

Determining factors influencing the willingness to pay for household waste separation services in District 5, Ho Chi Minh City

PHAM Viet Hai^{1,2*}, LE Thi My Quyen^{1,2}, VO Thi Minh Hoang^{1,2}, TRAN Thi Thanh Dung^{1,2}, LE Thi Tuyet Mai^{1,2}

¹ Faculty of Environment, University of Science, Ho Chi Minh City, Vietnam

² Vietnam National University, Ho Chi Minh City, Vietnam

* Corresponding email: pvhai@hcmus.edu.vn

Abstract: Domestic solid waste (HSW) management has emerged as a critical environmental challenge in urban areas of Vietnam, particularly in cities like Ho Chi Minh City, where escalating waste volumes and an overreliance on landfills pose threats to sustainability and public health. As HSW levels increase annually, the need for sustainable waste separation practices has become urgent. This study evaluates households' willingness to pay (WTP) for proposed HSW separation services in District 5, Ho Chi Minh City, and identifies key factors influencing their decision to financially support such services. Utilizing the Contingent Valuation Method (CVM), a widely used approach for estimating the non-market value of public services, we conducted a survey of 100 households to measure their WTP. Logistic regression analysis was applied to explore the impact of various demographic, socioeconomic, and behavioral factors on households' payment decisions. Results show that the average WTP is 31.91 thousand VND per month, with household income, family size, gender, social pressure, awareness of HSW benefits, and the ability to perform HSW separation as significant determinants. Income and awareness of HSW benefits positively influence willingness to pay, while household size, social pressure, and self-separation ability reduce willingness to pay. Based on our results, we propose short- and long-term policy recommendations to improve community acceptance and adoption of HSW separation services. In the short term, policies should focus on educational programs to increase public awareness about the importance of waste separation and financial assistance for low-income households to promote service uptake. In the long term, promoting self-separation practices within residential communities can foster a culture of environmental responsibility, gradually reducing reliance on third-party separation services. This study contributes to the understanding of behavioral and socioeconomic factors in HSW management, providing a foundation for future research and policy development in sustainable waste practices.

Keywords: willingness to pay; household waste separation; contingent valuation method; household solid waste

1. Introduction

Household solid waste (HSW) management is becoming an urgent environmental issue in the urban development process of cities in Vietnam, including Ho Chi Minh City. According to the 2021 Ho Chi Minh City Environmental Status Report, the city generates an average of 8,900 tons of HSW per day, with an estimated annual increase of 5-6% (DONRE HCMC, 2021). Although the volume of generated HSW is significant and on the rise, Ho Chi Minh City's primary treatment method remains landfilling, accounting for 69% of waste disposal, which presents secondary pollution risks to both the environment and public health. Additionally, the lack of comprehensive source-separation practices for solid waste poses challenges for developing optimal treatment technologies, such as recycling, composting, or waste-to-energy conversion (DONRE HCMC, 2021).

Meanwhile, households, as primary waste generators, are only responsible for paying for collection and partially for transportation of HSW, while other costs – including waste separation during the final treatment phase – are covered by the public budget. Low environmental fees that do not fully incorporate “the polluter pays principle” fail to incentivize households to reduce or separate their waste (DONRE HCMC, 2021). The 2020 Environmental Protection Law and related decrees were introduced with the expectation of transforming HSW management by mandating source separation and implementing a new pricing mechanism for HSW management services. However, this new management approach requires upgraded collection and transportation equipment, a more complex management system, and assurance of sufficient knowledge and skills for households to separate waste. Consequently, Ho Chi Minh City, like many other localities, will face significant challenges when implementing source separation mandates, set to take effect in 2025.

Given this situation, we propose waste separation services operated by collection units as a temporary solution, allowing local governments time to prepare the necessary requirements for a more sustainable system in which households actively separate their waste at the source. Under this proposal, waste separation services would be arranged between source collection units and households or residential communities. Assigning temporary responsibility for HSW separation to collection units could reduce management costs and burdens for local governments. Collection units, in turn, would gain additional funding from the separation service, allowing for upgrades in collection and transportation equipment instead of relying on public funding. Moreover, shifting the cost of HSW sorting from public budgets at the final treatment stage to separation fees during collection – as a type of environmental fee, in addition to existing collection costs – could incentivize households to proactively separate HSW at the source, as well as reduce emissions through recycling and reuse, thereby establishing a basis for future sustainable HSW management strategies.

