's free	732	45.13	62.51
Easy access	514	31.69	43.89
They are the only ones available	358	22.07	30.57
Others	18	1.11	1.54

**multiple responses*

While the respondents use plastics, they still provided reasons to be encouraged to stop using plastic and use an alternative. The majority of respondents would be encouraged to stop using plastic and use an alternative if it is inexpensive (62.43%). They will also be supportive of using plastic alternatives if the former is readily available (50.30%), and if incentives are provided for use of alternatives (20.24%) (Table 13).

Table 13. Reasons to encourage to stop using plastic and use alternatives

Reasons to encourage to stop using plastic and use alternatives	Frequency*	Percent of responses	Percent of cases
Plastic substitutes or alternatives should be inexpensive	731	46.00	62.43
Plastic substitutes or alternatives should be readily available	589	37.07	50.30
Users of plastic substitutes should be rewarded for their good practices	237	14.92	20.24
Others	32	2.01	2.73

**multiple responses*

Respondents purchase plastic or plastic packed products often, evidenced by means of 3.97 and 3.53, respectively (items 6 and 7, Table 11). According to Walsh *et al.* (2005), consumers at the bottom of the income bracket, like the respondents of this study, usually purchase single-serve packages. With a monthly income of PHP10,000 to PHP19,999, respondents are characterized as low-income but not poor (Albert *et al.*, 2018). Due to this economic position, the respondents are likely mostly driven by immediate needs and access; however, as previously mentioned, respondents may be encouraged to use plastic alternatives if such alternatives are inexpensive, readily available, and incentivized.

Respondents seldom separate biodegradable and non-biodegradable wastes (item 12, Table 11), with a mean of 3.11. Many of the respondents do not segregate wastes because they find it annoying, something noted by 44.32% of respondents. Respondents claimed that it is an unnecessary task because garbage collectors mix already separated waste, as signified by 43.55% of respondents. They also point to the lack of facilities for segregation at home or at business establishments that prevents them from segregating wastes, indicated by 33.48% of respondents (Table 14).

Table 14. Reasons for not separating biodegradable and non-biodegradable wastes

Reasons	Frequency*	Percent of responses	Percent of cases
It's annoying	519	35.31	44.32
Garbage collectors mix separated wastes	510	34.69	43.55
No facilities in the home or business establishment for segregation	392	26.67	33.48
Others	49	3.33	4.18

**multiple responses*

The person(s) assigned to sort or manage wastes in the household or household with business are usually members of the family, as evidenced by 43.04% of respondents (Table 15). Many respondents also mentioned that mothers are the main waste managers of households and households with small businesses, as indicated by 40.91% of respondents. Studies show that women are generally the ones responsible for household waste management (Yintii *et al*., 2005). They guide and teach their children and helpers about waste segregation (Bernardo, 2008).

Table 15. Person assigned to manage or sort waste

Assigned to manage or sort waste	Frequency*	Percent of responses	Percent of cases
All family members	504	39.07	43.04
Mother	479	37.13	40.91
Father	155	12.02	13.24
Children	85	6.59	7.26
House helper	21	1.63	1.79
Business establishment owner	28	2.17	2.39
Business establishment staff	18	1.40	1.54

**multiple responses*

RA 9003 also instructs segregation of wastes at the source, and households must be informed how to segregate wastes into compostable, non-recyclable, recyclable, and special or hazardous waste. This is a more complicated form of waste segregation from the usual biodegradable and non-biodegradable waste segregation.

The reasons given that prevent people from recycling include a lack of proper information, as noted by 65.84% of respondents, scarcity of time to recycle, as noted by 25.53% of respondents, and lack of appreciation for nature, as noted by 22.46% of respondents (Table 16).

Table 16. Reasons preventing people from recycling or reusing plastic

Reasons preventing people to recycle or reuse plastic	Frequency*	Percent of responses	Percent of cases
Lack of proper information on recycling or reusing plastic	771	45.65	65.84
There have a lot to do and no time to recycle or re-use plastic	299	17.70	25.53
They have no appreciation for nature	263	15.57	22.46
Some see no benefit in recycling or reusing plastic	201	11.90	17.16
The government has no program for recycling or reusing plastic	143	8.47	12.21
Others	12	0.71	1.02

**multiple responses*

Respondents state that they often dispose of different plastic wastes (mean = 4.08) (item 11, Table 11). The majority of the respondents have their own trash can, and claim that their wastes are collected, evidenced by 90.86% of respondents (Table 17).

Table 17. Plastic Waste Disposal

Plastic waste disposal	Frequency*	Percent of responses	Percent of cases
Own trash can, then collected	1,064	89.26	90.86
Thrown into a pit/burned	78	6.54	6.66
Taken to a temporary dumpsite	26	2.18	2.22
Discharged into rivers and waterways	13	1.09	1.11
Others	11	0.92	0.94

**multiple responses*

79.08% claim that garbage is collected by collectors from the barangay or municipality. Based on the Cavite Ecological Profile (2020), all cities and municipalities included in this study have big garbage trucks for waste collection. The City of Dasmariñas has the most, 12 big garbage trucks and 3 small garbage trucks. According to the same report, the usual solid waste disposal system in Cavite is to contract a sanitary landfill.

Further information may encourage pro-environmental practice. From a pre-defined list, information on the effects of plastic waste on the environment were identified by 48.76% of respondents. Fines or penalties for violating waste management laws were suggested by 44.24% of respondents. Proper waste management was identified by 42.61% of respondents (Table 18).

Table 18. Environmental information for pro-environmental practices

Environmental information	Frequency*	Percent of responses	Percent of cases
Effects of plastic waste on the environment	571	28.06%	48.76%
Fines or penalties for violating waste management laws	518	25.45%	44.24%
Proper waste management	499	24.52%	42.61%
Local government waste management program	292	14.35%	24.94%
Economic incentives from waste management	152	7.47%	12.98%
Others	3	0.15%	0.26%

**multiple responses*

The practices on waste segregation and disposal imply that the respondents perform good practices on conservation and mitigation efforts on the Imus River. Respondents strongly agree that self-discipline is a solution to the waste problem. Based on the interviews, self-discipline is described as the consistent practice by a member of the public of proper waste segregation and disposal with compliance to waste management. This requires an innate desire to practice pro-environmental activities, without requiring external motivations like penalties or incentives.

Positive Covariance for Knowledge and Attitude

Table 19. Covariances between knowledge, attitude and practices

Covariance between	Estimates	SE	CR	P	Label
Knowledge and Practices	.028	.029	.996	.334	par_4
Knowledge and Attitude	.130	.024	5.318	***	par_5
Attitude and Practices	-.007	.006	-1.166	.244	par_6

Based on the SEM, covariance was used to measure how knowledge, attitude, and practice vary together. Covariance is computed because the data is not in a standardized form. A positive covariance means both variables decrease or increase together. If one increases and the other decreases or vice versa, the covariance is negative. Only knowledge and attitude have a significant p-value (***) which is less than 0.001. The rest of the pairs have p-values that are not significant (0.334 and 0.244) (Table 19). The levels in knowledge and respondent attitude reflect each other. This result is similar to several studies (Abdikadir *et al*., 2018; Gadzekpo *et al.*, 2018) which linked high awareness and positive attitude, but noted low engagement among their respondents.

