Narrowing the gap between intention and behavior? An empirical study of farmers' waste classification in China

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The source classification of domestic waste is important for protecting China's rural environment but this is more difficult in rural areas than in urban areas due to the characteristics of farmers in China. This study discussed influencing factors of farmers' intention and behavior towards domestic waste classification and tried to determine whether there's a gap between intention and behavior. Based on 833 valid questionnaires in Taihu Lake Basin, a structural model was constructed to achieve the goals of this study. The results show that subjective norms, publicity and education, and classification intention are significantly related to behavior, and attitude is positively related to behavior and intention. Farmers' intention and behavior had a significant discrepancy with the average values of 4.374 and 3.103, respectively. Publicity and education activities can effectively reduce the degree of gap between them. In addition, attitude, subjective norm and behavior intention have positively moderating effect on publicity and education and waste classification behavior. The findings of this study help understand the *status quo* of farmers' behavior and intention of waste classification in Jiangsu Province and provide insights for promoting the development of rural domestic waste classification in China.

1 Introduction

Domestic waste generation in China has increased by 45.89% from 2013 to 2019 (MoEE, 2020), which puts great pressure on municipal waste treatment systems. China has expended great effort to address the domestic waste problem in cities (Yu et al., 2018), such as source classification, improving collection, transfer and harmless treatment facilities and so on (Knickmeyer, 2020; Li et al., 2020). However, these efforts have not been undertaken equally in rural areas. In China, approximately 40% of the population lives in rural areas, and domestic waste generation is also increasing dramatically along with the economy development (Tang et al., 2019). Meanwhile, the composition of rural domestic waste is becoming more complex due to the continuously diversified types of consumer goods, which makes rural domestic waste treatment one of the key tasks of comprehensively promoting rural revitalization in China.

Many studies have proven that domestic waste has brought severe challenges to the rural ecological environment (Yang et al., 2012), such as water, air and soil pollution (Zeng et al., 2016), breeding a large number of bacteria and mosquitoes, which seriously endanger the health of rural residents (Wang et al., 2019). Classification of waste at source is regarded as an effective way to mitigate these adverse impacts (Zhang et al., 2019; Knickmeyer, 2020). This can not only reduce the output of waste through recycling but also reduce harmful waste impact on the human body (Aphale et al., 2015; Babaei et al., 2015). However, at present, most of the waste was disposed through incineration or landfills after centralized collection in rural China (Han et al., 2019a). There is no effective classification treatment in the process of collection (Sun, 2019), which is inconsistent to build the beautiful countryside construction in China (Liu et al., 2021). In addition, rural areas in China are scattered, low population density and lack of funds may make domestic waste collection and transfer less conducive (Han et al., 2019a). Generally, the disposal of domestic waste in rural China has a long way to go. To this end, the Chinese government has promulgated a series of documents to emphasize the necessity of source classification of rural domestic waste (MoHURD, 2017; GOSC, 2018; Mohurd et al., 2022), such as promoting publicity and education in the rural areas and establishing a funding guarantee mechanism for rural domestic waste classification.

Farmers are key players of waste classification in rural areas, and their actions can determine the final effect of the policies (Teng et al., 2022). Understanding their intention and specific behavior in the process of waste classification to enhance their participation in waste classification is meaningful (Han et al., 2019b). However, most of the existing studies of waste classification are still focused on urban areas, while rural areas are less studied, especially for farmers' intentions and behavior (Xiao et al., 2020).

It is notable that empirical research shows that there's a gap between willingness and real waste classification behavior for urban residents in China (Zhang et al., 2020), which poses challenge to the effectiveness of classification policy. For example, the gap between willingness and behavior regarding waste classification was found in Ningbo (Chen et al., 2015) and Taishan, China (Zhang et al., 2019), which reflects the fact that intentions fail to translate into classification behavior in practice. This gap was also found in other areas, such as job search (Hooft et al., 2005), ethical consumption (Hassan et al., 2016), new energy vehicles consumption (He et al., 2021), electronic waste recycling (Echegaray and Hansstein, 2017), and patient behavior (Faries, 2016). Based on a systematic review, Sheeran and Webb (2016) found that although intentions can predict behavior, a gap exists between intention and behavior, approximately one-half of the time. Thus, does the gap between farmers' intention and action for waste classification exist in China still needs to be further explored, and how to narrow the gap is important for China's domestic waste management in rural areas.

Taking Jiangsu's rural domestic waste classification as an example, this study can make several contributions as follows: the results from this study can partly reveal the domestic waste classification status in rural area of China. It also can help to explain the gap between intention and behavior and identify factors that can narrow the gap, which is meaningful for the domestic waste management. In addition, this study can contribute to the intention and behavior gap research in general, at least in rural domestic waste classification.

