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Estimating Households' Willingness-to-Pay for an Improved Solid Waste Management in Butuan City, Philippines

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ABSTRACT

The concept of community participation has been a strategy of different organizations in implementing a program. A waste analysis and characterization study (WACS) was conducted in Butuan City, Philippines, before the disruption of the COVID-19 pandemic in 2020. Along with WACS is the determination of the household waste generators' willingness-to-pay (WTP) amount for improved management of solid waste in the City using the dichotomous choice contingent valuation method (DC-CVM). The study involved 427 randomly selected households who were asked how much they would pay based on the pre-identified bid prices. Respondents were iteratively asked for the WTP amount until the highest possible amount was elicited. The mean amount of WTP was estimated using the logistic regression model. The model considered the household's socio economic profile, solid waste generation, management practices, and perception as predictors of the WTP amount. As a result, households are willing to pay PhP19.27 every month. The model also shows that bid amount WTP, practice on segregation, awareness of collection schedule, respondent's age, and the household's total monthly income are significant factors affecting the willingness to pay. With the results on the suggested amount, it hopes to help the LGU Butuan Legislators and solid waste management task force formulate actions and strategies to ease the mounting problem of solid waste in the city.

Keywords: *Willingness-to-pay; solid waste management; dichotomous choice contingent valuation; logistic regression*

1 Introduction

Managing solid waste has always been in the mainstream of the national agenda. However, solid waste management issues have become problematic as it directly manifests in environmental conditions, human health, and the local economy (World Bank 2012). In Asia, countries like the Philippines, Indonesia, some parts of China, and India were tagged as having among the highest trash collection rates even during the late 1990s (World Bank 1999). The Philippines, moreover, has continued to suffer the mounting problem of solid waste in recent years as the total solid waste generated bloated based on the World Bank Report in 2012. The country was even dubbed as the world's 3rd biggest dumper of plastics in the ocean based on a study conducted by the University of Georgia in 2015 (University of Georgia 2015). Moreover, solid waste is projected to double shortly with the growing population and the enormous change due to urbanization (World Bank 2012).

In 2000, a roadmap to manage the growing dilemma of solid waste in the Philippines was

promulgated by the Republic Act (RA) 9003 or the Ecological Solid Waste Management Act of 2000 (Republic of the Philippines Official Gazette 2001). Through RA 9003, the provision of solid waste management (SWM) programs, institutional mechanisms, funds, and incentive sources for the implementation are given in detail. One of the provisions stipulated therein requires the country's local government units to prepare and submit a ten-year solid waste management plan (SWMP). This plan shall consist of all necessary components, such as the background information of the area, solid waste generation profile, current management practices, and proposed solid waste minimization and reduction programs and projects, among others. To carry out and realize what is being highlighted in SWMP, the provision of funds and authority to collect solid waste management fees sufficient to pay the cost incurred in implementing and financing SWM activities and projects are also emphasized.

The concept of community participation has been used as a strategy by different organizations in implementing a program. Community members may be involved at various stages of the project/ program, and the support may vary (Burns et al. 2004; Karibeeran and Kuruvilla 2015). The problems with solid waste management are a severe issue encountered and a responsibility not only by the local government but also a concern of the locals. Efforts are also evident from those individuals and institutions who advocate for a cleaner and sustainable environment since improper management of solid wastes implies human health (World Health Organization (WHO) 2016) and the economic condition of the locality (Yedla and Kansal 2003). Indeed, the community has a significant role in maintaining and sustaining an efficient solid waste management system in an area. However, immediate collective actions and support must be taken to address such a dilemma, and negative impacts may cease to occur. Willingness-to-pay (WTP) for a specific service or product is one way the community can express their support and contribution to a program/ project that an organization is promoting and implementing. While these services or products give people benefits and utility, they do not have a market price as they are not directly sold. Consequently, a price-based model approach will not be possible in this case. Contingent valuation surveys are one technique that elicits a willingness-to-pay amount for this aspect (Haab et al. 2002). Estimating the mean WTP amount involves several analyses, such as choosing the proper methodology and developing statistical models that will be used to compute the amount. Some approaches and techniques may involve simple computation, but others also require intensive calculation as it involves various variables and how the data was collected. The study of Ezebilo (Ezebilo 2013) applied the CVM to gather preference data on households' willingness to pay for services related to domestic trash management in underdeveloped nations. When evaluating the advantages of incorporating private companies in residential garbage management, the willingness to pay could be considered. Their paper covers variables such as sanitary inspector activities and travel time to garbage collection places, in addition to the variables frequently utilized in the published literature to predict willingness to pay for better residential waste management services.