Economic Value Derived from the Imus River

As stated by Brouwer *et al.* (2004), water provides goods (e.g. drinking water, irrigation water) and services (e.g. hydroelectricity generation, recreation, and amenity) that are utilized by agriculture, industry, and households. The provision of many of these goods and services is interrelated, determined by the quantity and quality of available water. They added that management and allocation of water entail consideration of its unique characteristics as a resource (Brouwer *et al*., 2004).

In other words, the economic value of the river can be measured based on the goods and services it provides to society or community.

Table 20. Use of the river

Benefiting from the Imus River	Frequency	Percent
No	882	75.3
Yes	289	24.7

The data regarding the goods and services that the respondents derive from the Imus River show that 75.3% of the respondents mentioned that they did not get any benefit from the river (Table 20). On the other hand, 24.7% said they benefited from the river.

Table 21. Good and services derived from the river

Commodities / Goods / Services	Frequency	Percent of responses	Percent of cases
Water	115	34.64	40
Agriculture	187	56.33	65
Tourism	7	2.11	2
Others	23	6.93	8

In terms of utility, Brouwer *et al*. (FAO, 2004) mentioned that the water requirements of agriculture are large relative to water requirements for other human needs. This idea is supported by the data taken from the area of this study. When questioned about goods and services obtained from the river, of the 289 respondents who said that they benefited from the river, 56.33% of these responses show that they were able to obtain agricultural products from the Imus River (Table 21). About 34.64% of responses noted a benefit relating to water taken from the Imus River. This was mentioned by 40% of the respondents benefiting from the Imus River. On the other hand, 6.93% of the respondents said that they get unspecified benefits from the river. Lastly, only seven or 2.11 % responses indicate that they use the Imus River for tourism.

The large number of respondents who did not benefit from the river mentioned the following reasons as to why they find no economic value from the river:

1. The water is deemed polluted because of the presence of garbage, and people deemed it unsafe to be used for agriculture and other domestic or food-related purposes. Those who were able to extract some economic value are those people living near the unpolluted part of the river.

2. In Silang, the river sits beside ravines that are too dangerous for the residents to access. Riverbanks are deemed uninhabitable, and the government do not allow them to put up houses and other permanent structures.

3. In Dasmariñas, Imus, and Bacoor, the river is already heavily polluted or heavily silted in some areas.

4. Kawit, Cavite has the most number of respondents that said that they benefit from the river because the town's side of the river is a good fishing ground. This means that most of those who benefit from the river are fishermen.

Garbage around the banks of the river and dirty water flowing to the river

Heavily silted and garbage littered part of the river with houses around the riverbanks.

Figure 5. Parts of the Imus River in Bacoor City (top) and in Brgy. San Luis in the City of Dasmariñas (bottom)

Relating to income derived from the use of the Imus River, 886 or 75.7% have no response or did not get any income from the river (Table 22). This is consistent with the number of respondents who said they did not benefit from the river (Table 20).

Table 22. Amount of income derived from the river

Amount Derived	Frequency	Percent
No response	886	75.7
5000 and below	228	3.6
5,001-10,000	42	19.5
Above 10,000	15	1.3

Table 23. Contribution of the Imus River to savings or income

Contribute to savings/income	Frequency	Percent
No	33	2.82
Yes	256	21.86
No response	882	75.32

In terms of the river's contribution to savings, only 256 or 21.9% of the respondents said yes (Table 23).

ATP and WTP on Plastic Waste Management

This study measured ATP and WTP for plastic waste management by utilizing the contingent valuation method, and further analysis was also done with multiple linear regression modeling to determine factors influencing ATP and WTP. During the conduct of the survey, respondents were directly asked about their household's monthly income and monthly expenditure. According to Aydin (2021), indicators of ability to pay include income, wealth, and spending.

38.2% report a monthly income ranging from PHP1,000 to PHP9,999, 49.5% PHP10,000 to PHP19,999, and 7.8 % PHP20,000 to PHP29,999 (Table 24).

Table 24. Household's monthly income

Monthly Income (PHP)	Frequency	Percent
1,000-9,999	447	38.2
10,000-19,999	580	49.5
20,000-29,999	91	7.8
30,000-39,999	35	3.0
40,000-49,999	10	0.9
50,000 and above	8	0.7
Mean (SD)	**12,977.47 (21,594.44)**	

The majority of respondents (87.7%) have a household monthly income ranging from PHP1,000 to PHP19,999. In 2018, the Philippine Institute for Developmental Studies (PIDS) identified social classes in the Philippines as proposed by Albert *et al*. (2018); a household is classified as poor if its monthly income is less than PHP10,957, while it is low-income if its income is between PHP10,957 and PHP21,914. Per this classification, most of the respondents of this study were poor or low-income. In the Cavite Ecological Profile (2020), it was reported that at least PHP8,497.00 on average per month was needed to meet both basic food and non-food needs of a family of five. This indicates a higher cost of living in Cavite than most other areas of the Philippines.

Table 25. Monthly expenditures on basic needs

Amount range (PHP)	Frequency	Percent
1,000-9,999	704	60.1
10,000-19,999	407	34.8
20,000-29,999	42	3.6
30,000-39,999	11	0.9
40,000-49,999	2	0.2
50,000 and above	5	0.4
Mean (SD): 9,935.18 (15,211.40)		

According to Pascasio et. al, (2019), the final consumption of goods and services is that used to directly satisfy human needs and wants. Intermediate consumption is that used for the further production of goods and services (Pascasio et. al, 2019). A majority of respondents, 60.1%, spend only up to PHP9,999 of their monthly

expenditure on basic needs, while 34.8% spend up to PHP19,999. Only 3.6% of households spend up to PHP29,999, with higher expenditures consisting of even smaller percentages (Table 25).

Table 26. Allocation of expenses

Category	Mean	Standard Deviation	Minimum	Maximum
Food	6,561.03	7,139.20	0	200,000
Non-food	3,382.06	8,654.70	0	250,000

The respondents' average monthly expenditure on food amounts to PHP6,561.03, with PHP3,382.06 for non-food items (Table 26). In 2018, a Caviteño family of five needs to earn at least PHP8,497.00 monthly to meet the family's basic food needs (CEP, 2020).

Table 27. Sources of income

Sources of Income	Frequency*	Percent of responses	Percent of cases
Wage/Salary	594	49.75	50.73
Earnings from business/livelihood	544	45.56	46.46
Pension/Monetary and non-monetary assistance from family members	56	4.69	4.78

**multiple responses*

When asked about how they keep up with their food expenditures, wage or salary was recorded as the main source of income by the majority (50.73%) of the respondents, and 46.46% of the respondents mentioned additional income from business or livelihood. In addition, 4.78% identified pension and/or monetary and non-monetary assistance from family members (Table 27).