2 Research framework and method

2.1 Hypothesis development

The theory of planned behavior (TPB), as a classic theory to explain people's behavior, proposes that human behavior is the outcome of a well-thought-out plan. According to TPB, attitude and subjective norms are the main variables that determine behavioral intention, then they all can determine the further behavior (Ajzen, 2020). Many scholars have applied this theory to study domestic waste classification intention and actions, and found that attitude, subjective norms and perceived behavior control were all correlated with behavioral intention positively (Wang K. et al., 2021; Wang Y. et al., 2021; Lou et al., 2022). TPB has also been proverbially applied to explain variance in intention and behavior in different fields (Ajzen, 2020), such as green consumption (ElHaffar et al., 2020), green hotel visit behavior (Chi et al., 2022), tourist behavior (Ulker-Demirel and Ciftci, 2020), and medicine reuse (Alhamad and Donyai, 2021).

The aforementioned studies also tried to determine the reasons and provide solutions to narrow the gap between intention and behavior. Some scholars have found that increasing classification knowledge (Wang K. et al., 2021; Wang Y. et al., 2021) and promoting subjective norms (Chen et al., 2015; Yu et al., 2018; Wang et al., 2020) can help to narrow the gap. On one side, it may directly promote the classification behavior of rural residents by increasing their knowledge and influencing their attitudes (Yu et al., 2018; Wang and Mangmeechai, 2021). On another side, with the wealth of public knowledge, social pressure faced by rural residents will increase, and the degree of subjective norms will improve, which may also nurture classification behavior. Publicity and education is a useful and practical way to increasing knowledge and promoting subjective norms (Ao et al., 2022). Therefore, we emphasized the effect of publicity and education on the intentions-behavior relationship, to see whether it can narrow down the gap.

Based on TPB theory and intuitive experience in the process of field research, the following hypotheses were set up and a model diagram was drawn:

Hypothesis 1. Attitude play a positive role in promoting behavioral intention.

Hypothesis 2. Subjective norms play a positive role in promoting behavioral intentions.

Hypothesis 3. Behavioral intention is positively correlated with behavior.

Hypothesis 4. Subjective norms can increase behavior.

Hypothesis 5. Publicity and education play a positive role in increasing attitudes.
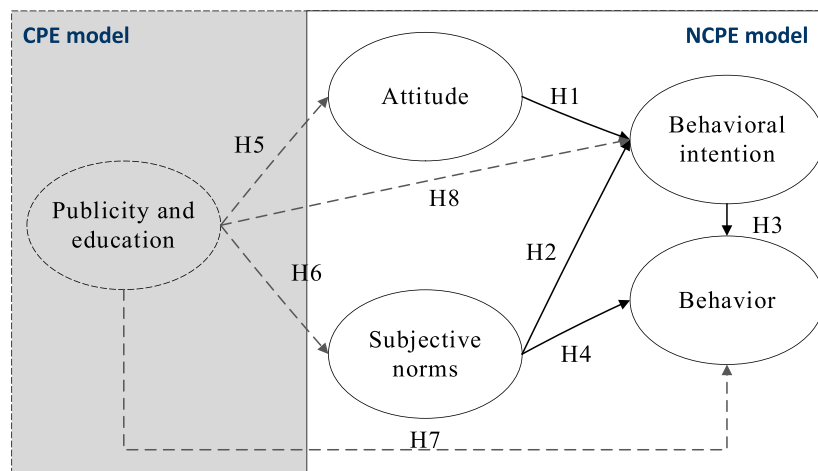
FIGURE 1
Research framework and hypotheses. Notes: CPE model represents the model conducting "Publicity and education," and NCPE represents a model without "Publicity and education."

Hypothesis 6. Publicity and education are positively related to subjective norms.

Hypothesis 7. Publicity and education are positively associated with behavior.

Hypothesis 8. Publicity and education are positively associated with behavioral intentions.

2.2 Data collection

2.2.1 Questionnaire design and trial survey

As shown in Figure 1, the framework of this study includes five latent variables. Each latent variable is measured with three subquestions. Subjective norms refer to pressure from family members, neighbors, and friends about waste classification. Attitude refers to farmers' cognition about their obligation to classify waste and protect environment. Publicity and education refer to the environmental publicity and education activities in the community, such as community bulletin boards.

To improve the quality of the data, each question of this study is revised based on more mature research in the past, combined with the background of this field survey. First, we drew on the practices of to select two variables in the TPB: attitudes and subjective norms (Webb et al., 2013; Park and Ha, 2014). Three subquestions were designed to measure each variable, and a scale from 1 (Totally disagree) to 5 (Totally agree) was created by the Likert scale (Ajzen and Fishbein, 2008). Famers can evaluate each question according to their actual situation. Similarly, we also designed a scale from 1 (Never)-to 5 (Always) to measure two variables: publicity and education, behavior (Wang et al., 2019; Zhang et al., 2019). A scale from 1 (Totally unwilling) to (Totally willing) was used to measure behavior intention. After completing the above work, we created a questionnaire and improved it on the input from experts in related fields. Then, we selected a local village to conduct a trial

survey to determine the real situation and adjust the questionnaire. Finally, we obtained a formal questionnaire, the main content of which is shown in Part I of Supplementary Materials.