The Local Government of Butuan is currently working on the City's SWMP. Being a first-class city and the regional center of the Caraga Region, the City has experienced a big leap in its economic and environmental conditions, thereby experiencing a considerable impact of urbanization. Further, the City has a total population of 372,910 based on the 2020 Census, a 10.64% increase from the previous census (Philippine Statistics Authority (PSA) 2020). This increase in the population also has a significant implication for waste generation. As of early 2019, there have been no concrete programs and actions of the local government on minimizing or reducing solid waste in the area. With the growing population and impacts of urbanization, the adverse effects of continuous solid waste generation may be exacerbated. In 2019, a waste analysis and characterization study (WACS) for Butuan City was conducted, an essential component of developing the SWMP of the City. Conducting WACS was crucial, as it comprised methods and processes that needed a careful and strategic collection of crucial information, such as solid waste characterization from different sources. The study determined the community's participation in a project highlighting the improvement of solid waste management in the area, e.g., regular and efficient waste collection from every household and establishment within the urban villages. In this study, the participation of the community, specifically the households from

urban villages, is expressed in the form of their willingness to pay for the services of managing solid wastes in the area and its sustainability. Household profile and their solid waste generation, practices, and perception of SWM/ SWMP were gathered as inputs to estimate the mean WTP amount.

2 Materials and Methods

Location of the Study

The study in 2019 involved households from 44 urban villages of Butuan City. Butuan City is a first-class, highly urbanized city located in the northeastern part of Mindanao Island. It is the regional center of the Caraga Region and covers roughly 4.1% (81,662 hectares) of the region's total land area. The city, with coordinates 8°57'18''N and 125°32'15''E, is bounded by some towns and municipalities of Agusan del Norte to the north, west, and south and by Agusan del Sur to its east.

Study Participants

Four hundred twenty-seven (427) randomly selected households actively participated in collecting waste information, perception, and socio-demographic characteristics. These participants are represented by the household head or anyone from the household who can respond and supply necessary demographic details of the household. Household members were also encouraged to participate in collecting data, most notably in preparing and organizing the household wastes ready for evaluation. The participating households have 4 to 6 members who are all permanently staying in the house, residents in the area for at least six months, have not engaged in any home-based business, and have not expected any celebration during the data collection period. This selection ensures no sudden fluctuation in waste generation, and the households are aware of the waste management practices in the area.

Survey Instrument

The study developed and validated the instrument to assess and characterize solid wastes and other pertinent information from the household sector. A household survey instrument was comprised of five parts, namely: (1) Household Basic Profile, where respondent's basic information, household composition, and economic status were determined; (2) Household Solid Waste Management Practices; (3) Household Solid Waste Knowledge and Awareness; (4) Household Solid Waste Characterization; and (5) Household

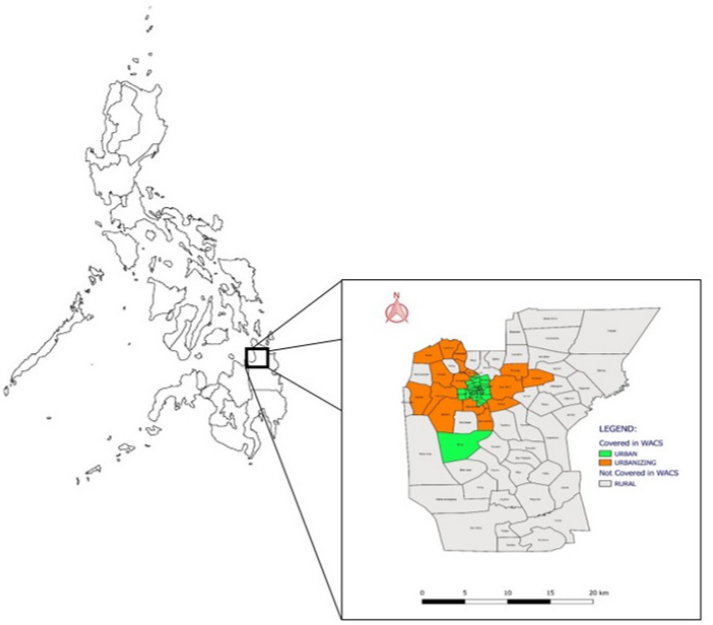

Figure 1. Map of Butuan City showing the sampling site

Willingness-to-Pay (WTP) for an Improved Solid Waste Management System.