Most household heads work as laborers, repairmen, drivers, fishermen, or farmers. To generate extra income, some mothers accept laundry from neighbors. During the pandemic, some respondents mentioned that they are also engaged in online sales

for varied commodities. Some depend on cash assistance they receive from the government through 4Ps and from their relatives, and others on pensions.

ATP for Plastic Waste Management

The difference between the monthly income and monthly expenditure of respondents represents the ATP, or the capacity to pay, for plastic waste management. The minimum and the maximum ATP of the 1,171 respondents were PHP0 and PHP300,000, respectively, with a mean of PHP3,266.31 and a standard deviation of PHP9,722.79. 29.55% of respondents cannot afford to pay more for plastic waste management (Table 28). The average ATP of respondents amounts to PHP3,266.31 per month or PHP39,195.72 annually. The average ATP was obtained using the formula below:

$$Average\ ATP = \frac{\sum ATP_i}{n} = Php3{,}266.31$$

Table 28. Frequency distribution of ATP. Negative values, where monthly expenditure exceeds monthly income, are reported as zero.

ATP	Frequency	Percent
0	346	29.55
1 - 1,000	154	13.15
1,001 - 2,000	174	14.86
2,001-3,000	131	11.19
3,001-4,000	66	5.64
4,001-5,000	109	9.31
Above 5,000	191	16.31

Relationship between demographic and other characteristics to ATP

Table 29. Relationship between the demographic profile and other characteristics to the respondent's ATP

Profile	Test statistic	p-value	Interpretation
Age	Pearson Correlation	0.116	Not Significant
Sex	Chi-square	0.707	Not Significant
Number of family members	Pearson Correlation	0.378	Not Significant
Land ownership	Chi-square	0.006	Significant
House/Business structure	Chi-square	0.001	Significant
Length of residence	Pearson Correlation	0.852	Not Significant
Source of income	Chi-square	0.382	Not Significant
Educational Attainment	Chi-square	0.010	Significant
Generated Waste	Pearson Correlation	0.153	Not Significant
Generated Plastic	Pearson Correlation	0.153	Not Significant
Household income	Pearson Correlation	0.000	Significant
Expenditures	Pearson Correlation	0.000	Significant
Knowledge	Pearson Correlation	0.731	Not Significant
Attitude	Pearson Correlation	0.394	Not Significant
Practices	Pearson Correlation	0.681	Not Significant

Significant predictors of the respondents' ATP were identified and were used in the Multiple Linear Regression Analysis. Some variables show a significant association with ATP: land ownership, house/business structure, educational attainment, household monthly income, and expenditures (Table 29).

Willingness to Pay for Plastic Waste Management

Table 30. WTP of respondents

Response	Frequency	Percent
No	230	19.6
Yes	941	80.4

Respondents were directly asked about their willingness to pay for plastic waste management, with the only possible answers being yes or no. A binary logistic regression model was utilized to determine the factors or predictors of the respondents' willingness to pay (Hoffmann, 2016).

A majority (80.4%) of the respondents expressed their willingness to pay for plastic waste management (Table 30). A similar study conducted in Northwest Ethiopia also shows that 81.06% were willing to pay for solid waste management (Mulat *et al.*, 2019).

Table 31. Equivalent amount of WTP

	N	Minimum	Maximum	Mean	Std. Deviation
WTP	1171	.0	1,000	37.88	60.80

The average amount respondents were willing to pay for plastic waste management was PHP37.88 ($0.76) per month, with a standard deviation of PHP60.80 (Table 31). This high variability reflects a wide range of amounts within the 1,171 responses.

Table 32. Frequency distribution of the WTP

Amount (PHP)	Frequency	Percent
0	230	19.6
1-100	904	77.2
101-200	27	2.3
201-300	4	0.3
301-400	2	0.2
Above 400	4	0.3

A majority of the 1,171 respondents (77.2%) were willing to pay values ranging from PHP1.00 to PHP100.00 per month for plastic waste management. Only 3.1% of respondents were willing to pay more than PHP100 per month (Table 32).

Relationship between demographic and other characteristics to WTP

Table 33. Relationship between demographics and other characteristics to the respondent's amount of WTP

Demographic profile	Test statistic	p-value	Interpretation
Age	Pearson Correlation	0.472	Not Significant
Sex	Chi-square	0.147	Not Significant
Number of family members	Pearson Correlation	0.896	Not Significant
Land ownership	Chi-square	0.008	Significant
House/Business structure	Chi-square	0.088	Not Significant
Length of residence	Pearson Correlation	0.204	Not Significant
Source of income	Chi-square	0.246	Not Significant
Educational Attainment	Chi-square	0.065	Not Significant
Generated Mixed Waste	Pearson Correlation	0.001	Significant
Generated Plastic Waste	Pearson Correlation	0.001	Significant
Household income	Pearson Correlation	0.405	Not Significant
Expenses	Pearson Correlation	0.191	Not Significant
Knowledge	Pearson Correlation	0.789	Not Significant
Attitude	Pearson Correlation	0.542	Not Significant
Practices	Pearson Correlation	0.013	Significant

Significant predictors of the amount of WTP of the respondents were identified and were used in the Multiple Linear Regression Analysis. Four variables show a significant association with WTP: land ownership, generated mixed waste, plastic waste generation, and practices (Table 33).

Proposed Government-Community-Private Sector Partnership Waste Management Program

Solid waste management in the Philippines has been a perennial problem, despite efforts undertaken by LGUs throughout the country. With the enactment and implementation of two State policies, namely Republic Act 9003 also known as Ecological Waste Management Act of 2000, and the Supreme Court Mandamus on Manila Bay (GR 171947-48), waste management is considered one of the highest priorities of the national government.

Republic Act 9003

The enactment of Republic Act 9003 institutionalized a systematic, comprehensive ecological solid management program in the Philippines. The law declared that it is now a state policy to set guidelines and targets for solid waste avoidance and volume reduction through source reduction and waste minimization measures including composting, recycling, re-use, recovery before a collection, treatment, and disposal of inappropriate and environmentally sound solid waste management facilities following ecological sustainable development principles.

Under RA 9003, Local Government Units (LGUs) are primarily responsible for effective and efficient solid waste management, particularly garbage segregation and disposal. Every LGU is required to develop a 10-year Solid Waste Management Plan (SWMP), including the establishment of MRF and sanitary landfills (DENR, 2019). Gamaralalage *et al*. (2016) state that the National Solid Waste Management Framework is underpinned by RA 9003, which is a legal framework in line with internationally recognized and accepted ISWM concepts.

SC Mandamus on Manila Bay

The Supreme Court issued SC Mandamus on Manila Bay (GR 171947-48) on Dec. 18, 2008, directing 13 government agencies to clean up, rehabilitate, and preserve Manila Bay. DENR Administrative Order No. 34 of 1990 defines coastal and marine waters under Class SB classification as areas regularly used by the public for bathing, swimming, and skin diving, etc. The Manila Bay area covers eight (8) provinces including Cavite.

