



ASSESSING PUBLIC AWARENESS AND WILLINGNESS TO PAY FOR HOUSEHOLD SOLID WASTE MANAGEMENT IN THE HIEP HOA DISTRICT, BAC GIANG PROVINCE

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Abstract

The amount of waste generated is increasing in both quantity and complexity, in line with the level of economic development, but the land area available for solid waste treatment is limited. Residents' attitudes and willingness to pay (WTP) regarding waste segregation at source and recycling were investigated in this study through a survey using questionnaires conducted in the Hiep Hoa district, Bac Giang province. These findings indicate that local people have a high level of environmental awareness. About 92.4 % of the respondents were satisfied with the current state of the environment and domestic solid waste management. The survey data showed a positive attitude toward segregating waste at the source in the Hiep Hoa district, with the majority of respondents (95.7 %) preferring to segregate their waste at home if required by the local government. More than half of the respondents (57.2 %) provided positive answers to WTP-related questions. The survey results confirmed the hypothesis that the probability of respondents saying 'yes' to the WTP question increases with education level, age, and bid, using logistic regression analysis. The average WTP was 53,440 VND/household/month. The findings of this study provide information on residents' awareness and WTP levels for solid waste management, which can be used by local governments to develop waste management solutions and promote sustainable household waste management by improving waste segregation at source and recycling.

Keywords: Solid waste; Awareness; Attitude; WTP; CVM; Hiep Hoa district.

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1. Introduction

Effective management of solid waste is crucial for sustainable development and environmental protection [1]. Inadequate waste management systems pose challenges to public health and contribute to pressing environmental problems [2]. In Hiep Hoa district, Bac Giang province,

rapid economic growth and population increase have led to a substantial increase in the amount and complexity of household solid waste. This has placed significant pressure on the limited waste treatment land area. According to the 2020 report from the district's Department of Natural Resources and Environment [3],

the district generates approximately 84,2 tons of household solid waste per day, equivalent to 30,312 tons per year. Urban solid waste accounts for 30,88 % of the total, with a daily production of 26 tons, while rural household waste accounts for 69,12 %, with a daily generation of 58,2 tons. The district comprises 24 communes, 1 town, and 165 villages [3]. Therefore, urgent attention is required to implement appropriate management practices for municipal solid waste in this area.

When determining the most suitable solid waste management system for a specific area, decision-makers must consider technical factors, implementation costs, and the attitudes of the population [4]. Public consensus plays a vital role in the successful implementation of a solid waste management plan. The development and execution of policies on source separation and recycling of waste should be based on people's behavior and willingness to pay (WTP) [5]. Nevertheless, there is limited empirical data available regarding the WTP, waste segregation at source, and recycling behavior of the residents in Hiep Hoa, Bac Giang province. To address the solid waste issue effectively and establish appropriate recycling facilities, the government of Hiep Hoa district requires the active participation of its residents. Without their involvement, effective implementation of policies and collaboration will remain challenging. Hence, it is imperative to survey to assess the behavior, attitudes, and WTP of the residents in the Hiep Hoa district.

Contingent Valuation Method (CVM) is a preference-based approach commonly employed to assess willingness to pay (WTP) or willingness to accept environmental goods. CVM has gained wide popularity due to its flexibility

and capacity to calculate total value. Numerous studies worldwide employ CVM to assess willingness to pay in the context of solid waste management [6-8]. The objective of these studies is to assist policymakers in formulating appropriate policies and legal regulations to address the developmental-environmental protection conflict, particularly in the realm of solid waste management.

To effectively address the solid waste management challenges in Hiep Hoa district, Bac Giang province, research titled "Assessing awareness and willingness to pay for household solid waste management" aims to evaluate people's awareness, attitudes, and behaviors towards waste management. The study utilizes the single-bound dichotomous CVM to estimate the WTP of households for waste segregation at source and recycling in the Hiep Hoa district. Furthermore, it examines the factors that influence individuals' WTP. The findings from this research will provide valuable insights for the implementation of sustainable solid waste management not only in the Hiep Hoa district but also in other similar regions.

2. Research methods

2.1. Data collection

The data used in this study were collected through a direct interview method, specifically a survey conducted in 2021. A total of 250 households residing in the Hiep Hoa district were included in the survey. These households were selected to represent three areas within the district: Thang town, Luong Phong commune, and Mai Dinh commune. The direct interview approach was chosen to ensure the collection of comprehensive and meaningful information, thereby enhancing the reliability of the data.

