"The impact of circular economy awareness on waste management by vendors in Hanoi, Vietnam"

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THE IMPACT OF CIRCULAR ECONOMY AWARENESS ON WASTE MANAGEMENT BY VENDORS IN HANOI, VIETNAM

Abstract

The circular economy is increasingly recognized as a crucial solution to environmental and economic challenges, gaining significant attention from the government, businesses, and citizens in Vietnam. As urban waste management becomes urgent, understanding the factors influencing sustainable waste management practices is essential. This study aims to assess the impact of circular economy awareness on the actual waste management behavior of market vendors in Hanoi. A total of 324 valid responses were collected directly from vendors in 2024. The paper applies an extended version of the theory of planned behavior framework, incorporating key variables such as circular economy awareness, willingness to pay, government policies, and behavioral barriers. Using the PLS-SEM method, the findings indicate that circular economy awareness has a positive influence on vendors' waste management behaviors, with significant effects through attitudes ($\beta = 0.425$), subjective norms ($\beta = 0.473$), perceived behavioral control ($\beta = 0.539$), and willingness to pay ($\beta = 0.462$). However, behavioral barriers negatively impact actual waste management behavior ($\beta = -0.179$). Notably, government policies, despite existing national strategies, do not appear to affect vendors' behavioral intentions ($\beta = 0.031$; p-value = 0.520). This suggests that such policies have yet to effectively reach or influence the target group. These findings emphasize the necessity for more targeted policy interventions to enhance circular economy awareness and foster sustainable waste management behaviors among market vendors. Strengthening engagement with vendors and improving policy effectiveness will be critical in promoting long-term environmental sustainability in Vietnam.

Keywords	circular economy awareness, waste management, behavior, vendors, theory of planned behavior
JEL Classification	F64, Q53, Q56

INTRODUCTION

In recent years, the rapid economic development and urbanization in Vietnam have significantly increased the amount of waste, especially municipal solid waste. As the country's economic center, Hanoi is also facing serious waste-related challenges, with approximately 7,000 tons of municipal waste generated each day, placing great pressure on the city's waste management system, including sorting, collection, treatment, and disposal, particularly in densely populated areas (MONRE, 2024).

Traditional markets in Hanoi are located in high-density areas and serve as key centers for the distribution, wholesale, and retail of goods and services, meeting about 30-40% of the consumption needs of the city's residents. Consequently, these markets are also major sources of municipal waste generation (Vietnam Academy of Social Sciences, 2021). Waste management at traditional markets plays a vital role in the overall waste management system of Hanoi, as these markets gen-

erate large amounts of organic waste from fresh food and packaging. Vendors function as both distributors and consumers, and therefore, their behavior in waste classification and treatment significantly influences the volume and types of waste discharged at markets before being collected by urban environmental service companies.

The circular economy is a sustainable development model that emphasizes waste reduction, reuse, and the circulation of materials (Ellen MacArthur Foundation, 2013). Vietnam has initiated a transition to a circular economy through its national socioeconomic development strategy, as stipulated in the Environmental Protection Law of 2020 and related legal documents. Successfully implementing the circular economy model requires not only policy frameworks but also the awareness and active participation of all societal sectors. Waste sorting, reuse, and treatment before disposal are fundamental practices of this model.

Vendors' awareness of the circular economy can significantly contribute to environmental protection, cost and resource savings, innovation, green jobs creation, and improved market waste management practices. Abadi et al. (2021) demonstrated that all three constructs of the theory of planned behavior (TPB) positively affect behavioral intention, which in turn significantly influences the actual waste management practices of vendors of fruit and vegetables in Kermanshah City, Iran. Furthermore, research on the role of circular economy awareness in the transition toward sustainable waste management has confirmed its positive effect on real-world behavior (Wang et al., 2020). These findings underscore the vital role of circular economy awareness in promoting sustainable waste management practices and emphasize its importance as a key factor in achieving long-term environmental goals (Škrinjarić, 2020; Dewi et al., 2022).

However, empirical research on urban waste management behavior in Vietnam has primarily focused on households (Dinh et al., 2022; Chuong et al., 2024). Despite the growing emphasis on circular economy principles in urban environmental strategies, vendors in traditional markets, who play a significant role in urban waste generation and management, have received limited attention. This empirical study addresses this gap by contributing to the existing literature on the link between awareness and waste management behavior. Moreover, its findings offer valuable insights for policymakers and local authorities seeking to promote circular economy awareness among traditional market vendors.