Cavite, as one of the provinces included as part of the Manila Bay area, was directed to implement the following:

1. Strict compliance on the management of solid waste in the municipality
2. Strict compliance on the management of liquid waste in the municipality
3. Relocation of informal families along riverbanks
4. Continuing information, education, and communication
5. Sustain law enforcement and monitoring

Cavite Waste Management Status

According to the Cavite Economic Profile (2019), the provincial government enacted Executive Order No. 29 in support of R.A. 9003. This EO requires all cities and municipalities of the province to establish waste reduction and recovery schemes and to convert their open dumpsites to controlled ones. It is complemented by Provincial Ordinance No. 007-2012 that regulates the use of plastics and promotes the use of environmentally friendly packaging and practices (CEP, 2020).

Table 34. Projected daily waste generation of selected cities and municipalities

City/ Municipality	Projected Waste generation (kg/day)	Waste Disposal Equipment			Frequency of Garbage Collection
		Compactors	Big garbage trucks	Small garbage trucks	
Kawit	42,824.94		1	3	Daily
Bacoor	36,3548.2				Daily (by contractor)
Imus	183,383.9		3	0	Barangay – once a week Market – Daily
Dasmariñas	231,673.7	8	12	3	Daily
Silang	136,452.3	5	1	7	Barangay – once a week Market – Daily
Total waste generated (5 areas) = 630,689.66 kg/day					
Total for the entire Cavite Province = 1,660,611 kg/day					

Source: *Cavite Ecological Profile, 2019*

The five areas covered generated 630,689 kg/day or 6,306 tons per day (Table 34). This is 38% of the total projected waste generated by the entire province in 2019. The City of Dasmariñas generates the most waste, and the City of Bacoor the least.

Persistent Solid Waste Disposal Problem Issues

Mamady (2016) revealed that major causes of improper management of solid waste are related to many things, including perceptions, socio-cultural practices, and municipal infrastructure.

The results of this study point to these causes. For instance, in terms of perception and socio-cultural practices, data from the five cities/municipalities covered by the study show the following results:

Knowledge about wastes

From the data earlier discussed regarding KAP in this study, in terms of their knowledge about plastic waste, 86.9% of respondents noticed waste in the river. 60.3% of all respondents had noticed people throwing garbage into canals, waterways, and rivers (Table 35).

Table 35. Knowledge on wastes in the river

Questions	Frequency (Percent)	
	No	Yes
Do you notice plastic wastes in the river?	153 (13.1%)	1,018 (86.9%)
Do you notice anyone throwing garbage in canals, waterways and/or in rivers?	465 (39.7%)	706 (60.3%)

These data reveal that despite the prohibition of LGUs, some people continue to dispose of garbage directly into the river. Various types of plastic and other waste is visible in the river despite government and community clean-up attempts (Figure 6).

The barangay captain of Sabutan, Silang, said during the courtesy call visit that government clean-ups are not enough to counteract poor disposal practices.

Figure 6. Part of the Imus River in Brgy. Sabutan in Silang

In Bacoor, data from CENRO notes the presence of garbage in the river. CENRO noted people engage in littering, and the illegal dumping of unsegregated waste into the river, despite government efforts to inform the public and enforce SWM laws.

These results fit data at the national and provincial levels. As pointed out by Gamaralalage *et al*. (2016), the implementation of solid waste management laws at the local government level is still very limited even after more than a decade has passed since enactment in 2016. They further noted that Municipal Solid Waste Management (MSWM) is one of the most serious environmental and public health issues in the Philippines. One to two-thirds of MSW generated is not properly collected, and is often dumped discriminately, contributing to flooding and increases in pests and disease (Gamaralalage *et al.*, 2016).

However, as of June 2020, all the cities and municipalities in Cavite, except for Trece Martires City and General Emilio Aguinaldo, have had their solid waste management plan approved (Cavite Ecological Profile, 2020) (Table 36).

Table 36. Cities and municipalities with approved solid waste management plan

City / Municipality	Year covered	NSWMC Resolution No.	Status (June 2020)	
Kawit	2015- 2024	316 B Series of 2017	Approved	Currently updating
Bacoor	2014 – 2023	111 Series of 2014	Approved	Currently updating
Imus	2015 – 2024	692 B Series of 2017	Approved	Currently updating
Dasmariñas	2015 – 2025	538 A Series of 2016	Approved	Currently updating
Silang	2015 – 2025	837 Series of 2016	Approved	Currently updating

Source: Cavite Ecological Profile, 2019 (updated 2020)

In a recent report from the Department of Environment and Natural Resources (2021), Cavite officials stated that solid waste management was the number one problem in Cavite when it comes to the environment. An estimated 50% of solid waste in the province goes into its rivers accounting for approximately 2,000 tons a day, of which 90% goes to Manila Bay (DENR, 2021).

Table 37. Availability and sustainability of waste management facilities

City / Municipality	Solid Waste Disposal System
Kawit	Suri Waste Management and Disposal Services, Calamba City, Laguna
Bacoor	Rizal Provincial Sanitary Landfill San Mateo Sanitary Landfill
Imus	Rizal
Dasmariñas	Brgy. Salawag, Dasmariñas City
Silang	Bauan, Batangas

Source: *Cavite Ecological Profile, 2019*

The solid waste disposal system in Cavite is by contract or utilization of sanitary landfills. All cities and municipalities in the province also have their centralized MRF (CEP, 2020) (Table 37). Despite this, this study shows that respondents are often unaware of the existing waste management facilities of LGUs in Cavite.

This study also reveals important issues related to SWM in the locale of the study. Specifically:

Awareness of proper disposal of waste

Respondents slightly agree that people throw plastic waste into the river due to a lack of awareness/knowledge on proper disposal (Table 38).

Table 38. Lack of awareness on waste disposal

Item	Mean ± SD	Interpretation
People throw plastic wastes into the river due to a lack of awareness/ knowledge on proper waste disposal.	3.39 ± 1.24	Slightly Agree

On incentives for SWM to community

891 (76.1%) of respondents are aware of the economic program that the government provides for observing proper waste management (Table 39).

Table 39. Knowledge on incentives for SWM to community

Questions	Frequency (Percent)	
	No	Yes
Do you know that there is an economic program that the government provides for observing proper waste management	280 (23.9%)	891 (76.1%)

Respondents agree that people will be encouraged to recycle plastic waste if such actions come with incentives like money and food (Table 40).

Table 40. Incentives to encourage people to recycle plastic waste

Item	Mean ± SD	Interpretation
People will be encouraged to recycle plastic waste if it has incentives like money or food	3.99 ± 1.02	Agree

On enforcement

Respondents agree that strict enforcement of the law will prevent people from dumping their garbage in the river (Table 41). They also see increased self-discipline as a solution in the face of the simplicity of littering (Table 42), and agree existing clean-up efforts make a difference (Table 43).