Table 1. Demographic characteristics of the survey sample (n = 250)

Characteristic		Number of households	Percentage (%)
Age	From 20 to 35 years old	53	21.2
	From 36 to 45 years old	123	49.2
	From 46 to 55 years old	52	20.8
	Over 55 years old	22	8.8
Gender	Male	35	14.0
	Female	215	86.0
Education	High School	86	34.4
	College/University	140	56.0
	Post-graduate	24	9.6
Occupation	Official	74	29.6
	Worker	63	25.2
	Housekeeper	52	20.8
	Small business owner	61	24.4
Income (VND/month)	Under < 5 million	21	8.4
	From 5 - 10 million	87	34.8
	From 10 - 20 million	95	38.0
	Over 20 million	47	18.8

Current methodologies for estimating WTP encompass continuous CVM and discrete CVM [9]. Continuous CVM allows respondents to freely provide open-ended responses by stating the maximum amount they are willing to pay, facilitating easier data analysis. However, this approach has limitations when respondents lack sufficient background information regarding the research subject or when uncertainty exists regarding the maximum amount they can contribute [10]. In contrast, discrete CVM simplifies the process by only requiring respondents to choose their willingness to pay without specifying a specific amount. This alleviates the inconsistency issue between stated WTP and actual payment capabilities [9]. Thus, to gather the necessary data for both individuals' WTP and the specific amount they are willing to pay, we employed the single-bound Dichotomous CVM. Within the survey questionnaire, respondents were presented with the following question: "Are you willing to pay for the segregation and recycling of

solid waste?". The answer options included "Yes" and "No". For those who expressed a willingness to pay, several predetermined value options were provided based on preliminary discussion from experts. These options included amounts of 30,000, 50,000, 70,000, 90,000, and 110,000 VND per month. Subsequently, respondents were prompted with a follow-up question asking them to specify the highest price they would be willing to pay.

2.2. Data analysis

The data analysis for this study involved the utilization of various methods, including descriptive statistics to assess people's awareness, attitudes, and behaviors regarding solid waste management in Hiep Hoa district. Additionally, binary regression analysis was employed as a popular model to estimate the probability and determine the impact of key factors on an individual's WTP. The CVM method is founded on the random utility theory developed by McFadden [11]. It can be expressed in the following form:

$$\text{Log}_e \left[\frac{Pr}{1-Pr} \right] = \beta_0 + \beta_1.Bid + \beta_2.Income + \beta_3.Education\ level + \beta_4.Household\ size + \beta_5.Age + \beta_6.Solid\ waste\ volume + \beta_7.Waste\ segregation\ at\ source \quad (1)$$

In which, β_0 : Constant; β_1 - β_{10} : Coefficients

The probability function has the following form:

$$P_r = F(x'_i\beta) = \frac{e^{\text{Log}_e \left[\frac{Pr}{1-Pr} \right]}}{1 + e^{\text{Log}_e \left[\frac{Pr}{1-Pr} \right]}} \quad (2)$$

3. Results and Discussion

3.1. The awareness, attitudes, and source separation and recycling behavior of residents in Hiep Hoa district, Bac Giang province

People's environmental awareness serves as a significant indicator to gauge the progress of a community. It

encompasses various aspects such as knowledge, individual thinking and behavior, community cooperation, and attitudes toward building a sustainable society. This information is highly valuable for local authorities in their efforts to plan for sustainable social development (Figure 1).

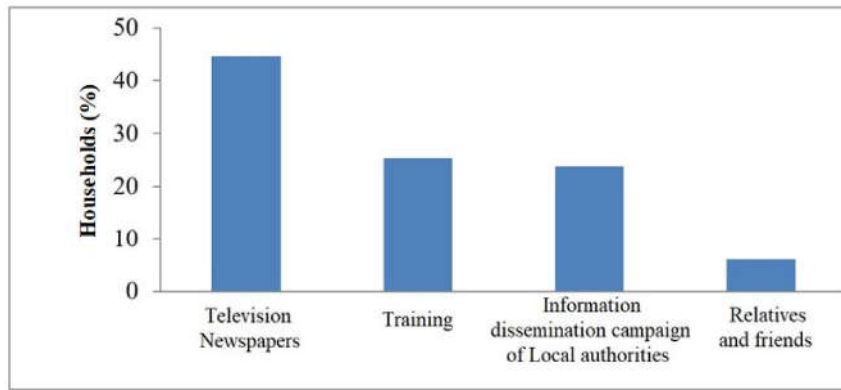


Figure 1: Sources of environmental knowledge information for the general public

According to the research, an overwhelming majority of respondents (80,8 %) demonstrated concern for environmental issues. Television and newspapers emerged as the primary sources of environmental information for most individuals (44,7 %). Local authorities in Hiep Hoa district also played a substantial role (23,8 %) in disseminating environmental information. Around 87,4 % of respondents actively engaged in environmental activities, belonging to self-management groups, signing environmental commitments, and participating in awareness campaigns.