1. LITERATURE REVIEW

The escalating crisis of environmental degradation, particularly due to ineffective waste disposal, has driven global interest in sustainable waste management practices. In response, researchers and policymakers alike have sought to understand the underlying behavioral mechanisms that govern waste management decisions. One of the most widely applied frameworks in this domain is the theory of planned behavior (TPB), proposed by Ajzen (1991). This theory posits that an individual's intention to perform a behavior is shaped by three key factors: attitude, subjective norms, and perceived behavioral control. These components have been consistently shown to influence pro-environmental intentions and behaviors across a variety of settings, including waste segregation, recycling, and waste reduction (Zhang et al., 2021; Abadi et al., 2021; Muniandy et al., 2021; Yu et al., 2018; Raghu & Rodrigues, 2022).

To capture the complexity of waste management behaviors, especially in developing countries, recent studies have extended TPB to incorporate additional variables that better reflect economic and contextual realities. One such variable is willingness to pay, which reflects individuals' readiness to contribute financially to waste collection or recycling initiatives. Research shows that it is closely tied to both perceived environmental responsibility and socioeconomic status. For instance, Afroz et al. (2009) and Michael et al. (2024) demonstrate that when financial costs are perceived as too high, individuals are less likely to participate in waste programs, especially among youth and low-in-

come earners (Mai & Hoffmann, 2012; Wang et al., 2016b). Thus, willingness to pay acts as both a motivational and limiting factor in sustainable waste practices.

Government policy is another critical external factor influencing behavioral intention. Effective policy mechanisms, including regulation, enforcement, public education, and infrastructure investment, can significantly influence individual and collective waste management behaviors (Zhang et al., 2019; Xu et al., 2017). Studies conducted in China and Vietnam show that supportive policies improve public participation in waste sorting, especially when these policies are complemented by localized awareness campaigns and incentive structures (Thai & Van Thich, 2022; Zhang et al., 2021).

Beyond policy and economic considerations, an emerging strand of literature emphasizes the need to transition from a linear to a circular economy model, which promotes waste reduction through principles of reuse, recycling, and resource regeneration. However, the success of circular economy implementation hinges heavily on circular economy awareness. Circular economy awareness refers to the public's knowledge, recognition, and behavioral alignment with circular economy principles. Studies from various regions, including China, Malaysia, Portugal, and Saudi Arabia, demonstrate that higher levels of circular economy awareness are positively associated with eco-conscious behavior, especially among university students and young consumers (Guo et al., 2017; Abdul-Hamid et al., 2024; Dewi et al., 2022; Alves et al., 2023; Almulhim & Abubakar, 2021). Vagner (2021) and Smol et al. (2018) further highlight the role of national education programs in raising circular economy awareness and embedding sustainable practices into everyday life. Despite these promising findings, limited attention has been paid to the role of circular economy awareness in influencing TPB dimensions (attitude, subjective norms, perceived behavioral control) or in shaping willingness to pay, particularly in informal or small-scale commercial settings.

Moreover, behavioral intentions do not always lead to actual behavior, particularly in the presence of behavioral barriers. These barriers include a wide range of structural and psychological factors, such as lack of time, space, infrastructure, information, or financial support. They inhibit individuals from adopting sustainable waste practices even when they possess the intention (Zhang et al., 2015; Wang et al., 2011; Singh & Giacosa, 2018; Uehara et al., 2023). In Vietnam and other Southeast Asian countries, vendors in traditional markets and food stalls often face acute infrastructural and economic challenges, making it difficult to engage in waste segregation or recycling despite supportive intentions (Djuwita et al., 2020).

Despite growing literature on TPB and sustainable behavior, few studies have integrated circular economy awareness, willingness to pay, government policy, and behavioral barriers into a unified, extended TPB framework. Even fewer have examined this integration in the context of informal vendors, who contribute significantly to urban waste generation but remain understudied. This paper seeks to address these critical gaps by proposing a comprehensive model that explores the influence of these four constructs on TPB components and waste management behavior among vendors in Vietnam.

In summary, the existing literature emphasizes the critical role of individual attitudes, subjective norms, perceived behavioral control, and willingness to pay in shaping waste management behaviors. Furthermore, government policies and circular economy principles have been recognized as essential drivers for promoting sustainable waste management practices. However, barriers related to infrastructure, knowledge, and financial constraints remain significant challenges. This study seeks to address these gaps by exploring the impact of circular economy awareness on vendors' waste management behavior in Vietnam (Figure 1). Accordingly, the following hypotheses are proposed:

H1: *Circular economy awareness positively impacts the attitude of vendors in Hanoi toward waste management behavior.*