Table 41. Enforcement of laws on garbage disposal

Item	Mean ± SD	Interpretation
Strict enforcement of the law will prevent people from dumping garbage in the river	4.35 ± 0.78	Agree

On self-discipline

Table 42. Self-discipline as solution to waste problem

Item	Mean ± SD	Interpretation
People can easily throw plastic wastes into the river because the river is close to their homes	3.49 ± 1.27	Slightly Agree
Self-Discipline is the Solution to the waste problem	4.73 ± 0.54	Strongly Agree

On clean-up drive

Table 43. Efforts of various groups in reducing plastic pollution in the river

Item	Mean ± SD	Interpretation
The efforts of various groups to clean up the river are helping to reduce plastic pollution in the river	4.52 ± 0.62	Strongly Agree

On lack of facilities or infrastructures for waste disposal

Respondents slightly agree that people throw plastic waste in the river because they lack other disposal options. They also agree that people would be encouraged to recycle plastic waste if there is a proper waste collection system and management facility present in their locality (Table 44).

Table 44. Proper waste collection systems and facilities

Item	Mean ± SD	Interpretation
People throw plastic waste in the river because of the lack of other waste disposal options	3.20 ± 1.25	Slightly Agree
Proper waste management facilities will keep people from improperly disposing of waste plastic	4.43 ± 0.69	Agree
People will be encouraged to recycle plastic waste if there is a proper waste collection system and management facility.	4.46 ± 0.63	Agree

Such responses suggest that either the collection of waste or the community waste management facility is perceived as inadequate. The amount of waste generated by communities may exceed the capacity of LGUs who collect and dispose of it. On the other hand, data presented by barangay officials suggests they are aggressively implementing the national and local laws on waste management. The Municipality of Kawit created a river filtering system and MRF to comply with local laws on waste management (Figure 7).

Figure 7. River filtering system (top) and MRF in Brgy. Aplaya (bottom) in Kawit

According to the Department of Natural Resources, 21 of the 23 cities and municipalities of Cavite have limited capacity to put up their own solid waste facility, due to the limited availability of land in the province. The DENR Secretary also notes that rainfall caused trash from various waterways, including those in Cavite, to drift to Manila Bay. The increase in the garbage in rivers may be attributed to the closure of all dumpsites in the province, which was done to comply with Republic Act 9003 or the Ecological Solid Waste Management Act of 2000. Cavite officials have appealed for the DENR to help in setting up sanitary landfills in various areas of the province (DENR, 2021). Such statements align with the results of this study.

The major issues that were presented from the data at the national, provincial, and the local community levels (based on the survey results of this study), necessitate the need to come up with additional intervention/action from the three major sectors concerned with waste management: the community, the government, and the private sector. While all are waste generators, the government plays a key role due to its mandate to provide public service and protect the Philippine environment. Thus, the task of cleaning up the environment, specifically stipulated by RA 9003, must be spearhead by the state/government, seeking the cooperation of the community and the business/private sector.

Thus, this paper proposes a Government-Community-Private Sector Partnership to implement a massive and sustained information and education drive, incentive giving, and strict enforcement of government laws, strengthen volunteerism and cooperation of the community and the need to involve and harness the financial and management prowess of the private sector in solid waste management.

This proposed community-based government and private sector-led solid waste management program highlights the cooperation needed between the government, private sector, and grassroots local community in the management of solid waste.

Active and sustained government cooperation with the private sector through Public-Private Projects can help local government units defray the cost of putting up waste management facilities and otherwise improving the collection, processing, and disposal of garbage. Local businessmen and institutional agencies at the community level are encouraged to participate in successfully implementing solid waste disposal and recycling in their respective areas. The proposed program zeros in on three important areas, based on the data collected, that contribute to the improper disposal of waste that usually ends up in the Imus River (Figure 8).

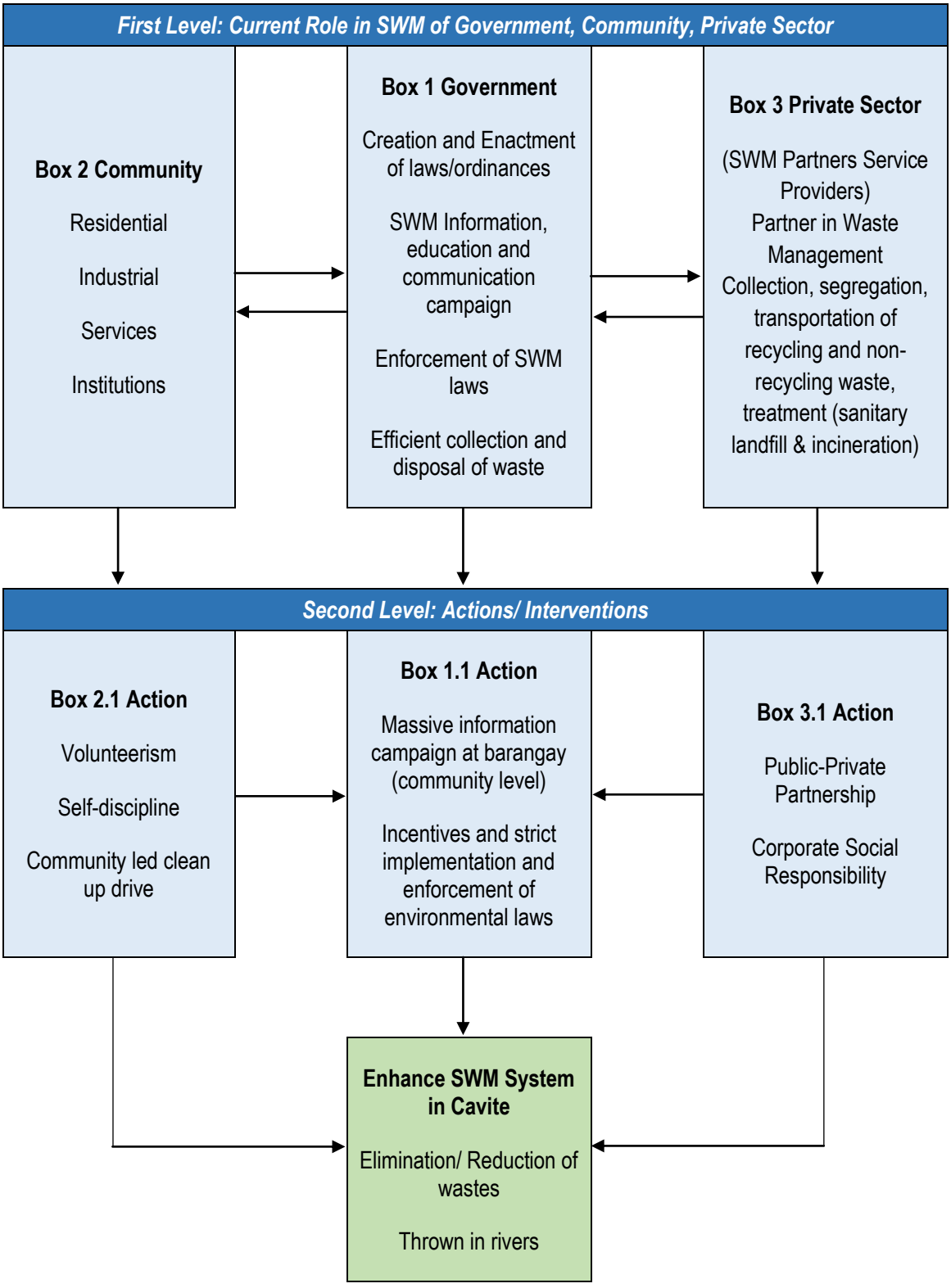

Figure 8. Government-Community-Private Sector SWM Partnership Framework

The main stakeholders in the SWM process (Figure 8) include the community i.e. residents, industry and services, the government, and the private sector i.e. contractors hired to handle SWM related activities by the government.