This study aims to preliminarily determine the willingness to pay (WTP) and the factors influencing households' payment decisions for the proposed HSW separation service in District 5, one of the central areas of Ho Chi Minh City. Accordingly, the findings on households' WTP for this service, obtained through the Contingent Valuation Method (CVM), could serve as a reference for future research in establishing environmental fees for HSW management. Meanwhile, the influence of several factors on households' payment decisions provides a basis for policy suggestions in HSW management; for instance, promoting incentives for residents to pay for third-party HSW separation services, or causing residents to be unwilling to pay for this service and instead prefer to separate waste at the source – a more sustainable policy.

2. Literature review

Research on WTP in solid waste management has received attention through various approaches, including the Contingent Valuation Method (CVM) (Ke et al., 2022). CVM enables researchers to estimate the monetary value that residents are willing to pay for a public service or environmental improvement by collecting stated preferences through structured surveys (Mitchell & Carson, 2013). In addition, identifying the factors that influence households' decisions to financially support waste separation services provides meaningful insights for policymakers and urban planners. Logistic regression is frequently employed in these studies due to its suitability for estimating the likelihood that households will pay for HSW services based on demographic, socioeconomic, and behavioral variables (Afroz et al., 2011; Han et al., 2019; Nixon & Saphores, 2007).

Existing studies indicate that demographic factors significantly influence household decisions regarding WTP for environmental services. Income is one of the most frequently discussed factors, as households with higher income levels generally exhibit a higher WTP for environmental services, including HSW separation (Fattah et al., 2022; Nixon & Saphores, 2007). Higher income not only improves financial capacity but is also linked to greater awareness of the importance of public services related to the environment (Arimah, 1996; Han et al., 2019). Educational attainment also plays a critical role, with many studies indicating that households with higher education levels are more likely to understand the benefits of environmental protection, thus showing a higher WTP for waste separation services (Fattah et al., 2022; Mulat et al., 2019; Song et al., 2016; Yuan & Yabe, 2014). However, research also indicates that groups with lower levels of education may also exhibit a higher WTP (Bartelings & Sterner, 1999). Additionally, other demographic factors, such as occupation, age, family size, and gender, have also been identified as relevant factors (Fattah et al., 2022; Han et al., 2019; Massoud et al., 2021; Mulat et al., 2019; Song et al., 2016; Yuan & Yabe, 2014; Zeng et al., 2016).

In addition, behavioral factors, including awareness, attitude, social pressure have been shown to significantly influence WTP for environmental services in various studies (Bhawal Mukherji et al., 2016; He et al., 2021; Nixon & Saphores, 2007; Pakpour et al., 2014; Wang et al., 2018). Studies indicate that households with a clear understanding of the benefits and importance of waste separation, as well as relevant legal regulations, are generally more willing to pay, as they recognize that their actions can mitigate negative environmental impacts (He et al., 2021; Wang et al., 2018). Moreover, a positive attitude toward waste separation activities can promote WTP, as it reflects individual support for environmental protection and sustainable initiatives (Song et al., 2016). Social pressure is also a crucial factor, as social norms encourage individuals to conform and be willing to pay for services to maintain a positive image within the community (Jones et al., 2010; Wang et al., 2018). However, the ability to perform waste separation independently often has the opposite effect. Households with the resources and capability to sort waste themselves are frequently less inclined to pay for third-party services, given that they can manage waste sorting without external support (Wang et al., 2018). These behavioral factors play an important role in

encouraging or discouraging household WTP, providing essential insights for designing policies that foster community participation in waste management.