This suggests a commendable level of environmental consciousness among the people of Hiep Hoa district.

As for the local environment, the majority of respondents (82,3 %) expressed some degree of satisfaction, while 17,7 % reported dissatisfaction. Generally, the proportion of individuals satisfied with the quality of the local environment in the Hiep Hoa district is relatively higher compared to urban areas. Nonetheless, a significant portion of respondents (68 %) expressed concerns about the increasing severity of solid waste pollution in Hiep Hoa District.

They emphasized the need for more effective measures from local authorities to improve solid waste management and treatment in the future.

Numerous environmental studies have explored the role of environmental attitudes in influencing environmental behavior. In waste management programs, community participation is crucial for

their success, particularly in the reduction, source separation, and recycling of solid waste. It has been widely recognized that segregating solid waste at the source is a fundamental step in addressing this issue. Therefore, the survey included questions aimed at collecting local opinions and attitudes regarding the source separation of solid waste (Figure 2).

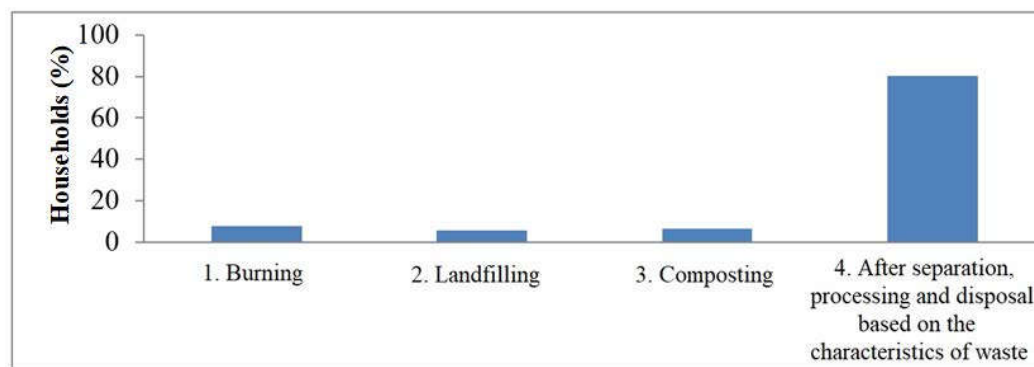


Figure 2: Public opinions on effective methods for household solid waste treatment

Analysis of the survey data reveals a positive attitude towards source separation, with 80,4 % of respondents considering the method of source separation, treating, and disposing of solid waste based on its characteristics to be the most effective approach. In the survey results, it was

found that a vast majority of individuals (97.9 %) believe that segregating waste at its source is crucial for sustainable solid waste management. Additionally, a significant portion (95.7 %) indicated a willingness to segregate solid waste at home if required by the government.

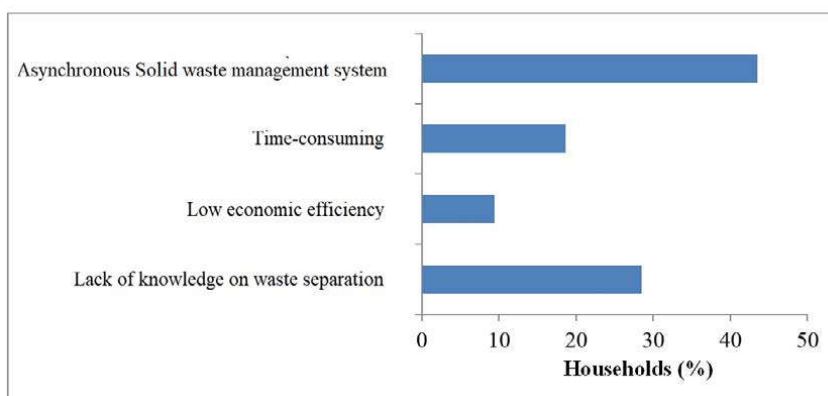


Figure 3: Factors contributing to ineffective source separation of household solid waste in Hiep Hoa district

Furthermore, the study aimed to explore the reasons behind the lack of effectiveness in source separation of solid

waste in the Hiep Hoa district (Figure 3). The investigation findings indicate that the major contributing factors

are the lack of synchronized systems and insufficient collection and source separation resources, accounting for 45 % of the reported causes. Additionally, inadequate knowledge concerning solid waste segregation at source was identified as a significant factor, constituting 28 % of the reported reasons. Challenges such as the time-consuming nature of the process and low economic efficiency were also mentioned as barriers limiting individuals' engagement in source separation.