The SWM process is explained by highlighting the first level role of the three players, namely the government, community, and the private sector.

The government (Box 1, Figure 8) as the major stakeholder in SWM, provides the formulation, creation, and enactment of SWM laws and ordinances. It has the responsibility to disseminate information, education, and communication campaigns for the better understanding of SWM issues. The government is also responsible for the enforcement of SWM laws, the efficient collection and disposal of waste, and the provision of SWM facilities and infrastructure.

The community (Box 2, Figure 8) is a waste generator, but also a waste reducer at source through recycling, composting, or reuse.

The private sector (Box 3, Figure 8) is a partner in waste management, performing SWM management duties based on the contact /function given to them. They are responsible for the collection, segregation, transportation of recycling and non-recycling waste, treatment (sanitary landfill & incineration), and disposal of waste.

The 2nd level role (Figure 8) highlights the proposed action/intervention that the players should do to enhance the SWM process in the communities near the Imus River.

To explain:

Box 1.1 refers to the contribution of the community via providing volunteers for clean-up drives and observing self-discipline by strictly observing proper waste disposal.

Volunteerism and self-discipline can be inculcated or practiced by households in the community. This can be done through the changes in attitude regarding solid waste management practice compliance. As pointed out by Onanuga and Odunsi (2018), attitudinal change regarding solid waste disposal practices is required. They mentioned that this can be achieved through enlightenment programs designed to create awareness of the negative effects of indiscriminate solid waste disposal practices on public health and the environment. These programs could be held at public places such as town and community halls.

Box 2.1 refers to government interventions to improve SWM in the areas near the Imus River. Specifically, the paper recommends a massive information campaign.

A report from Asian Development Bank (ADB) detailed the vital role of an information, education, and communication (IEC) campaign in engaging the community and civil society to bring about a better understanding of key waste

management issues. Many IEC campaigns, though, are relatively short-term and do not sustainably achieve engagement. IEC is meant to achieve a sustainable community attitudinal change regarding SWM, which takes more than a decade and is essentially generational (ADB, 2017).

Thus, it is recommended that a sustained and massive information campaign should be introduced to continuously remind the community about the need to properly follow solid waste management. Strict implementation and enforcement of SWM laws must also be carried out.

Onanuga and Odunsi (2018) suggested national governments should adopt punitive measures, as SWM is the statutory responsibility of local governments. Furthermore, they mentioned there should be comprehensive enforcement of environmental legislation relating to environmental sanitation offenses.

This is necessary because respondents of this study revealed that some people do not follow proper waste disposal. As pointed out by Shehu *et al*. (2018), governments should strengthen their legislative instruments and establish necessary sanctions and enforcement mechanisms on members of the public who fail to comply with environmental legislation and laws (Shehu, 2018). Onanuga and Odunsi (2018) state that punitive measures attached to indiscriminate acts of disposal should be publicized through the mass media to ensure public awareness. Environmental marshals should also regularly monitor waste collection. Defaulters should be arrested and made to pay fines, with serious cases tried in courts that can hear such cases.

Lastly, on SWM-related infrastructure and facilities, as Onanuga and Odunsi (2018) argued, concerned local government agencies also need to be effective and efficient by providing solid waste storage facilities in proximity to residences and institutions for ease of waste collection from households and personnel. This intervention is needed to address the result of this study referring to the concerns of respondents with regards to the provision of adequate SWM facilities in the community.

Box 3.1 refers to the contribution of the private sector to assist both the government and community to provide infrastructure and facilities to improve SWM via the Integrated Solid Waste Management (ISWM) system, a Public-Private Partnership mode of investment. LGUs should invite SWM companies that use ISWM in a PPP arrangement.

The study of Memon (2010) on ISWM based on the 3R approach (reduce, reuse, and recycle) aimed at optimizing the management of solid waste from all the waste-generating sectors (municipal, construction and demolition, industrial, urban

agriculture, and healthcare facilities) and involving all the stakeholders (waste generators, service providers, regulators, government, and community/ neighborhoods). They mentioned that 3R helps to minimize the amount of waste from generation to disposal, thus managing the waste more effectively and minimizing the public health and environmental risks associated with it. Lastly, the new concept of ISWM has been introduced to streamline all stages of waste management, i.e., source separation, collection and transportation, transfer stations and material recovery, treatment and resource recovery, and final disposal.

Furthermore, Memon (2010) stated that ISWM was originally targeted at municipal solid waste management (MSWM), but now the United Nations Environment Programme (UNEP) is promoting this concept to cover all waste generating sectors to optimize the level of material and resource recovery for recycling, as well as to improve the efficiency of waste management services.

Data from Mohan *et al*. (2016) presented the successful case of Saharanpur, a small city in India. They noted that the municipal government, facing a difficult problem in terms of solid waste collection and disposal, collaborated with an NGO and a private SWM company and initiated a pilot PPP project on solid waste management in 2006. With a persistent focus on processing, recycling, and user fees, the project was successful, and able to surpass the national benchmark of 80% waste recovery set by the Indian Ministry of Urban Development (MoUD). 941 or 80.4% of the respondents in Mohan *et al*. (2016) were willing to set aside a certain amount to pay for the user fees of a solid waste management program initiated by the government (Table 45).

Table 45. Willingness to set aside certain amount for waste management (Mohan *et al*. 2016)

Response	Frequency	Percent
No	230	19.6
Yes	941	80.4

The results of our study also show that the respondents are willing to set aside an average of 37 pesos to support a solid waste management system or program (Table 46).

Table 46. Amount willing to set aside for waste management

Amount (PHP)	Frequency	Percent
1 – 99	738	63.0
100 – 199	177	15.1
200 – 299	17	1.5
300 – 399	6	.5
400 and above	4	.3
Mean (SD)	***37.88 (60.80)***	

Data from UNEP (2009) show that the ISWM system has been pilot tested in few locations (Wuxi, China; Pune, India; Maseru, Lesotho) and has been well received by local authorities. The UNEP report added that it has been shown that with appropriate segregation and recycling systems, a significant quantity of waste can be diverted from landfills and converted into a resources (UNEP, 2009).

Lastly, Onanuga and Odunsi (2018) believe that to encourage the private investors, whose primary intention is profit-oriented, the budget of the local government could provide for subsidies. Otherwise, public-private partnerships should be encouraged as a measure to ensure waste is collected.