3. Methodology

3.1. Data Collection and Sampling Framework

In this study, CVM is applied to determine the WTP prices of households for HSW separation services. CVM is widely used to evaluate non-market values, especially those related to public services or environmental improvements, through a willingness-to-pay approach. Since the study aims to identify factors influencing WTP for waste separation services among households in District 5, Ho Chi Minh City, respondents are expected to have experience with solid waste management activities in their residential area. This background enables them to understand the potential impacts and benefits of such services to facilitate informed decisions regarding payment. Therefore, the target respondents are households that have resided continuously in the study area for 12 months or more.

The total sample size required for this study was calculated using Yamane Taro's formula (1967):

$$n = \frac{N}{1 + N * e^2} \quad (1)$$

Where:

n: sample size,

N: total number of households residing in District 5, Ho Chi Minh City,

e: margin of error.

In 2023, District 5 had over 38,454 households. With a confidence level of 90%, the minimum sample size required for the study was determined to be 100 households. A convenience sampling method was used to select these 100 households.

As the study data includes personal information, to ensure representativeness of household perspectives, the respondent must be either the head of the household or a member involved in waste management activities, such as waste separation or regular payment of waste collection fees. Each household representative participated in a face-to-face interview conducted by trained interviewers.

To collect data for calculating WTP and assessing the factors affecting it, a survey questionnaire was developed with four sections:

- *Section 1*: This section includes screening questions such as residential area, household residency status (temporary or permanent), and duration of residence. This section aims to help the study identify suitable respondents – households that have resided in District 5, Ho Chi Minh City, for more than 12 months.

- *Section 2*: This section consists of survey questions designed to measure household awareness, attitudes, social pressure, and ability to perform waste separation. In this study, these concepts are measured using a 5-point Likert scale, ranging from strongly disagree (1) to strongly agree (5), with observed variables being statements related to the concept being measured.

- *Section 3*: This section provides detailed information about the HSW separation service, its community benefits, and the conditions for service implementation, described clearly and comprehensively. Households participating in the survey are given a specific scenario about their involvement, including potential service cost information to ensure respondents can make informed decisions. The core of this section includes an open-ended question regarding WTP, allowing participants to specify the maximum amount they feel appropriate, thereby reflecting their actual willingness to pay.

- *Section 4*: This section covers demographic information about the households, including the gender, age, occupation, and educational level of the household head (or a member involved in household waste management), as well as housing type, family size, and household income.

3.2. Data Analysis

The logistic regression model is applied to evaluate the impact of various factors on households' payment decisions for waste separation services. Numerous studies on willingness to pay in solid waste management have shown the suitability of this model. In this study, the logistic regression model is used to estimate the dependent variable as the logit of the probability that a household decides to pay for the service. The independent variables include age, gender, housing type, educational attainment, occupation, family size, average household income, awareness of HSW separation activities, attitude toward HSW separation activities, social pressure regarding HSW separation activities, and ability to perform HSW separation activities, as shown in Table 3.1. Through logistic regression, the study can determine the influence of each

factor on the probability that a household is willing to pay for this service, thereby providing a basis for designing policies and incentive programs that enhance community participation.

Tab. 3.1. Description of independent variables

No.	Independent variables	Symbol	Description	Type of data
1	Average household income	Inc	The average monthly income of the household (million VND/month).	Ratio Data
2	Family size	Siz	The number of family members in the household.	Ratio Data
3	Age: Lower 20 20 - 35 35 - 60 Upper 60	Age Age20 Age20-35 Age35-60	Age of the household head or respondent representing the household. = 1: Age20, = 0: other = 1: Age20-35, = 0: other = 1: Age35-60, = 0: other	Nominal Data
4	Gender	Gen	Gender of the household head or respondent: = 1: Male, = 0: Female	Nominal Data
5	Housing type: Private house Apartment Rented	Hou Hou_Pri Hou_Apt	Type of residence of the household: = 1: Hou_Pri, = 0: other = 1: Hou_Apt, = 0: other	Nominal Data
6	Educational attainment: Graduate Undergraduate High school Secondary school Primary school Unlisted	Edu Edu_Gra Edu_Und Edu_Hig Edu_Sec Edu_Pri	The highest education level of the household head or respondent: = 1: Edu_Gra, = 0: other = 1: Edu_Und, = 0: other = 1: Edu_Hig, = 0: other = 1: Edu_Sec, = 0: other = 1: Edu_Pri, = 0: other	Nominal Data
7	Occupation: Retired Government employee Office staff Business owner Worker Homemaker Student Unlisted Unemployed	Occ Occ_Ret Occ_Gov Occ_Ofs Occ_Buo Occ_Wrk Occ_Hom Occ_Stu Occ_Unl	The current occupation of the household head or respondent: = 1: Occ_Ret, = 0: other = 1: Occ_Gov, = 0: other = 1: Occ_Ofs, = 0: other = 1: Occ_Buo, = 0: other = 1: Occ_Wrk, = 0: other = 1: Occ_Hom, = 0: other = 1: Occ_Stu, = 0: other = 1: Occ_Unl, = 0: other	Nominal Data