H2: *Circular economy awareness positively impacts the subjective norms of vendors in Hanoi toward waste management behavior.*
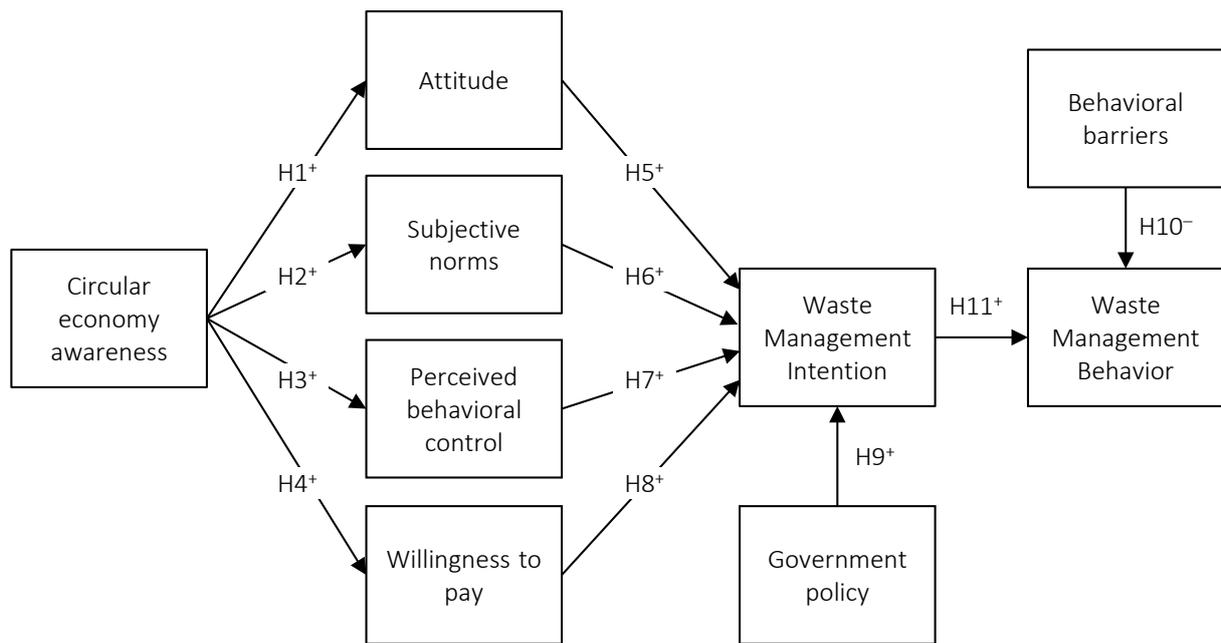
Figure 1. Theoretical framework

H3: *Circular economy awareness positively impacts the perceived behavioral control of vendors in Hanoi toward waste management behavior.*

H4: *Circular economy awareness positively impacts the willingness to pay of vendors in Hanoi.*

H5: *Attitude toward waste management behavior positively impacts the intention to engage in waste management behavior among vendors in Hanoi.*

H6: *Subjective norms positively impact the intention to engage in waste management behavior among vendors in Hanoi.*

H7: *Perceived behavioral control positively impacts the intention to engage in waste management behavior among vendors in Hanoi.*

H8: *Willingness to pay positively impacts the intention to engage in waste management behavior among vendors in Hanoi.*

H9: *Government policy positively impacts the intention to engage in waste management behavior among vendors in Hanoi.*

H10: *Behavioral barriers negatively impact the actual waste management behavior of vendors in Hanoi.*

H11: *Intention to engage in waste management behavior positively impacts the actual waste management behavior of vendors in Hanoi.*

2. METHOD

To achieve the research objective, quantitative data were collected through face-to-face surveys using questionnaires with vendors over more than one month, from December 28, 2023, to February 2, 2024.

The questionnaire was designed based on a thorough review of the literature and structured in accordance with the proposed research model. The questionnaire contained two groups of questions. The first section on demographic data included age, gender, education level, and monthly income. The second section encompassed constructs such as circular economy awareness, attitude, subjective norms, perceived behavioral control, government policy, willingness to pay, behavioral barriers, intention, and behavior. These factors were measured using a 37-item scale, adapted from Xu

et al. (2017, 2020), Liakos et al. (2019), Guo et al. (2017), Abadi et al. (2021), and Wang et al. (2020). The questions were translated into Vietnamese to facilitate the recording of responses from the survey subjects.

Pilot interviews were conducted with 20 randomly selected vendors to assess and validate the clarity and comprehensibility of the questionnaire. The respondents had to evaluate 37 statements on a scale from 1 to 5 (1: strongly disagree; 2: disagree somewhat; 3: neutral; 4: agree somewhat; 5: strongly agree).

The study sample consisted of Vietnamese vendors who have been concerned with waste management over the past four years. To ensure representativeness and avoid bias, the research team conducted face-to-face interviews at 18 major markets in 12 districts of Hanoi, yielding a total of 330 responses. Following data collection, Microsoft Excel was employed to clean the data and perform a descriptive analysis of the sample characteristics. After processing, 324 responses were retained for analysis.