To enhance the efficiency of solid waste segregation at source at the source, it is crucial to make synchronized investments in infrastructure development, solid waste treatment, and recycling facilities, as well as the provision of collection and source separation vehicles. Additionally, guidelines for uniform source waste separation should be issued. Equally important is the need to further enhance public awareness regarding environmental protection.

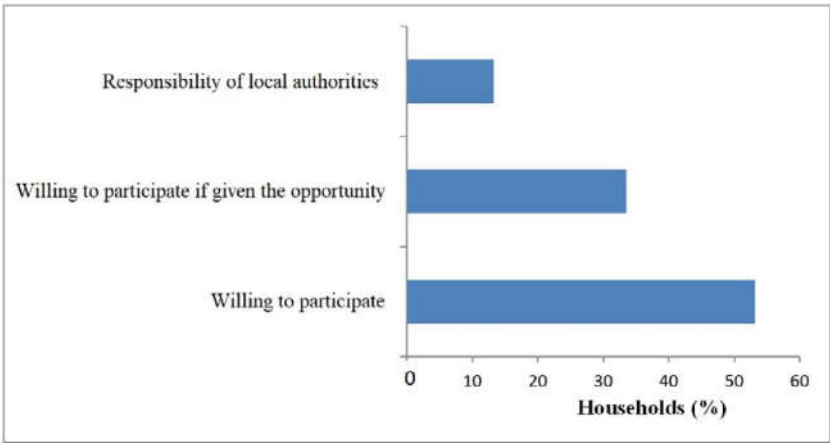


Figure 4: Public willingness to participate in household solid waste segregation at source and recycling

The survey conducted in the Hiep Hoa district regarding people's behavior towards solid waste segregation at source revealed several positive outcomes. An overwhelming majority of respondents (98,8 %) expressed their willingness to contribute to the protection of the local environment. Only a small percentage (1,2 %) stated their reluctance, citing the view that solid waste segregation at source and recycling should be the responsibility of the local government.

Respondents offered various solutions to enhance solid waste recycling and source separation in the Hiep Hoa district. The most frequently suggested solution, voiced by 38,5% of participants, was the organization

of more environmental activities and awareness campaigns to foster greater environmental consciousness. This was followed by recommendations to enhance environmental control facilities, mentioned by 28 % of respondents. Additionally, 20,3 % of participants believed that promoting the development of environmental laws would be a highly effective approach.

The study also focused on understanding the reasons why source separation was not effectively implemented in the Hiep Hoa district. Investigation findings revealed that an unsynchronized system and inadequate collection and source separation resources (accounting for 45 %) along with insufficient knowledge

about solid waste segregation at source (accounting for 28 %) were identified as the primary causes. Additionally, concerns about the time-consuming nature of the process and perceived low economic benefits were cited as reasons limiting people's engagement in source separation of solid waste.

3.2. Willingness to pay for solid waste recycling and source separation in Hiep Hoa district, Bac Giang province

The survey results, using the CMV approach, revealed that 57.2 % of respondents expressed a willingness to pay, which was higher than the 42.8 % who indicated an unwillingness to pay.

Table 2. The proportion of willingness to pay for solid waste management services

BID (VND/month)	Total of households	Willing to pay		Unwilling to pay	
		Number of households	Percentage (%)	Number of households	Percentage (%)
30,000.0	50	48	96.0	2	4.0
50,000.0	50	42	84.0	8	16.0
70,000.0	50	30	60.0	20	40.0
90,000.0	50	20	40.0	30	60.0
110,000.0	50	3	6.0	47	94.0
Total	250	143	57.2	107	42.8

Table 2 showcases the distribution of responses to the valuation question, illustrating the count of respondents who expressed a willingness to pay at each specified bid level, ranging from 30.000 to 110.000 thousand VND per month. The majority of respondents indicated a preference for lower bid levels, with 96 %, 84 %, 60 %, and 40 % of respondents stating their willingness to pay 30.000, 50.000, 70.000, and 90.000 VND per

month, respectively. Notably, only 6 % of respondents exhibited a willingness to pay the highest bid level of 110.000 VND. These estimates reflect the minimum expectations of respondents regarding their willingness to pay.

The analysis of the survey data in Table 3 indicates that the average household WTP in the Hiep Hoa district was 53,440 thousand VND per month.