Presently, the Municipality of Silang is in talks with ARN Central Group, a private company handling the SWM program in Cebu. The ARN Central Group is proposing a PPP arrangement and are offering Silang an ISWM that will process solid and water wastes. If the proposed PPP pushes through, this would become the first government-private partnership using the ISWM system in Cavite.

Conclusions and Recommendations

Conclusion

Based on the analysis, the following conclusions are drawn:

Respondents are knowledgeable about the negative effects of plastic pollution in the Imus River and their community, as evidenced by a high knowledge level (mean = 12.97) from 88% of the total number of respondents. They are aware that plastic waste makes the environment look unpleasant, that accumulated plastic waste in canals/waterways/rivers can cause flooding, and that plastic pollution in the river can be harmful to human health. They are also cognizant of the government programs such as the plastic ban and river clean-ups. One notable result is that barangay officials are recognized as the source of environmental information and implementers of river clean-ups.

Respondents showed a high positive attitude with a mean of 4.18 with a standard deviation of 0.45 regarding conservation and mitigation efforts in the Imus River. They strongly agree that self-discipline is the solution to the waste problem and that plastic pollution waste in the river is dangerous to the community.

The respondents demonstrated good practice (mean = 3.237, standard deviation = 0.652) on the conservation and mitigation efforts on the Imus River. While they often use products in plastic sachets, pouches, and wrappers, especially for 3-in-1 coffee and candy, they seldom use plastic cutlery and plastic bottles. They also seldom buy home plastic-wrapped cooked foods from a restaurant or cafeteria, and plastic-packed products in malls or supermarkets. Moreover, a majority have a trash can and claim that their waste is collected. However, some throw garbage into pits, burn it, or take it to a temporary dump site. Respondents also seldom segregate biodegradable and non-biodegradable wastes. Despite some contradicting practices, the overall waste segregation and disposal is considered good.

Among the three domains of knowledge, attitude, and practice, a positive covariance was only observed between knowledge and attitude.

Only 289 (24.7%) respondents claim that they benefit economically from the river. These respondents were fishermen from Kawit. Potential benefits from the river relate to agricultural products, the use of water from the river, and tourism. However, a large number of respondents found the river too polluted and unsafe for such agricultural and domestic purposes. In upland stretches the river is too dangerous for residents to access, and its shores are uninhabitable for residential purposes.

The ATP range of the respondents was PHP0 to PHP300,000, with a mean of PHP3,266.31 and standard deviation of PHP9,722.79. The average ATP of respondents was PHP3,266.31 per month, or PHP39,195.72 annually. There were only three variables that emerged as predictors of ATP: elementary educational attainment, household income, and household expenditure. Respondents with elementary level education tended to have a higher ability to pay: PHP191.02 higher on average compared to the other educational attainment levels. Moreover, for every peso increase in the monthly household's income of the respondents, ATP also increases by PHP0.978 on average, holding the other variables constant. Also, for every peso increase in the monthly household's expenditure of the respondents, ATP decreases by PHP0.969 on average, holding the other variables constant.

Variables that significantly correlated with the WTP of respondents were the amount of generated plastic waste and the practice score. Based on the Amount of WTP regression model, for every unit increase in the amount of plastic waste generated, the amount that the respondent is willing to pay increases by PHP2.756, holding other variables constant. Likewise, for every unit increase in the practice score, the respondents' willingness to pay a certain amount for plastic waste management increases by PHP 7.235, holding other variables constant.

On the recommended community-based plastic waste management program based on the collected data on KAP, ATP, and WTP of different stakeholders, interventions should focus on massive IEC drive, provision of incentives, strict enforcement of SWM laws, community involvement, and strong public-private partnerships.

Recommendations

Based on the results of this study, the following recommendations are given to propel an effective community-based waste management program:

1. *Massive IEC drive.* Develop innovative and creative means of engaging and motivating the households to increase pro-environmental practice. A critical review of the existing programs and projects on waste management must also be undertaken to determine if they are still appropriate or relevant in the present context of the barangays.

2. *Provision of incentives.* Practical interventions like incentives or rewards may be instituted to achieve interest while promoting environmental sustainability. In particular, incentives may be given to households with small businesses that provide product refills, use alternative packaging, and are compliant with waste management policies.

3. *Strict implementation and enforcement of SWM laws.* Barangay officials are mandated to strictly enforce ESWM policies, and sanction violators.

4. *Community involvement.* This is hoped as a voluntary initiative as volunteer groups and individuals were observed to be active in the river clean-ups. A strong volunteer program should be created to maintain and engage these volunteers for continuous involvement in the river clean-up and other possible environmental programs.

5. *Engage the private sector* via BOT also known as Public-Private Partnership that will invest using the ISWM system. External partnerships should be sought for funding and technical assistance. Some projects may be linked to government agencies like DTI and DENR.

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Appendix

SUPPORTING ANALYSIS OF DATA

Appendix Table 1. Model Summary

Model	R	R Square	Adjusted R Square	Standard Error of the Estimate
1	0.996	0.992	0.992	869.5289

The table for the model summary (Appendix Table 1) shows that the R value is 0.996, with an R-squared value of 0.992 implying 99.2% of the variability of the respondents' ATP was explained by the model. This implies a high positive correlation between the dependent and independent variables.

Appendix Table 2. Analysis of variance (ANOVA)

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	109727681962.479	12	9143973496.873	12093.915	**.000**
Residual	875541269.616	1158	756080.544		
Total	**110603223232.095**	**1170**			

An ANOVA analysis (Appendix Table 2) shows that the model is significant in explaining the existing relationships between variables.

Appendix Table 3. Significant predictors of ATP

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	233.853	61.751		3.787	**.000**
Land not owned	-76.215	66.366	-.004	-1.148	.251
Business not owned	-48.864	60.125	-.002	-.813	.417
EA No Formal Education	-52.850	254.639	-.001	-.208	.836
Elementary level	191.024	87.479	.006	2.184	**.029**
Elementary grad	58.700	103.856	.002	.565	.572
HS level	82.733	69.645	.004	1.188	.235
College level	-2.570	89.561	.000	-.029	.977
College grad	-50.710	101.831	-.001	-.498	.619
Post grad	-53.005	358.979	.000	-.148	.883
Vocational	-43.368	139.309	-.001	-.311	.756
Household Income	.978	.003	2.173	333.796	**.000**
Household Expenses	-.969	.004	-1.516	-233.27	**.000**

The variables that were found to be significantly correlated with ATP were categorical. These variables refer to land ownership, house/business structure, and educational attainment. Dummy variables were created for modeling. The continuous variables such as household income and expenditure were utilized in their original level of measurement. There were only three variables as significant predictors of ATP: elementary level educational attainment, household income, and household expenditure (Appendix Table 3). The constant value was also found to be significant with a 0.00 value.