Table 1. Demographic profile of respondents

Item	Characteristics	Number	Percentage
Gender	Female	249	76.9%
	Male	75	23.1%
Age	Below 25 years old	12	3.7%
	25–35 years old	36	11.1%
	35–50 years old	137	42.3%
	Over 50 years old	139	42.9%
Education Level	Below the high school level	137	42.3%
	High school level	103	31.8%
	Vocational Level	33	10.2%
	Associate Degree	16	4.9%
	Bachelor's Degree	35	10.8%
Income (per month)	Below 5 million VND	49	15.1%
	5–10 million VND	182	56.2%
	10–15 million VND	53	16.4%
	15–20 million VND	21	6.5%
	Over 20 million VND	19	5.9%

Table 1 shows that more women participated in the interview than men, accounting for 76.9%. Age distribution of interviewees is as follows: over 50 (42.9%), 35–50 (42.3%), 25–35 (11.1%), and under 25 (3.7%). Regarding education level, 42.3% of respondents have not completed high school, while 31.8% have a high school diploma. In addi-

tion, 10.2% have received vocational training, 4.9% have a college degree, and 10.8% have a bachelor's degree. Regarding income distribution level, from 5 to 10 million VND – 56.2%, from 10 to 15 million VND – 16.4%, under 5 million VND – 15.1%, from 15 to 20 million VND – 6.5%, the rest earn over 20 million VND.

The paper utilized SmartPLS 4.0 software for data analysis, applying partial least squares structural equation modeling (PLS-SEM) to investigate both direct and indirect relationships among the variables. PLS-SEM was selected for this study due to its appropriateness for exploratory research and theoretical model development. It delivers estimation results similar to CB-SEM, especially when CB-SEM uses Maximum Likelihood estimation. PLS-SEM serves two main purposes:

a. exploring and predicting research constructs; and

b. testing and validating relationships between constructs based on theoretical frameworks (as an alternative to CB-SEM).

These purposes are highly applicable across diverse fields such as finance, education, management, business, accounting, sociology, and psychology. A key advantage of PLS-SEM is its lack of reliance on normally distributed data, unlike CB-SEM. Furthermore, PLS-SEM is more flexible regarding sample size, making it ideal for studies with limited data (Nguyen & Vu, 2021).

In the data analysis process, the study initially assessed the quality of observed variables within the measurement model by evaluating scale reliability, including outer loadings, Cronbach's alpha, and composite reliability. Additionally, convergent validity was examined through the average variance extracted (AVE), while discriminant validity was assessed using the Fornell–Larcker criterion and the heterotrait–monotrait (HTMT) ratio. Subsequently, the structural model was tested by identifying potential multicollinearity issues through the variance inflation factor (VIF), assessing the explanatory power of the model via the coefficient of determination (R^2) and effect size (f^2), and analyzing the significance of hypothesized relationships based on path coefficients and p-val-

ues. Finally, a mediating analysis was conducted to test the impact of circular economy awareness on waste management behavior through attitude, subjective norms, perceived behavioral control, and willingness to pay.

3. RESULTS

Table 2 provides a detailed overview of the reliability and validity of all constructs. Internal consistency was assessed using Cronbach's alpha coefficients, while outer loadings were analyzed

to evaluate the representation of each item by its construct. Composite reliability (CR) was used to measure the degree to which items within the same group reflect the latent construct, and average variance extracted (AVE) was calculated to determine the proportion of variance captured by each construct in relation to measurement error.

It is recommended that the outer loading coefficients of the indicator variables should exceed 0.70, as proposed by Hair et al. (2017). The loading coefficients of all items in Table 2 are great-

Table 2. Reliability and validity analysis

Factors	Items	Validity		Reliability	
		Outer Loadings	Average variance extracted (AVE)	Cronbach's alpha	Composite reliability (CR)
AT	AT1	0.819	0.657	0.826	0.885
	AT2	0.751			
	AT3	0.83			
	AT4	0.84			
BH	BH1	0.782	0.652	0.893	0.918
	BH2	0.781			
	BH3	0.819			
	BH4	0.852			
	BH5	0.787			
	BH6	0.82			
CEA	CEA1	0.774	0.604	0.829	0.882
	CEA2	0.885			
	CEA3	0.823			
	CEA4	0.801			
	CEA5	0.561			
IN	IN1	0.837	0.693	0.853	0.9
	IN2	0.874			
	IN3	0.847			
	IN4	0.768			
P	P1	0.919	0.874	0.857	0.933
	P2	0.95			
SN	SN1	0.851	0.661	0.828	0.886
	SN2	0.823			
	SN3	0.807			
	SN4	0.767			
PBC	PBC1	0.725	0.597	0.831	0.881
	PBC2	0.789			
	PBC3	0.79			
	PBC4	0.816			
	PBC5	0.741			
BB	BB1	0.754	0.566	0.764	0.837
	BB2	0.827			
	BB3	0.585			
	BB4	0.819			
WTP	WTP1	0.837	0.681	0.767	0.865
	WTP2	0.804			
	WTP3	0.834			

Note: AT = attitude; BH = waste management behavior; CEA = circular economy awareness; IN = waste management intention; P = government policy; SN = subjective norms; PBC = perceived behavioral control; BB = behavioral barriers; WTP = willingness to pay.

er than 0.70, except for two variables: CEA5 and BB3. However, the outer loading coefficients for CEA5 and BB3 both fall within the range from 0.4 to below 0.7. Therefore, the decision to retain or remove them is considered in conjunction with other indices such as CR and convergent validity (estimated by the AVE coefficient) of those factors.