8	Awareness of HSW separation activities	Awr	Awareness of household solid waste (HSW) separation activities by the household. This variable is measured on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree), reflecting the household's understanding and awareness of the benefits and process of HSW separation.	Ordinal Data
9	Attitude toward HSW separation activities	Att	The household's attitude toward participating in HSW separation activities. This variable is measured on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree), indicating the household's willingness and positive outlook towards engaging in HSW separation.	Ordinal Data
10	Social pressure regarding HSW separation activities	Soc	The level of social pressure felt by the household regarding participation in HSW separation activities. This variable is measured on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree), indicating the extent of influence from community or social expectations.	Ordinal Data
11	Ability to perform HSW separation activities	Abi	The household's capability to carry out HSW separation activities. This variable is measured on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree), representing the household's confidence and actual capacity to participate in HSW separation.	Ordinal Data

The probability of a household being willing to pay for waste separation services is represented by the following equation:

$$WTP = \frac{1}{1 + e^{-(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k)}} \tag{2}$$

Logit of the probability that a household decides to pay for the service:

$$\text{Ln}\left(\frac{WTP}{1-WTP}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k \tag{3}$$

With the independent variables considered in this study (Table 3.1), the logistic regression model is specified as follows:

$$\text{Ln}\left(\frac{WTP}{1-WTP}\right) = \beta_0 + \beta_1 Inc + \beta_2 Siz + \beta_3 Age + \beta_4 Gen + \beta_5 Hou + \beta_6 Edu + \beta_7 Occ + \beta_8 Awr + \beta_9 Att + \beta_{10} Soc + \beta_{11} Abi + \varepsilon \tag{4}$$

Where:

WTP: The likelihood that a household is willing to pay for the service, with *WTP* = 1 if the respondent is willing to pay for the service and 0 otherwise.

β_0 : Intercept term

$\beta_1, \beta_2, \dots, \beta_{11}$: Regression coefficients of the independent variables shown in Table 3.1

The study uses $\exp(\beta_i)$ (odds ratio) to interpret the impact of independent variables on the likelihood of a household’s willingness to pay for the services. The odds ratio specifically indicates how many times this likelihood increases or decreases when an independent variable increases by one unit, ceteris paribus.

4. Results and discussion

4.1. Demographic and Socio-economic characteristics

The demographic and socio-economic characteristics of the 100 respondents in this survey are presented in Table 4.1. Of the respondents, 35% were male and 65% were female, slightly differing from Ho Chi Minh City's overall distribution (45.9% male, 54.1% female). Most respondents were aged between 20 and 60, with 44% in the 20-35 age group and 42% in the 35-60 age group. These age ranges represent individuals with substantial life and economic experience, likely contributing reliable insights.

Educational attainment varied among respondents, with 42% having an undergraduate degree, followed by high school (20%) and graduate education (10%). This sample shows a higher proportion of well-educated individuals compared to the average in Ho Chi Minh City, reflecting the higher educational level typical of central urban areas. In terms of occupation, 25% of respondents were business owners, while 22% were students, 19% office staff, and 11% homemakers.