Eliciting the WTP amount started with a hypothetical scenario that states the current waste generation, management, and ordinances implemented in the City. It also discussed the importance of the households' participation in the success of the organization project, just like improving the solid waste management system in the City where they belong. Bid prices of PhP 10.00, PhP 20.00, PhP 30.00, PhP 40.00, PhP 50.00, PhP 60.00, and PhP 70.00 were determined based on related literature and consultations with different stakeholders during the focused group discussion (FGD) that reflects the payment capacity of households in the Philippines. The hypothetical scenario is given as follows:

The City Government of Butuan is trying to correctly manage solid waste and create a mechanism for efficient waste collection. The city has passed many SP ordinances and executive orders focusing on management and implementing solid waste laws and regulations properly to ensure that the town has adhered to the provisions of RA 9003 or the Ecological Solid Wastes Management Act of 2000.

The participation of the community and other stakeholders is also an indicator of the success of these efforts. Community members may be involved at different stages of the programs, and the support may vary. The problems with solid waste management are a serious issue encountered not only by the city government but also by those individuals and institutions who advocate for a cleaner and sustainable environment since improper management of solid wastes implies the health and economic condition of the community. Indeed, the community has a significant role in maintaining and sustaining an efficient solid waste management system in an area.

Suppose a project will be established to improve the solid waste management system in the city, specifically on having regular waste collection in your area. Are you willing to pay monthly an amount of PhP _____for the project?

0 No
1 Yes
(if the answer is YES, the amount is increased until the maximum amount is determined)
Maximum WTP amount: PhP _____?
(if the answer is NO, the amount is lowered until the final amount is determined)
WTP amount: PhP _____

Determinants and Estimation of WTP amount

Willingness-to-pay for a specific service or product is one way the community can express their support and contribution to a program that an organization is promoting. In this study, services were in the form of improving solid waste management in Butuan City by doing a regular and more efficient collection of wastes from the source. Such services do not have a market price as they are not directly sold, and thus, using a price-based model approach will not be possible in this case. Instead, contingent valuation surveys are one technique that elicits a willingness-to-pay amount for this aspect (Haab et al. 2002). With this approach, information about the target population will be needed, associated with its willingness to pay in exchange for a service.

Two primary analyses were performed to come up with a mean WTP estimate. The first was the determination of factors influencing the willingness to pay for improved solid waste management in the area using the logit model. Second, estimating the mean WTP amount based on the model and using the mean WTP formula given in the study by Adamu et al. (2015).

The logit model has been widely used in determining factors that significantly influence the willingness to pay for an improved solid waste management system (Awunyo-Vitor 2013; Addai and Danso-Abbeam 2014; Amemiya 1981). To determine factors of WTP, the study used the threshold decision-making theory, which states that a person's decision is conformed to the set threshold (Hill and Kau 1981). In this case, the household head's decision whether to pay or not to pay for improved solid waste management services is based on the characteristics of a specific factor, such as socio-demographic profile, SWM practices, and awareness, among others. Such a condition is presented using the equation below.

$$Y_i = \beta X_i + \mu_i \qquad \text{Eq.1}$$

where Y_i is described as $Y_i=1$, when the decision is to pay for the services, that is, if X_i is greater than or equal to a critical value, X*; and $Y_i=0$ otherwise.

Note that X* represents the threshold value of the independent variables, X, and Equation 1 represents a dichotomous choice model involving the estimation of the probability of willingness to pay for improved waste management services, Y, as a function of independent variables, X. Independent variables may be the socio-demographic profile of the household, SWM practices, awareness, and many others, which believed to influence the willingness to pay for the services.