Table 2 shows that Cronbach's alpha values range from 0.764 to 0.893, while the CR values fall between 0.837 and 0.933. Since all values exceed the 0.70 threshold (Hair et al., 2017), the construct reliability in this study is deemed appropriate, demonstrating strong internal consistency.

The AVE value is recommended to be at least 0.50 to achieve convergent validity (Fornell & Larcker, 1981). All AVE values in Table 2 are higher than the required 0.50, which means that the measurement scale meets the convergence criterion well and has high convergent validity.

The study performed tests to assess the model's discriminant validity, which refers to the degree to which latent variables are theoretically distinct from each other and, in practice, show no correlation (Wang et al., 2016a). Discriminant validity is ensured when the square root of the AVE for a latent variable exceeds its correlations with other variables, as stated by Fornell and Larcker (1981). Table 3 shows that the square roots, bolded values, are higher than the correlations among constructs.

Additionally, the paper assesses discriminant validity using the heterotrait–monotrait (HTMT) ratio, which evaluates the distinctiveness of the measurement model. The results in Table 4 indicate that the HTMT values for all latent variables range from 0.116 to 0.79, all of which are below the threshold of 0.9 (Henseler et al., 2015). Therefore, the measurement model demonstrates accuracy in its distinctiveness.

Table 3. Fornell-Larcker criterion

Factors	AT	BH	CEA	IN	P	PBC	SN	BB	WTP
AT	0.811	–	–	–	–	–	–	–	–
BH	0.486	0.807	–	–	–	–	–	–	–
CEA	0.425	0.483	0.777	–	–	–	–	–	–
IN	0.472	0.595	0.407	0.832	–	–	–	–	–
P	0.221	0.42	0.404	0.345	0.935	–	–	–	–
PBC	0.459	0.677	0.539	0.567	0.423	0.813	–	–	–
SN	0.474	0.551	0.473	0.582	0.434	0.615	0.773	–	–
BB	−0.066	−0.291	−0.094	−0.201	−0.235	−0.295	−0.096	0.753	–
WTP	0.45	0.547	0.462	0.504	0.445	0.59	0.524	−0.232	0.825

Note: AT = attitude; BH = waste management behavior; CEA = circular economy awareness; IN = waste management intention; P = government policy; SN = subjective norms; PBC = perceived behavioral control; BB = behavioral barriers; WTP = willingness to pay.

Table 4. Heterotrait-monotrait (HTMT) ratio of correlation

Factors	AT	BH	CEA	IN	P	PBC	SN	BB	WTP
AT	–	–	–	–	–	–	–	–	–
BH	0.567	–	–	–	–	–	–	–	–
CEA	0.502	0.565	–	–	–	–	–	–	–
IN	0.555	0.665	0.469	–	–	–	–	–	–
P	0.261	0.477	0.478	0.393	–	–	–	–	–
PBC	0.555	0.79	0.646	0.665	0.498	–	–	–	–
SN	0.574	0.646	0.568	0.678	0.526	0.749	–	–	–
BB	0.116	0.307	0.126	0.225	0.265	0.327	0.147	–	–
WTP	0.56	0.658	0.559	0.61	0.542	0.728	0.645	0.291	–

Note: AT = attitude; BH = waste management behavior; CEA = circular economy awareness; IN = waste management intention; P = government policy; SN = subjective norms; PBC = perceived behavioral control; BB = behavioral barriers; WTP = willingness to pay.

Table 5. f² and R²

Factors	AT	BH	CEA	IN	P	PBC	SN	BB	WTP	R² adjusted
AT	–	–	–	0.036	–	–	–	–	–	0.178
BH	–	–	–	–	–	–	–	–	–	0.381
CEA	0.220	–	–	–	–	0.409	0.288	–	0.272	–
IN	–	0.488	–	–	–	–	–	–	–	0.440
P	–	–	–	0.001	–	–	–	–	–	–
PBC	–	–	–	0.046	–	–	–	–	–	0.288
SN	–	–	–	0.076	–	–	–	–	–	0.221
BB	–	0.050	–	–	–	–	–	–	–	–
WTP	–	–	–	0.018	–	–	–	–	–	0.211

Note: AT = attitude; BH = waste management behavior; CEA = circular economy awareness; IN = waste management intention; P = government policy; SN = subjective norms; PBC = perceived behavioral control; BB = behavioral barriers; WTP = willingness to pay.