Most participants lived in private houses (74%), while the rest resided in rented houses (17%) or apartments (9%). Household size was diverse, with an average of 4 members per household; 35% of households had four members, and 45% had three or five members. The majority of respondents (31%) reported a monthly household income between 15-30 million VND, which may influence their willingness to pay for waste separation services.

Tab. 4.1. Demographic and Socio-economic characteristics of the respondents (n = 100)

No.	Demographic and Socio-economic characteristics (n = 100)		Percentage	Ho Chi Minh City's Percentage *
1	Gender	Male	35.0%	45.9%
		Female	65.0%	54.1%
2	Age (year(s) old)	Lower 20	3.0%	25.7%
		20 - 35	44.0%	30.7%
		35 - 60	42.0%	34.0%
		Upper 60	11.0%	9.7%
3	Educational attainment	Graduate	10.0%	1.1%
		Undergraduate	42.0%	22.2%
		High school	20.0%	30.5%
		Secondary school	7.0%	25.7%
		Primary school	5.0%	12.9%
		Unlisted	16.0%	7.6%
4	Occupation	Retired	3.0%	-
		Government employee	7.0%	-
		Office staff	19.0%	-
		Business owner	25.0%	-
		Worker	3.0%	-
		Homemaker	11.0%	-
		Student	22.0%	-
		Unlisted	3.0%	-

		Unemployed	7.0%	-
5	Family size (member(s))	2	12.0%	19.4%
		3	23.0%	21.6%
		4	35.0%	24.8%
		5	22.0%	11.3%
		6	4.0%	5.3%
		7	3.0%	5.4%
		8	1.0%	-
6	Housing type	Private house	74.0%	65.3%
		Apartment	9.0%	0.5%
		Rented house	17.0%	33.8%
7	Average household income (million VND/month)	Lower 5	1.0%	-
		5 - 15	26.0%	-
		15 - 30	31.0%	-
		Upper 30	25.0%	-
* Completed Results of The Viet Nam Population and Housing Census 2019 (VN GSO, 2020)				

4.2. Willingness to Pay Price

According to survey results, 63% of households are willing to pay for HSW separation services, indicating substantial support for the service among households. The average price that households are willing to pay is 31.91 ± 3.58 thousand VND per month, a price considered appropriate given residents' economic conditions.

Households' reasons for willingness to pay for the service are diverse. The most frequently cited reason is that HSW separation conducted by collection units could alleviate the challenges local authorities face in implementing HSW sorting regulations, such as insufficient collection equipment or a lack of widespread public familiarity with waste sorting practices. Additionally, the fast-paced lifestyle in central areas of large urban centers may make self-sorting waste inconvenient for residents. Therefore, 58.73% of residents are willing to pay because they want to save time by outsourcing the sorting task to a service provider.

Meanwhile, 37% of surveyed households are unwilling to pay for this service. The authors categorized the reasons for unwillingness into two groups, "Type I" and "Type II", based on respondents' perspectives on HSW separation activities (Table 4.2). Type I reasons reflect the view that waste collection and sorting are the responsibility of local authorities rather than households, and that the current cost of HSW management is already too high, leading households to refuse any additional fees. These two reasons were fairly common, accounting for 24.32% and 35.31% of households unwilling to pay, respectively. These survey results suggest that a segment of residents may lack awareness of their responsibility to separate HSW as primary waste generators. Furthermore, they may not fully realize that current HSW management costs encompass only collection and partial transportation fees, thus failing to account for the broader social impacts of household waste generation. In contrast, Type II reasons reflect respondents' constructive perspectives on HSW separation activities. Specifically, 51.35% of those unwilling to pay indicated that they prefer to sort waste at home themselves. Additionally, 16.21% of those unwilling to pay believed that these separation services do not provide a sustainable long-term solution and may even contradict the objectives of the established HSW separation regulations.