The results lead to the formulation of the ATP regression model given below.

$$ATP_i = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \cdots . + \beta_p X_{ip} + \varepsilon_i$$

$$ATP_i = 233.853 + 191.02\ (Elementary\ Level) + 0.978\ (Household\ Income) - 0.969\ (Household\ Expenses)$$

Based on the ATP regression model, the respondents with educational attainment of elementary level tend to have a higher ability to pay of PHP191.02 on average as compared to those who have higher or lower educational attainment. The model shows that for every peso increase in the household's monthly income, ATP also increases by PHP0.978 on

average, holding the other variable constant. For every peso increase in the household's monthly expenditure, ATP decreases by PHP0.969 on average, holding the other variable constant.

Further analysis was done to determine the variables that were significant predictors of the respondents' WTP.

Appendix Table 4. Omnibus Tests for Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	99.653	12	**.000**
	Block	99.653	12	.000
	Model	99.653	12	.000

The model is significant in presenting the relationship between the dependent variable and independent variables (Appendix Table 4).

Appendix Table 5. Nagelkerke R Square

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	1060.550	0.082	0.130

The Nagelkerke R Square value is 0.130 (Appendix Table 5). This means that only 13% of the variation of willingness to pay of the respondents was explained by the model. Other factors were not captured in this study. This value does not represent the goodness of fit of the model.

Appendix Table 6. Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	5.551	8	.697

The model fits the data (Appendix Table 6). The null hypothesis presents that the model fits the data against the alternative that the model does not fit the data. The significance of 0.697 causes the null hypothesis to be retained.

Appendix Table 7. Classification Table

Observed			Predicted		
			AWTPQ3		Percentage Correct
			.0	1.0	
Step 1	WTP	.0	6	224	2.6
		1.0	9	932	99.0
	Overall Percentage				**80.1**

80.1% of the cases were correctly predicted by the mode. 99% was correctly predicted in the group of respondents who are willing to pay a certain amount as payment for the conduct of the plastic waste management program in the Imus River. On the other hand, only 2.6% was correctly predicted in the group of respondents who are not willing to pay (Appendix Table 7).

Appendix Table 8. Variables in the Equation

	B	S.E.	Wald	df	Sig.	Exp (B)	95% CI for EXP (B)	
							Lower	Upper
Land Ownership	1.272	.228	31.051	1	**.000**	3.567	2.280	5.579
House/Business Structure	-1.608	.210	58.916	1	**.000**	.200	.133	.302
Educational Attainment			14.083	8	.080			
No Formal Education	-1.350	.749	3.252	1	.071	.259	.060	1.125
Elementary Level	-.071	.488	.021	1	.885	.932	.358	2.423
Elementary Graduate	-.792	.489	2.617	1	.106	.453	.174	1.182
High School Level	-.175	.448	.152	1	.697	.840	.349	2.019
High School Graduate	-.249	.432	.333	1	.564	.779	.334	1.817
College Level	.283	.485	.340	1	.560	1.327	.513	3.430
College Graduate	.161	.502	.103	1	.748	1.175	.440	3.140
Post Graduate	20.092	16104.580	.000	1	.999	531960606.671	.000	.
Monthly Income	<.001	.000	6.378	1	**.012**	1.000	1.000	1.000
Monthly Expenses	<.001	.000	6.612	1	**.010**	1.000	1.000	1.000
Constant	1.715	.534	10.322	1	**.001**	5.558		

The results of these predictive variables (Appendix Table 8) can be converted into the WTP logistic regression model below:

$$Log\left[\frac{p(WTP)}{1-WTP}\right] = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \cdots . + \beta_p X_{ip} + \varepsilon_i$$

$$\log\left(\frac{p}{1-p}\right) = 1.715 + 1.272(Land\ ownership) - 1.608(business\ structure) + 0.001(Monthly\ Income) + 0.001(Monthly\ Expenses)$$

Based on the WTP logistic regression model, the odds or likehood of WTP of landowners tend to be 1.272 higher compared to those who were not landowners, holding the other variables constant. The likelihood of WTP of those who own the business building structure were 1.608 times lower than those who do not own the building structure, holding the other variables constant. Monthly income and monthly expenditure were found to be both significant predictors of the respondent's WTP. However, the comparison between the WTP and the two variables was statistically negligible (Appendix Table 8).

Appendix Table 9. Analysis of variance

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	55039.60	3	18346.53	5.014	.002
Residual	4266620.93	1166	3659.195		
Total	**4321660.53**	**1169**			

An ANOVA analysis (Appendix Table 9) shows that the model is significant in explaining the existing relationships between variables.

Appendix Table 10. Coefficients for WTP

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	8.565	11.422		.750	.454
	Land owned	-3.247	3.917	-.024	-.829	.407
	PQ12.1(Plastic)	2.756	.978	.083	2.818	**.005**
	Practice score	7.235	3.520	.061	2.055	**.040**

Variables that were found to be significantly correlated and significant in predicting the amount of WTP of the respondents were the amount of generated plastic waste and the practice score (Appendix Table 10). The results of the WTP regression model is provided below:

$$Amount\ of\ WTP_i = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \cdots . + \beta_p X_{ip} + \varepsilon_i$$

$$Amount\ of\ WTP = 2.756 * \text{Amount of generated plastic waste} + 7.235 * \text{Practice Score}$$

Based on the Amount of WTP regression model, it shows that for every unit increase in the amount of plastic waste generated, the amount that the respondent is willing to pay increases by PHP2.756, holding the other variables constant. In addition, for every unit increase in the practice score, the respondents' willingness to pay a certain amount for plastic waste management increases by PHP 7.235, holding the other variable constant.

Appendix Table 11. R Square

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.113	0.013	0.010	60.4913

Based on the SEM model, the result shows that the R value was only 0.113. This implies a low positive correlation between dependent and independent variables. The R-square value of 0.013 implies that only 1.3% of the variability of the willingness (amount) to pay of the respondents was explained by the model (Appendix Table 11).

The Research Team

Dr. Socorro Grace M. Red, the project's team leader, is a faculty from DLSU-D for nearly 20 years. She currently works as a Lasallian Formator under the University Lasallian Family Office. She has broad experience in teaching, community organizing, and conducting relief and rehabilitation activities in the disaster-stricken areas. Dr. Red has been engaged in several research projects related to environment and youth development.

Dr. Maria Theresa D. Gochuico is the project's co-leader. She is the current coordinator of the Lasallian Community Development Center (LCDC), the extension arm of the DLSU-D. Her extensive experience in extension and specialization in development communication is evident in her research projects on knowledge management, environmental communication, and community development

Dr. Jan Phillip D. Mallari is a Development Studies Professor and currently the Director of the College of Liberal Arts and Communications Graduate School of DLSU-D. His research outputs are in the field of Political Economy, Poverty Studies, Philippine Economic History and Sustainable Development.

Mr. Edwin S. Bunag is an Assistant Professor of Mathematics and Statistics Department and the former Director of the General Services Office of DLSU-D. He is also a former member of the Board of Directors of the Operations Research Society of the Philippines (ORSP) and a member of the Mathematical Society of the Philippines (MSP).

Mr. Elmer N. Jimenez is a registered Guidance Counselor and a registered psychologist. He is affiliated with DLSU-D for almost 20 years under the Student Wellness Center. His passion is to understand behavior and assist person in trouble to maintain a balance life.