The probability formula is given as

$$Prob(Y_i = 1) = F(\beta' X_i) \quad \text{Eq. 2}$$

While

$$Prob(Y_i = 0) = 1 - F(\beta' X_i) \quad \text{Eq. 3}$$

Where Y_i is the observed response for the i^{th} observation (household) of the response variable, Y. This study uses the logistic cumulative distribution function F to estimate the probability, P. It is given as

$$Prob(Y_i = 0) = 1 - F(\beta' X_i) = 1 - \frac{e^{\beta' X_i}}{1+e^{\beta' X_i}} = \frac{1}{e^{\beta' X_i}} \quad \text{Eq. 4}$$

The model is a regression of the conditional expectation of Y on X, which is given as

$$E\left(\frac{Y}{X}\right) = 1[F(\beta' X_i)] + 0[1 - F(\beta' X_i)] = F(\beta' X_i) \quad \text{Eq. 5}$$

The relative effect of each of the independent variables on the probability of a household's WTP is obtained by differentiating Equation 5 to X_i, resulting to

$$\frac{\partial P_i}{\partial X_i} = \left[\frac{\lambda^{\beta' X}}{1+\lambda^{\beta' X}}\right]\beta = F(\beta' X)[1 - F(\beta' X)]\beta \quad \text{Eq. 6}$$

Parameters, β, are estimated using the maximum likelihood approach. The logistic regression model is preferred over the linear probability regression model in determining factors that significantly influence the household's WTP because of its parameter estimates that are asymptotically consistent and efficient (Awunyo-Vitor 2013).

The estimation of the mean amount of WTP is done using the equation below (Adamu et al. 2015).

$$Mean\ WTP = \frac{\beta_0 + (\sum \beta_i X_i)}{-\beta_1} \quad \text{Eq. 7}$$

where β_0 the estimated constant; β_i parameter of the coefficients; X_i is the mean value/ the value of the reference category of explanatory variables; and β_1 coefficient of the bid price.

The equation requires parameter estimates from the logistic regression methodology. In this approach, the dependent variable classified the household and whether they would pay. Further, the respondents were also asked how much they would pay. The bidding approach was used to iteratively ask the respondent for the WTP until the highest possible amount was elicited. Bid prices were given as PhP10.00, PhP20.00, PhP30.00, PhP40.00, PhP50.00, PhP60.00, and PhP70.00. Factors that could significantly influence the household's WTP include the respondent's and household's profile, solid waste management (SWM) practices, knowledge and awareness of SWM policies and laws, attitude towards SWM, and solid wastes generated by the household.

3 Results and Discussion

Socio-economic Profile of Household Participants

The average monthly income of households was PHP 29,924.45. Seventy-four percent (74%) of the respondents were female, while more than 70% were married. Most respondents were 40 years old and above, averaging 48.44 years old. Respondents have been in the area for around 25 years. On average, households consist of about five (5) members. Several respondents have graduated high school; at the college level; and have completed higher education, which comprised 24.12%, 21.08%, and 26.46% of the total respondents (Table 1).

Household Solid Waste Management Practices

Households utilized garbage bins and cellophane or sack bags to store their wastes. Out of the 427 households, 58.31% stored their waste in garbage bins, of which 79.12% of these bins were enclosed. Moreover, 92.97% of the respondents used cellophane or sack bags (Table 2).

Most of the households sold-out glass bottles (56.44%), plastic bottles (52.69%), tin cans (46.37%), metals (51.05%), wires (36.30%), and nails (39.81%) as means of disposal. Moreover, wastes such as batteries, cellphones, paint cans, bulbs, paper or cardboard, rubber slippers, rubber tires, and expired medicines were

discarded while fabrics or textiles were reused. Vegetable or fruit peels and animal wastes were thrown in the compost pits, and food leftovers were fed to animals. Proper management of waste is yet a significant concern in urban areas. Composting would help stabilize organic waste (Sarkar et al. 2016). Composting is good for the environment because, when applied to land, it reduces greenhouse gas emissions and enhances soil quality. Completing the system's loop is consistent with the circular economy idea (Fadhullah et al. 2022). Composting is a low-cost method of keeping inexpensive materials out of landfills while producing agricultural products (Saha et al. 2010). It is an aerobic biological process that leverages natural microorganisms to turn organic matter that can be broken down into a substance resembling hummus. Currently, various public or private businesses use approximately 8 to 9 % of the trash produced to produce compost. There are significant differences between the technology used for compost by manufacturing organizations.