Tab 4.2. Reasons for Households' Willingness and Unwillingness to Pay for HSW Separation Services

Percentage (%)		Reasons		Number of Respondents	Percentage (%)
Unwilling to pay	37%	Type I	Consider waste sorting to be the responsibility of local authorities	9	24.32%

		Refuse to pay additional fees for HSW management	13	35.13%
	Type II	Prefer to separate waste by themselves	19	51.35%
		Consider the services not to be a long-term solution	6	16.21%
Willing to pay	63%	Save time	37	58.73%
		No need to change disposal habits	17	26.98%
		Believe the service helps resolve existing issues	39	61.90%
		Average WTP price: 31.91 ± 3.58 (thousand VND/month)		

4.3. Factors Influencing Willingness to Pay

Tab 4.3. Logistic regression analysis results on factors influencing the Willingness to Pay for HSW separation services in District 5 (n=100)

Variables		B	Sig.	exp(β _i)
Intercept		4.036	0.282	56.596
Average household income (Inc)		0.149	0.001***	1.16
Family size (Siz)		-1.412	0.003***	0.244
Age (Age)	Age20	-	-	-
	Age20-35	1.185	0.631	3.271
	Age35-60	0.719	0.727	2.052
Gender (Gen)	Male	1.919	0.081*	6.816
Housing type (Hou)	Hou_Pri	0.844	0.358	0.322
	Hou_Apt	-1.799	0.251	0.166
Educational attainment (Edu)	Edu_Gra	1.166	0.612	3.210
	Edu_Und	0.823	0.644	2.277
	Edu_Hig	0.426	0.765	1.531
	Edu_Sec	-2.218	0.460	0.109
	Edu_Pri	-3.306	0,117	0.037
Occupation (Occ)	Occ_Ret	-0.794	0.749	0.452
	Occ_Gov	-0.973	0.668	0.378
	Occ_Ofs	-1.953	0.432	0.142
	Occ_Buo	-0.198	0.936	0.821
	Occ_Wrk	-0.530	0.990	0.948
	Occ_Hom	-0.263	0.912	0.769
	Occ_Stu	-1.308	0.623	0.270
	Occ_Unl	-4.437	0.816	0.012
Awareness of HSW separation activities (Awr)		1.265	0.065*	3.542
Attitude toward HSW separation activities (Att)		0.887	0.319	2.427
Social pressure regarding HSW separation activities (Soc)		-1.49	0.030**	0.225
Ability to perform HSW separation activities (Abi)		-1.165	0.008***	0.312
Log likelihood		-131.791		
Current prediction (%)		91		

Prob>chi ²	0
Pseudo R ²	0.513
Sample size	100
Note: * Significant at the 10% level; ** Significant at the 5% level; *** Significant at the 1% level.	

The logistic regression results are presented in Table 4.3. The model’s Pseudo R² value reaches 0.513, along with a prediction accuracy of 91%, indicating that the variables largely explain the variation in WTP decisions. This also confirms the suitability of the model in analyzing the relationship between individual factors and payment decisions for HSW separation services.

Average household income has a positive and substantial impact on WTP. The likelihood of paying for HSW separation services increases with household income, as indicated by the positive coefficient for income (B = 0.149, sig. = 0.001). This finding aligns with fundamental economic theory, which suggests that income generally correlates positively with consumption demand, particularly for public and environmental services (Anand & Ravallion, 1993). Consequently, households with higher incomes may exhibit greater willingness to pay to enhance environmental quality, thereby promoting a clean and sustainable community space.

Conversely, family size has a negative effect on WTP, with a coefficient of B = -1.412 (sig. = 0.003). This result suggests that larger families are less willing to pay for HSW separation services, possibly due to higher financial burdens, which necessitate more cautious spending on non-essential services. In this scenario, households with more members may prioritize financial resources for essential living expenses over environmental services.

Gender is also a factor influencing WTP decisions. $\exp(\beta_i) = 6.816$ indicates that if the respondents is male, the likelihood of the household agreeing to pay is 6.816 times higher compared to female respondents. The gender disparity in WTP may be related to men having greater exposure to information about the benefits of waste separation, as well as a tendency toward more discretionary spending.