Table 3. Descriptive statistics of public willingness to pay for the improvement of the domestic solid waste management system in Hiep Hoa district, Bac Giang province

No.		WTP
1	Mean (VND/household/month)	53,440.0
2	Standard deviation	23,732.0
4	Minimum	20,000.0
5	Maximum	110,000.0
6	Number of households	250

WTP level exceeded the applied fee of approximately 50.000 VND/household/month in Ho Chi Minh city and other major cities in Vietnam for household source waste separation, processing, and

recycling [8]. This indicates a growing environmental concern among the residents, particularly regarding domestic solid waste. The estimation results also indicated that the number of respondents

willing to pay gradually decreased as the management service fee increased, in line with the economic theory of the demand curve [9]. These findings can serve as a reference for designing plans and estimating necessary funding to promote solid waste segregation at source and recycling in Hiep Hoa district, Bac Giang province.

3.3. Analyzing factors influencing the willingness to pay for solid waste recycling and source separation in Hiep Hoa district, Bac Giang province

A binary regression model was employed to study the factors influencing WTP. The analysis results are summarized in Table 4

Table 4. The determinants of households willing to pay for solid waste management system

No.	Independent variables	Explanation	Coefficient -B	P-value (Sig.)
1	Constant		0.837	0.000
2	Household Income	Average monthly income of respondent (VND per person monthly) Under 5 million =1; 5 to 10 million =2; 10 to 20 million =3; Over 20 million =4	0.053	0.061*
3	Educational level	Respondent's highest level of education (High school = 1; college/university =2; Postgraduate = 3	0.125	0.002**
4	Household size	Number of household members (people)	0.022	0.468
5	Age	Year of respondents (From 20 to 35 years old = 1; From 36 to 45 years old = 2; From 46 to 55 years old = 3; Over 55 years old = 4)	0.004	0.813
6	Solid waste volume	Average amount of solid waste per day per household (Kg/day)	0.042	0.334
7	Waste segregation at the source	1: Segregation at source 0: No Segregation at source	0.052	0.398
8	BID	Willing to pay (VND/household/month)	0.001	0.000**
R ²		0.67		
** Indicates significance at the 1% level.				
* Indicates significance at the 5% level.				

The squared correlation coefficient (R^2) of the model is 0,67, indicating that the variables included in the model account for 67 % of the variation in WTP, while the remaining 33 % can be attributed to other factors not considered in the model.

Among the variables examined, the two variables such as Bid and education level show statistically significant relationships with WTP at the 1 % significance level. The income variable also shows statistical significance at the 5 % level. Specifically, the coefficients

for education level and household income level are positive, suggesting that individuals with higher education and income are more likely to have a positive WTP response. These findings align with previous studies by Niringiye et al., [7] and Rahji et al., [6]. On the contrary, the coefficient for the Bid variable is negative, indicating that higher solid waste management service fees are associated with a lower probability of expressing willingness to pay. Other factors such as the number of family members, age, amount of solid waste generated by the household,

and implementation of waste segregation at source at home do not demonstrate statistical significance ($p\text{-value} > 0,05$) and thus have no significant influence on respondents' WTP.

Based on the aforementioned analysis results, it is evident that a systematic and formal approach to raising awareness is crucial. Consequently, it becomes imperative to enhance publicity efforts through various channels, such as television, and to organize environmental events. Furthermore, incorporating environmental concerns, particularly solid waste management, into formal education programs at all levels and providing targeted training sessions in collaboration with local authorities are essential measures. These endeavors will ensure the dissemination of precise and accurate information, especially regarding source solid waste separation. Additionally, when implementing pricing structures for local solid waste management services, regional aspects and varying levels of economic development must be taken into account to ensure financial sustainability.

4. Conclusion

Research findings indicate a notable level of environmental awareness among individuals, with a growing concern for the impacts of solid waste management. The survey data demonstrates positive attitudes and support for the implementation of source separation of solid waste in the Hiep Hoa district. Over half of the respondents (57,2 %) provided affirmative responses concerning their WTP and openly shared their insights and perceptions on related matters. The average WTP amount was determined to be 53.440 VND per household per month.

Utilizing binary regression analysis, the survey outcomes affirm the hypothesis that the likelihood of respondents endorsing the WTP proposition increases in tandem with their level of education and income, and decreases in response to higher prices for solid waste management services. The study outcomes are expected to furnish local authorities with vital information regarding the prevailing situation, public attitudes, and WTP regarding solid waste management. It is crucial to systematically raise awareness through various channels and integrate solid waste management into education to promote solid waste segregation at source and recycling efforts within Hiep Hoa District, aiding in sustainable waste management.

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