In general, more than half (63.47%) of the households of Butuan City practiced segregation daily (Table 3). On the other hand, 29.27 percent, the highest percentage, have yet to practice recycling. The same went with composting (38.64%) and waste dropping at MRF (38.64%). Moreover, 28.10% of households sometimes reused solid wastes. It can also be noticed from these results that there were still households in the City that still need to fully participate in the implementation of RA 9003 (Ecological Solid Waste Management Act of 2000). Interesting to note that the participants were segregating yet low levels of recycling the waste. A study by Fadhullah et al. (2022) stated that there was not much difference between the respondents who did and did not separate their waste and suggested there is space to expand the practice of waste segregation. Emerging nations lack waste segregation techniques, most notably in Asia

Table 1. Socio-economic profile of the household respondents in Butuan City

Variables	Frequency (%)	Mean (in PhP)	Standard Error
Monthly Income (in PHP)		29,924.45	40,052.67
Age (in years)			
18 - 19 years old	0.7		
20 - 29 years old	11.0		
30 - 39 years old	17.1	48.44	14.16
40 - 49 years old	22.7		
50 - 59 years old	23.2		
60 years and above	25.3		
No. of Years of Residency		25.55	16.58
Household Size		5.15	0.92
Sex			
Male	26.0		
Female	74.0		
Civil Status			
Single	8.9		
Married	70.9		
Separated	1.9		
Widow/er	9.2		
Live-in	9.2		
Educational Attainment			
No Education	3.51		
Elementary Level	6.09		
Elementary Graduate	0.23		
High School Level	13.82		
High School Graduate	24.12		
Vocational Graduate	2.81		
College Level	21.08		
College Graduate	26.46		
Post-graduate	1.87		

Table 2. Waste storage system of the household in Butuan City, Philippines in 2019

Storage of Wastes	f	%	Enclosed?	f	%
Garbage bin	249	58.31	Yes	197	79.12
			No	52	20.88
Cellophane/ Sack	397	92.97	Yes	284	71.54
			No	113	28.46

Table 3. Solid waste management practices of households in Butuan City, Philippines

Solid Wastes Management Practices	Never	Rarely	Sometimes	Often	Always
Segregation	2.11	5.85	15.46	13.11	63.47
Recycling	29.27	20.37	24.59	7.96	17.80
Reusing	16.16	26.70	28.10	11.48	17.56
Composting	38.64	14.52	18.03	9.37	19.44
Dropping wastes at the MRF	48.71	6.56	17.10	8.43	19.20

Note: Figures in %

(Vassanadumrongdee and Kittipongvises 2017) and Africa (Dlamini et al. 2017), because they didn't fully get the importance of trash separation. As a result, the quantity of municipal solid waste disposed of in landfill sites generally rises at the source, placing the remaining landfill area in jeopardy more quickly than initially predicted (Fadhullah et al. 2022).

Household Awareness and Knowledge of Solid Waste Management Practices

Most households in the villages (64.40%) know the location of the MRF and perceive that the MRF is functional/operational (66.28%). Moreover, 96.96% of these households know the classification of waste. Furthermore, 92.04% of the households were aware of the waste collection schedule in the villages. There was a regular collection of garbage, according to 86.18% of the households, which was collected in the morning and once a week. All villages had vehicles to collect wastes from the households, wherein 77.27% claimed that they had mini dump trucks to transport waste to the sanitary landfill. In Kelantan, Malaysia burying and burning rubbish is a widespread practice for waste disposal in rural and isolated locations. In contrast, stationary waste storage containers are offered primarily at the sides of major roads in urban or semi-urban areas. The Kota Bharu Municipal Council (KBMC) is the local agency in charge of providing stationary waste storage containers at waste collection sites within the Kota Bharu district, collecting the solid waste roughly three times per week by compactor vehicles, and transporting waste to the dumpsite situated in the district in Bachok (Kamaruddin et al. 2016).