Additionally, awareness of HSW separation activities plays an important role in promoting WTP. The positive coefficient for awareness (B = 1.265, sig. = 0.065) suggests that individuals with greater knowledge of the benefits of HSW separation are more willing to pay for such services. This emphasizes the importance of education and community awareness programs in encouraging pro-environmental behavior. Heightened awareness of environmental benefits leads residents to recognize the value of the services, resulting in a more positive payment attitude.

Social pressure regarding HSW separation activities, conversely, exhibits an adverse effect, as indicated by the negative regression coefficient (B = -1.49). This finding suggests that residing in a community that actively promotes source separation may actually decrease the likelihood of paying for the service, potentially because residents feel obligated to adhere to social norms regarding self-sorting. In such a context, social pressure may prompt some households to choose home waste sorting over paying for professional support services.

Ability to perform HSW separation activities is also a key factor in payment decisions. Those who can sort waste themselves tend to be less willing to pay for the service, with a negative coefficient (B = -1.165, sig. = 0.008). This result implies that individuals proficient in managing their waste may perceive the service as unnecessary, thus lacking the incentive to pay for it.

Other factors, such as housing type, occupation, age, and educational attainment, did not show statistical significance in this model. This suggests that WTP decisions for HSW separation services mainly depend on household awareness and socio-economic characteristics rather than individual characteristics alone.

Based on the research model's findings, HSW separation policies are recommended with different approaches in the short and long term. In the short term, programs should focus on education, financial support for low-income households, and awareness improvement to enhance community acceptance of HSW separation services. Knowledge of HSW separation gained from short-term programs will serve as a foundation for implementing long-term initiatives. Accordingly, this knowledge enables households to

undertake waste separation independently, while previously introduced HSW service fees provide incentives that encourage a trend toward self-separating in residential communities. As a result, increased social pressure, along with households' established ability for self-separating, will motivate them to separate waste independently rather than relying on service providers.

5. Conclusion

This study determined the average WTP price among households in District 5, Ho Chi Minh City, for household solid waste separation services to be 31.91 thousand VND per month. Household income, family size, gender, awareness of HSW separation benefits, and the ability to independently perform HSW separation activities were significant factors influencing payment decisions. Households with higher income levels and greater awareness of HSW separation benefits tended to be more willing to pay, while larger families, those in communities that promote waste separation, or those with self-separating ability were less inclined to pay. These findings provide policy insights to encourage and enhance community acceptance of HSW separation services.

Based on these findings, this study proposes policies to enhance effectiveness and community acceptance of waste separation services. In the short term, focus should be placed on community awareness and education programs that highlight the benefits of source-separated waste. For low-income households, financial support measures such as subsidies or service fee reductions for HSW separation could be considered by the government to encourage broader participation. The knowledge and skills gained from short-term programs would serve as a foundation for long-term initiatives. In the long term, the adoption of previously introduced service fees would help foster a trend of independent waste separation within the community, thereby reducing reliance on external service providers. As social pressure increases and the ability for self-sorting becomes established over time, households will be encouraged to engage in independent waste sorting rather than depending on external services.

A limitation of this study is the use of an open-ended CVM approach, which may lead to dispersion in WTP price values. To enhance the accuracy of results, future research could adopt a closed-ended CVM approach, with specific bidding levels developed based on the results of this study. This approach would narrow the WTP price variation range and provide more reliable data for designing and implementing sustainable waste separation policies in the community.

Acknowledgements

This research is funded by University of Science, VNU-HCM under grant number T2023-137.

Conflicts of Interest

The authors declare no conflict of interest.