Based on the CR and AVE coefficients, it can be determined that the indicators CEA5 and BB3 are valid and should be retained in the model.

Once the research data have been confirmed to be reliable and valid, the tests evaluate the predictive power of the structural model and multicollinearity tests, which are essential assumptions of the PLS-SEM model, before analyzing the relationships in the research model. The results of these evaluations are presented in Tables 5 and 6. The R^2 coefficient is used to measure the overall explained variance, which indicates the explanatory power within the endogenous structure, f^2 index is used to assess the magnitude of the effect of each independent variable on the dependent variable in the research model, and variance inflation factors (VIFs) to check for multicollinearity among the constructs.

According to the results in Table 5, the endogenous variable "intention" has an R^2 adjusted = 0.440. Hence, attitude, subjective norms, perceived behavioral control, willingness to pay, and policy have a moderate level of explanation for the behavioral intention to implement waste management. The explanation level of waste management intention for the waste management behavior is only moderate, given the R^2 adjusted = 0.381. This could be attributed to the research›s focus on a limited number of input variables (Henseler, 2017; Henseler et al., 2009).

Comparing effect size f^2 with the criterion of Cohen (1988) in Table 5, circular economy awareness has a moderate impact on attitude, subjective norms, willingness to pay, and a high impact on perceived behavioral control. Subjective norms, perceived behavioral control, and attitude

Table 6. Path coefficients and hypotheses testing

Path	VIF	Path coefficient	T-value	P-values	Hypothesis	Results
CEA → AT	1	0.425	8.229	0.000	H1	Supported
CEA → SN	1	0.473	9.232	0.000	H2	Supported
CEA → PBC	1	0.539	12.226	0.000	H3	Supported
CEA → WTP	1	0.462	10.592	0.000	H4	Supported
AT → IN	1.433	0.168	3.064	0.002	H5	Supported
SN → IN	1.885	0.280	4.468	0.000	H6	Supported
PBC → IN	1.991	0.226	3.868	0.000	H7	Supported
WTP → IN	1.798	0.134	2.069	0.039	H8	Supported
P → IN	1.369	0.031	0.643	0.520	H9	Not Supported
BB → BH	1.042	− 0.179	4.26	0.000	H10	Supported
IN → BH	1.042	0.559	14.613	0.000	H11	Supported

Note: AT = attitude; BH = waste management behavior; CEA = circular economy awareness; IN = waste management intention; P = government policy; SN = subjective norms; PBC = perceived behavioral control; BB = behavioral barriers; WTP = willingness to pay.

have a weak impact on the waste management intention. Meanwhile, policy does not impact waste management intention, and willingness to pay has a weak level of impact. Waste management intention has a significant impact on waste management behavior. In contrast, the behavioral barriers variable has a weak impact on the waste management behavior.

Finally, the VIF coefficients for all items fell within the acceptable range of 1 to 1.991 (Table 6). Therefore, there is no multicollinearity issue among the predictor variables (Hair et al., 2019).

The next step is to test the research hypotheses. To assess the relationships within the research model at a 0.05 significance level, a bootstrap analysis with 5,000 samples was performed. The results of this analysis are presented in Table 6.

The path coefficients for circular economy awareness to attitude ($\beta = 0.425$; p-value = 0.000), subjective norms ($\beta = 0.473$; p-value = 0.000), perceived behavioral control ($\beta = 0.539$; p-value = 0.000), and willingness to pay ($\beta = 0.462$; p-value = 0.000) toward waste management are all positive and significant at the 5% significance level. This suggests that circular economy awareness has a positive impact on attitude, subjective norms, perceived behavioral control, and willingness to pay. These findings support hypotheses *H1*, *H2*, *H3*, and *H4*.

The path coefficients for attitude ($\beta = 0.168$; p-value = 0.002), subjective norms ($\beta = 0.280$; p-value = 0.000), perceived behavioral control ($\beta = 0.226$; p-value = 0.000), and willingness to pay ($\beta = 0.134$; p-value = 0.039) toward the behavioral intention to implement waste management are all positive and significant at the 5% significance level. This suggests that vendors' behavioral intention to implement waste management is positively influenced by attitude, subjective norms, perceived behavioral control, and willingness to pay. These findings support hypotheses *H5*, *H6*, *H7*, and *H8*.

However, the policy variable ($\beta = 0.031$; p-value = 0.520) has no significant impact on waste management intention, which contradicts the findings of previous studies (Dinh et al., 2022; Matin et al., 2022; Tian et al., 2022). Thus, hypothesis *H9* is rejected.

Hypothesis *H10* is supported at the significance level of 5%. The result shows that behavioral barriers ($\beta = -0.179$; p-value = 0.000) have a negative impact on waste management intention. This means that behavioral barriers such as space limitations, infrastructure, knowledge gaps in sorting, time constraints, lack of consistency, and monthly income negatively impact the behavior of waste management among vendors.