Household Solid Waste Characterization

On the average amount of waste produced per capita, more than a quarter kilo (0.27 kg/capita/day) was generated daily. On the other hand, biodegradable, non-recyclable, and recyclable waste was almost the same except for special wastes generated in the least quantity. This value fell within the range of 0.12 to 5.1 kg per person per day of waste generated from the South Asia Region (Ezebilo 2013) and within the scope of 0.10 – 0.71 kg per capita per day, the average waste generation rates for all LGUs in the country, excluding Metro Manila (Sarkar et al. 2016).

Willingness-to-Pay (WTP) for an Improved City's Solid Waste Management

Generally, the probability of responding "Yes" decreases as the bid price increases. That is, households tend to decline a higher bid price and prefer a lower amount for their willingness to pay and vice versa. This principle is consistent with economic theory (Adamu et al. 2015).

Socio-economic profile, SWM practices, awareness of the related laws and policies, perception, and solid waste generation of household participants were gathered to estimate the mean WTP amount for improved solid waste management

Table 4. Awareness on Material Recovery Facility (MRF) and collection of wastes of households in Butuan City, Philippines

		Frequency	Percentage
Do you know the location of the MRF?			
	Yes	275	64.40
	No	152	35.60
Do you think the MRF is operational/functional?			
	Yes	283	66.28
	No	144	33.72
Are you aware of the classification of wastes, whether it is biodegradable, recyclable, residuals, hazardous, etc.?			
	Yes	414	96.96
	No	13	3.04
Are you aware of the schedule of wastes collection in your area?			
	Yes	393	92.04
	No	34	7.96
Frequency of wastes collection			
	Everyday	71	16.63
	Once a week	275	64.40
	Twice a week	33	7.73
	Thrice a week	20	4.68
	Four times a week	2	0.47
	Five times a week	5	1.17
	Six times a week	6	1.41
	Not definite	3	0.70
	No response/none	12	2.81
Time of Collection			
	Morning	310	72.60
	Afternoon	19	4.45
	Morning and afternoon	9	2.11
	Anytime	72	16.86
	No response	17	3.98
Is there a regular collection as scheduled?			
	Yes	368	86.18
	No	57	13.35
	No response	2	0.47
Does Your village have a vehicle for wastes collection purposes only?			
	Yes	396	92.74
	No	29	6.79
	No response	2	0.47
Type of vehicle			
	Mini Dumptruck	306	77.27
	Regular Dumptruck	22	5.56
	Tricycle	78	19.70
	Multicab	30	7.58
	Pedicab	9	2.27
	No response	11	2.78

Table 5. Waste generated in several categories (in kg) per household and per capita in Butuan City, Philippines

Type of Waste	Amount of Wastes (in kg)	
	Household	Per capita
Biodegradable	0.4026	0.0805
Non-recyclable	0.3755	0.0751
Recyclable	0.3136	0.0627
Special Waste	0.2611	0.0522
Total	1.3528	0.2706

Table 6. WTP to bid price and probability of "Yes" response in Butuan City, Philippines

Bid Price	n	WTP Response		Probability of Responding
		No	Yes	"Yes" (%)
10.00	60	3	57	95
20.00	62	3	59	95
30.00	61	10	51	84
40.00	64	17	47	73
50.00	61	21	40	66
60.00	60	25	35	58
70.00	59	24	35	59

Table 7. Logistic regression model for estimating mean amount WTP from the Household Sector in Butuan City, Philippines

Variables	B	S.E.	Wald	Sig.	Exp(B)	95% C.I. for EXP(B)		Mean value/ reference category
						Lower	Upper	
Amount WTP (in PHP)	.077	.010	61.385	.000***	1.080	1.059	1.100	-
Total wastes generated (kg/day)	-.227	.812	.078	.780	.797	.162	3.914	0.899
Practice: Segregation	.349	.139	6.264	.012**	1.417	1.079	1.862	4.29
Awareness: Schedule of Collection in the area	-1.062	.500	4.520	.034**	.346	.130	.920	1 (Aware of the collection schedule)
Age (in years)	.019	.010	4.004	.045**	1.019	1.000	1.039	48.44
Total household monthly income (in PHP)	.000	.000	3.303	.069*	1.000	1.000	1.000	29,924.45
Constant	-3.039	.736	17.024	.000	.048			-