Literature - References

1. Afroz, R., Tudin, R., Hanaki, K., & Masud, M. M. (2011). Selected socio-economic factors affecting the willingness to minimise solid waste in Dhaka city, Bangladesh. *Journal of Environmental Planning and Management*, 54(6), 711-731.
2. Anand, S., & Ravallion, M. (1993). Human development in poor countries: on the role of private incomes and public services. *Journal of economic perspectives*, 7(1), 133-150.
3. Arimah, B. C. (1996). Willingness to pay for improved environmental sanitation in a Nigerian City. *Journal of Environmental management*, 48(2), 127-138.
4. Bartelings, H., & Sterner, T. (1999). Household waste management in a Swedish municipality: determinants of waste disposal, recycling and composting. *Environmental and resource economics*, 13, 473-491.
5. Bhawal Mukherji, S., Sekiyama, M., Mino, T., & Chaturvedi, B. (2016). Resident knowledge and willingness to engage in waste management in Delhi, India. *Sustainability*, 8(10), 1065.
6. Department of Natural Resources and Environment of Ho Chi Minh City (2021). 2021 Ho Chi Minh City Environmental Status Report.
7. Fattah, M. A., Rimi, R. A., & Morshed, S. R. (2022). Knowledge, behavior, and drivers of residents' willingness to pay for a sustainable solid waste collection and management system in Mymensingh City, Bangladesh. *Journal of Material Cycles and Waste Management*, 24(4), 1551-1564.
8. General Statistics Office of Vietnam. (2019). Completed Results of The Viet Nam Population and Housing Census 2019. Hanoi, Vietnam: General Statistics Office.
9. Han, Z., Zeng, D., Li, Q., Cheng, C., Shi, G., & Mou, Z. (2019). Public willingness to pay and participate in domestic waste management in rural areas of China. *Resources, conservation and recycling*, 140, 166-174.

10. He, J., Yu, Z., & Fukuda, H. (2021). Extended theory of planned behavior for predicting the willingness to pay for municipal solid waste management in Beijing. *Sustainability*, 13(24), 13902.
11. Jones, N., Evangelinos, K., Halvadakis, C. P., Iosifides, T., & Sophoulis, C. M. (2010). Social factors influencing perceptions and willingness to pay for a market-based policy aiming on solid waste management. *Resources, conservation and recycling*, 54(9), 533-540.
12. Ke, J., Cai, K., Yuan, W., Li, J., & Song, Q. (2022). Promoting solid waste management and disposal through contingent valuation method: A review. *Journal of Cleaner Production*, 379, 134696.
13. Massoud, M., Lamah, G., Bardus, M., & Alameddine, I. (2021). Determinants of waste management practices and willingness to pay for improving waste services in a low-middle income country. *Environmental management*, 68(2), 198-209.
14. Mitchell, R. C., & Carson, R. T. (2013). Using surveys to value public goods: the contingent valuation method. Rff press.
15. Mulat, S., Worku, W., & Minyihun, A. (2019). Willingness to pay for improved solid waste management and associated factors among households in Injibara town, Northwest Ethiopia. *BMC research notes*, 12, 1-6.
16. Nixon, H., & Saphores, J.-D. M. (2007). Financing electronic waste recycling Californian households' willingness to pay advanced recycling fees. *Journal of Environmental management*, 84(4), 547-559.
17. Pakpour, A. H., Zeidi, I. M., Emamjomeh, M. M., Asefzadeh, S., & Pearson, H. (2014). Household waste behaviours among a community sample in Iran: An application of the theory of planned behaviour. *Waste management*, 34(6), 980-986.
18. Song, Q., Wang, Z., & Li, J. (2016). Residents' attitudes and willingness to pay for solid waste management in Macau. *Procedia environmental sciences*, 31, 635-643.
19. Viet Nam General Statistics Office (2020). Completed Results of The Viet Nam Population and Housing Census 2019. Statistical Publishing House, Hanoi.
20. Wang, Z., Dong, X., & Yin, J. (2018). Antecedents of urban residents' separate collection intentions for household solid waste and their willingness to pay: Evidence from China. *Journal of Cleaner Production*, 173, 256-264.
21. Yamane, T. (1967). *Statistics: An introductory analysis* (2nd ed.). New York: Harper & Row.
22. Yuan, Y., & Yabe, M. (2014). Residents' willingness to pay for household kitchen waste separation services in Haidian and Dongcheng districts, Beijing city. *Environments*, 1(2), 190-207.
23. Zeng, C., Niu, D., Li, H., Zhou, T., & Zhao, Y. (2016). Public perceptions and economic values of source-separated collection of rural solid waste: A pilot study in China. *Resources, conservation and recycling*, 107, 166-173.