With a significance level of 5%, the result shows that behavioral intention has a positive impact on the behavior of implementing waste management ($\beta = 0.559$; p-value = 0.000). Therefore, hypothesis H11 is supported.

For the mediation analysis, the study examines the role of an intermediate variable, referred to as the mediator, in explaining how an independent variable affects the outcome.

Firstly, the study evaluated each indirect effect relationship. Table 7 shows the four significant indirect effect relationships with p-values < 0.05 (the significance level at 5%). Therefore, circular economy awareness can be seen as a significant factor in affecting the actual behavior of vendors via intermediate variables such as willingness to

Table 7. Mediating effect analysis

Mediating effects	Indirect effects	Original Sample	T-value	P-values
Specific	CEA →WTP → IN → BH	0.027	2	0.023
	CEA → SN → IN → BH	0.058	3.478	0.000
	CEA → PBC → IN → BH	0.054	3.376	0.000
	CEA → AT → IN → BH	0.031	2.548	0.005
Total	CEA → BH	0.289	5.536	0.000

Note: AT = attitude; BH = waste management behavior; CEA = circular economy awareness; IN = waste management intention; P = government policy; SN = subjective norms; PBC = perceived behavioral control; BB = behavioral barriers; WTP = willingness to pay.

pay, subjective norms, perceived behavioral control, and attitude.

The analysis evaluated the total indirect effect of circular economy awareness on the behavior of implementing waste management. The result in Table 7 shows the indirect relationship of circular economy awareness to this behavior of vendors with p-value = 0.000 < 0.05 (the significance level at 5%). This result confirms the importance of building and enhancing circular economy awareness within the vendor community to promote sustainable waste management behavior in the traditional market.

4. DISCUSSION

This study examines how circular economy awareness influences the waste management behavior of vendors in Hanoi, Vietnam. The findings largely align with prior studies on waste management behavior.

Circular economy awareness has a moderately positive effect on attitude, subjective norms, and willingness to pay. This aligns with previous research by Nguyen et al. (2025). Vendors mentioned that they have been exposed to content related to the circular economy model, mainly on digital platforms. As a result, they have become aware of the potential of this economic model in protecting the environment and conserving natural resources. When circular economy awareness undergoes positive changes, it contributes to fostering positive attitudes among vendors toward waste management, recycling, and reuse. Additionally, if vendors' awareness improves alongside societal pressures, expectations, and evaluations from those around them, it helps shape their perceptions, making them feel compelled to act in ways that are valued by society. This, in turn, motivates them to participate in waste management. Furthermore, their positive attitudes can spread and create a ripple effect within society, encouraging the community to adopt sustainable lifestyles and inspiring more people to engage in waste management. This increases support for sustainable waste management solutions and lays the groundwork for greater acceptance of paying a higher price for waste management services.

Circular economy awareness significantly influences perceived behavioral control. This can be attributed to the fact that when vendors fully comprehend the benefits and principles of the circular economy model, they feel more confident and capable of controlling their consumption behaviors. They believe they can take actions that contribute to environmental protection, such as waste management, recycling, and other sustainable practices. This awareness not only strengthens their belief in their personal ability to adopt sustainable behaviors but also motivates them to actively participate in changing their habits toward more responsible waste management. Consequently, this contributes to overall sustainable development.

Attitude, subjective norms, perceived behavioral control, and willingness to pay have a moderately significant influence on vendors' behavioral intentions (Wang et al., 2020; Jain et al., 2020; Soorani & Ahmadvand, 2019; Abadi et al., 2021; Xu et al., 2020; Dalila et al., 2020; Michael et al., 2024). This implies a gap between these variables and their intention to implement waste management. One reason for this is that modifying waste management habits is not easily achievable in the short term. Additionally, vendors often lack the necessary drive and support to move from awareness to concrete actions, as they tend to prioritize initiatives that provide financial benefits.

The behavioral barriers negatively affect the waste management behavior of vendors, implying that vendors are limited in knowledge, finance, time, infrastructure, and space to manage waste effectively. Debnath et al. (2023) and Zhang et al. (2015) have noted similar patterns. This can be explained by the characteristics of the business areas of vendors in traditional markets in Hanoi. Through a direct survey, it was found that most vendors sell at kiosks with a small area, less than 15m². The nature of their work limits their time and income, and their educational level is not high, mainly below high school or high school level, accounting for more than 70%. In addition, Vietnam is currently a lower-middle-income country (World Bank, 2023). In 2023, the average labor income was 7.1 million VND per month (General Statistics

Office, 2023). This leads to financial constraints when switching to eco-friendly tools and equipment for the circular economy model. Moreover, the survey exposed challenges on the environmental management side. There is still a lack of waste collection and sorting bins in the markets, which do not meet the technical safety and hygiene standards for effective and sustainable waste management. Besides, there is a lack of coordination between waste collectors and vendors, which also causes difficulties in the waste management process. Therefore, these barriers negatively affect waste management under the circular economy model during business operations.