*Legend: Pseudo R^2=0.418; Overall percentage of correctly classified= 80.3%; *, **, *** significant at α=0.10, 0.05 and 0.01, respectively.*

in the City. These data were considered predictors for the development of the logistic regression model. The dependent variable is the classification of respondents and whether they were willing to pay a certain amount. Six predictors were included in the final model from those factors considered (Table 7). These are the following: (1) the amount of WTP (in PhP); (2) total wastes generated by the household (in kg/day); (3) whether a specific household is practicing segregation; (4) how aware the household on the schedule of waste collection in the area; (5) respondent's age (in years); and (6) the household's total monthly income (in PhP).

From the given model and using the logistic regression model, the mean WTP amounts to PhP19.27 for every household per month. The total aggregated WTP in the City is estimated at Php7,185 975.70 with the 2020 City population (PSA 2020). The estimated amount is below the annual budget allocation of the City's solid waste management. The WTP for an enhanced SWM system's determinants has greatly influenced the respondents' willingness to pay for waste pickup. Factors affecting WTP significantly are the amount of WTP (at α=0.01), the practice of segregation, awareness of collection schedule, age (at α=0.05), and total household monthly income (at α=0.10), which could mean that the higher the income, the more likely the participants would be willing to pay for the enhanced management. This demonstrates that higher WTP for participants with higher incomes is expected compared to respondents with lower incomes due to respondents' increased ability to spend because of their higher income (Ezebilo 2013). Theoretically, they argued that people are more likely to participate in SWM in higher-income areas than lower-income regions. This outcome is consistent with both the hypothesis and other research findings. Contractors with more paid-up capital or high-income returns demonstrated a higher WTP for SWM services, which shows a fruitful connection between revenue and WTP to provide better SWM services (Kassa and Teshome 2016).

4 Conclusion and Recommendations

This WTP estimate study was conducted prior to the COVID-19 pandemic and could serve as an essential baseline of the city's perspective on solid waste management. Four hundred twenty-seven households from urban villages in Butuan City participated in the study. Most participants belonged to the middle-income class, comprising 65.80% of the total sample size. Our results show that the income status of the household also influences waste generation. Household monthly expenditures were also determined by those basic needs such as food, electricity bill, transportation, communication, and clothing as the top priorities of most households.

Common solid wastes and their corresponding ways of disposal were identified. Surprisingly, a significant percentage of households still practiced burning wastes, especially biodegradable ones, amidst the intensive implementation of RA 9003. This law penalizes those who use burning as means of disposal. Results also showed that most households across different income levels practiced waste segregation. However, the proportion of households who practiced recycling, reusing, composting, and dropping wastes at the designated MRF was seen to be alarmingly low. These facts about inadequate and improper practices of households were manifested in the growing dilemma of the City wherein wastes and trash are still noticeable.

In terms of the current services jointly provided by the City and village local government units, there is a need to intensify the locals' awareness of the availability of these services to avoid possible improper waste management beginning at the household level. Furthermore, the schedule and vehicle used for waste collection must also be given attention as households are still trying to figure out these services.

Given the socio-economic profile, SWM practices, awareness of related laws and policies, perception, and solid waste generation of household participants, the mean WTP amounts to PhP 19.27 for every household per month. Moreover, factors that are seen as significant to affect the WTP are the amount of WTP, the practice of segregation, awareness of the collection schedule, age, and total household monthly income. Therefore, this estimated value can reference the city government of Butuan to collect the amount from its constituents in exchange for more efficient and sustainable services on solid waste management.

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Statement of Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript.

6 Literature Cited

Adamu, A., Yacob, M.R., Radam, A., Hashim, R., & Adam, S. (2010). Economic Valuation of Ecotourism Resources in Yankari Game Reserve, Bauchi Nigeria. *Procedia Environmental Sciences,* **30**, 139 -144.

Addai, K.N., & Danso-Abbeam, G. (2014). Determinants of Willingness to Pay for Improved Solid Waste Management in Dunkwa-on-Offin, Ghana. *Journal of Agriculture and Environmental Sciences,* **3**(1), 1-9.

Amemiya, T. (1981). Qualitative response model: a survey. *Journal of Economic Literature,* **19**, 1483 – 1536

Awunyo-Vitor, D., Ishak, S., & Jasaw, G.S. (2013). Urban Households' Willingness to Pay for Improved Solid Waste Disposal Services in Kumasi Metropolis, Ghana. *Urban Studies Research*, **2013**.

Burns, D., Heywood, F., Taylor, M., Wilde, P., & Wilson, M. (2004). Making Community Participation Meaningful. A Handbook for Development and Assessment.

Dlamini, B. R., Rampedi, I,T., Ifegbesan, A.P. (2017). Community Resident's Opinions and Perceptionsbon the Effectiveness of Waste Management and Recycling Potential in the Umkhanyakude and Zulu land District Municipalities in the KwaZuluNatal Province of South Africa. *Sustainability*, **9**(10), 18-35.

Ezebilo, E. (2013). Willingness to pay for improved residential waste management. *International Journal of Environmental Science and Technology*, 413-422.

Fadhullah, W., Imran, N. I., Ismail, S. N., Jaafar, M. H., & Abdullah, H. (2022). Household solid waste management practices and perceptions among

residents in the East Coast of Malaysia. *BMC Public Health,* **22**(1), 1-20

Haab, T. (2002). Valuing Environmental and Natural Resources. MPG Books Ltd, Bodmin, Cornwall.

Hill, L., & Kau, P. (1981). Analysis of purchasing decision with multivariate probit. *American Journal of Agricultural Economics,* **53**(5), 882–883

Kamaruddin, S.M., Ahmad, P., Norsyamira, A. (2016). Community Awareness on Environmental Management through Local Agenda 21 (LA21). *Procedia - Social and Behavioral Sciences,* 729-737

Karibeeran, S., & Kuruvilla, C. (2015). Community Participation towards Effective Social Work Practice. *Indian Journal of Applied Research,* **3.6**(12):16-18.

Kassa, B., & Teshome, Y. M. (2016). Smallholder farmer's willingness to pay for improved soil and water conservation practice: A contingent valuation study in Abaro-Toga watershed Ethiopia. *American Journal of Business, Economics and Management.* **3***,* 432

Philippine Statistics Authority (PSA) (2020). Census of Population 2020. Total Population by Province, City, Municipality and Barangay.

Republic of the Philippines Official Gazette. Republic Act 9003. 2001. Retrieve at: https://www.officialgazette.gov.ph/2001/01/26/republic-act-no-9003-s-2001/

Saha, J., Panwarr, N., & Singh, M. (2010). An assessment of municipal soild wast compost quality produced in different cities of India in the perspective of developing quality control indices. *Waste Management,* 192-201.

Sarkar, S., Pal, S., & Chanda, S. (2016). Optimization of a Vegetable Waste Composting Process with a Significant Thermophilic Phase. *Procedia Environmental Sciences,* **35**, 435- 440.

University of Georgia. Magnitude of plastic waste going into the ocean calculated: 8 million metric tons of plastic enter the oceans per year. ScienceDaily. 2015. Retrieved November 26, 2019 from www.sciencedaily.com/releases/2015/02/150212154422.htm

Vassanadumrongdee, S., Kittipongvises, S. (2017). Factors influencing source separation intention and willingness to pay for improving waste management in Bangkok, Thailand. *Sustainability Environmental. Resources*, **28**, 90-99.

World Bank. What a Waste: A Global Review of Solid Waste Management. Urban Development Series Knowledge Papers. Urban Development & Local Government Unit World Bank 1818 H Street, N.W. Washington, D.C. 20433, U.S.A. 2012.

World Bank. What a Waste: Solid Waste Management in Asia. Urban Development Sector Unit. East Asia and Pacific Region. The International Bank for Reconstruction and Development/THE WORLD BANK 1818 H Street, N.W. Washington, D.C. 20433, U.S.A. 1999.

World Health Organization (WHO). Waste and Human Health: Evidence and Needs. WHO Regional Office for Europe UN City, Marmorvej 51 DK-2100 Copenhagen Ø, Denmark, 2016.

Yedla, S., & Kansal, S. (2003). Economic Insight into Municipal Solid Waste Management in Mumbai: A Critical Analysis. *International Journal of Environment and Pollution,* **19**(5), 516 – 527.