In addition, government policy does not affect vendors' intention to implement waste management. This finding contradicts prior evidence by Li et al. (2020) and Wang et al. (2020), implying that current regulations are not yet complete and there are no specific regulations for vendors. Circular economy policy in Vietnam is currently only focused on the scope of enterprises. During the survey, vendors said that the market management boards were still not very close to conveying the regulations of the state. This implies that legal documents have not reached the majority of the people. In addition, there are still many shortcomings in preferential policies and incentives for organizations and individuals to participate in environmental protection activities, which are difficult to apply and have not created a breakthrough to mobilize social participation in environmental protection work (Ministry of Industry and Trade, 2023). Waste management still faces many obstacles because there are no mandatory regulations, sanctions, or incentive mechanisms (Tran, 2023).

Intention is the primary factor influencing vendors' waste management behavior in Hanoi. This conclusion is in line with the findings of Abadi et al. (2021) and Khan et al. (2020). When a group exhibits high consensus regarding a specific goal or intention, the likelihood of collective action to achieve that goal increases, leading to greater effectiveness in adopting new policies or models. Additionally, vendors recognize that waste management not only maintains cleanliness in their business areas but also con-

tributes to broader environmental protection. This awareness creates a strong motivation to actively participate in sustainable waste management practices.

Circular economy awareness positively influences vendors' waste management behavior, mediated by factors such as attitude, subjective norms, perceived behavioral control, and willingness to pay. This highlights the critical role of these variables in transmitting the influence of circular economy awareness to the actual behavior of vendors. Specifically, circular economy awareness positively affects vendors' attitudes. When they hold positive attitudes, they are more likely to effectively adopt the circular economy model in waste management and engage in environmentally friendly behaviors. Circular economy awareness also contributes to shaping norms in the thoughts and actions of vendors, encouraging them to voluntarily participate in waste management activities through the application of the circular economy model. Furthermore, circular economy awareness enhances vendors' confidence in their ability to perform behaviors. When they have confidence in their abilities, they are more inclined to participate in and maintain effective waste management practices. Additionally, a deeper understanding of the circular economy increases their willingness to invest in environmentally friendly waste management solutions, ultimately enhancing the overall quality of waste management behavior.

However, this study still has some limitations. Firstly, the study used a convenience sampling method through direct surveys, so the representativeness is low, the generalizability is not high, and the opinions of the survey subjects may not be fully reflected. Secondly, the explanatory power of waste management intention on waste management behavior is only at a moderate level of 38.1% due to the limited number of input variables.

Future studies should supplement additional indicator variables into the observational model, expand the scale of the survey, and increase the number of responses to further enhance the measurement of the effect of circular economy awareness on vendors' waste management behavior.

CONCLUSION

The purpose of this study was to explore the impact of circular economy awareness on the waste management behavior of vendors in Hanoi, Vietnam, using an extended theory of planned behavior (TPB) model. The findings reveal that intention plays a significant role in driving the actual waste management behavior of vendors. However, the impact of behavioral barriers on these behaviors was weak, suggesting that vendors are more likely to transition from intention to action when they have a strong intention to engage in waste management practices. Although attitude, subjective norms, perceived behavioral control, and willingness to pay were found to have a relatively low impact on vendors' waste management intentions, circular economy awareness showed a moderate positive effect on these variables. This suggests that a strong understanding of the circular economy can enhance the predictive power of the TPB model by reinforcing the relationships between its key components. Notably, the study also found that government policies had little influence on vendors' waste management intentions, highlighting a gap in the implementation and awareness of these policies.

From these results, circular economy awareness plays a crucial role in shaping vendors' intentions and waste management behaviors. By improving vendors' awareness and understanding of the circular economy, it is possible to strengthen key factors in the extended TPB model that contribute to more effective waste management practices. However, barriers such as insufficient government support, lack of proper infrastructure, and financial constraints must be addressed to facilitate a smoother transition from intention to action. Moreover, the mediating effects of variables like willingness to pay, subjective norms, and perceived behavioral control indicate that these factors should be targeted in future initiatives to improve vendor waste management behavior.

For future research, it would be valuable to explore the long-term effects of circular economy awareness on waste management behavior, as well as to investigate the role of additional external factors, such as socioeconomic conditions and local cultural influences, in shaping waste management behavior. Additionally, further studies could examine the effectiveness of specific interventions, such as policy changes and educational campaigns, in enhancing the impact of circular economy awareness and improving overall waste management outcomes.

AUTHOR CONTRIBUTIONS

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