2.2.2 Study area

The questionnaires were finally completed in three cities in southern Jiangsu Province (Wuxi, Changzhou and Suzhou), part of the Taihu Lake Basin, which has a leading economic position in China. With its rapid economic development, environmental pressure is also serious in this region, including rural environmental degradation. Hence, compared to less developed regions, Jiangsu Province has initiated many pilot measures to curb environmental pollution (Peng et al., 2020), including rural domestic waste collection, transportation, and treatment system construction (General Office of the CPC Jiangsu Provincial Committee, 2018). Currently, the model of "village collection, township transfer, and county treatment" has been successfully implemented in this area.

To ensure data quality, we randomly selected 8–9 villages in three prefecture-level cities (a total of 25 villages). The geographical locations of the 25 villages are shown in Figure 2. With the help of the local village committee and volunteers, 50 farmers were randomly selected from each village to finish the questionnaire, see Part II of Supplementary Materials. In this survey, 1,250 questionnaires were collected in total. After excluding invalid questionnaires (missing key values, outliers, etc.), a total of 833 valid questionnaires were obtained. Finally, we used the data from 833 questionnaires for data analysis and obtained descriptive statistical results, as shown in Table 1.

Table 1 shows that the characteristics of farmer households are obvious, the proportion of males and females in this sample is balanced, and most of them are over 50 years old, which is in line with the current situation of the rural residential population in China. The educational level of the sample is low, most of them are below senior high school, and the *per capita* annual income is generally not high. 88.57% of famers are willing to classify waste, but only 23.04% can classify the waste correctly.
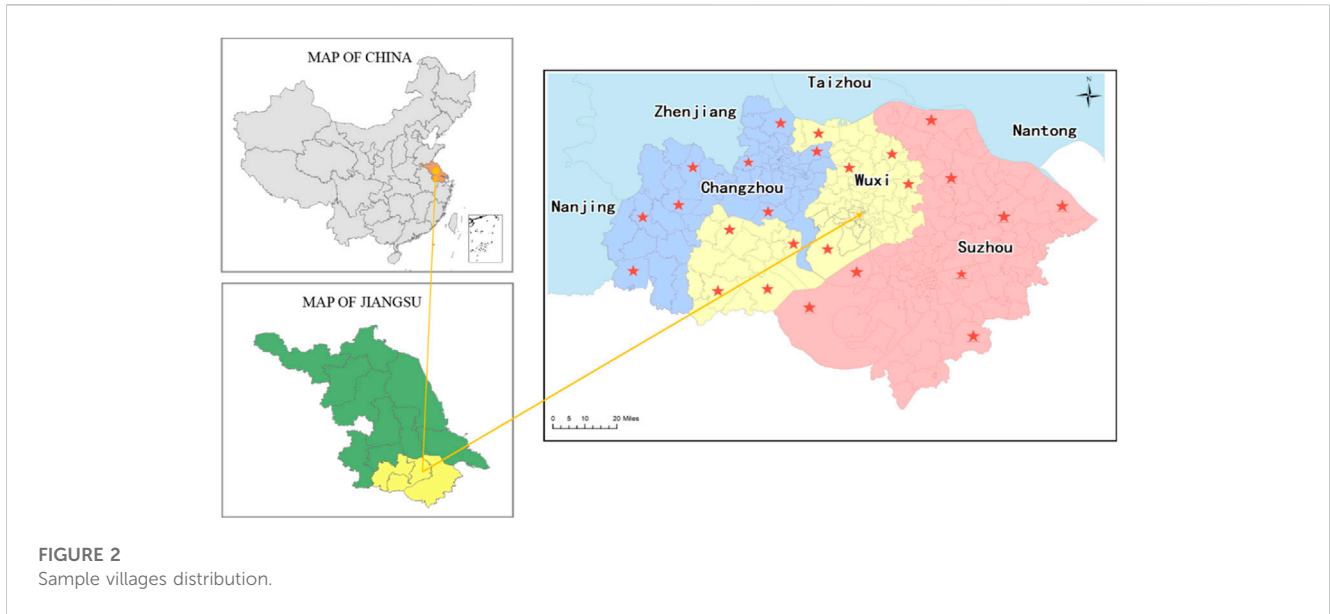
FIGURE 2
Sample villages distribution.

TABLE 1 Demographic characteristics of the respondents.

Variable	Category	Frequency	Percentage (%)
Gender	Male	431	51.7
	Female	402	48.3
Age	Under 30	40	4.8
	30–39	68	8.2
	40–49	69	8.3
	50 and older	656	78.7
Education level	Below senior high school	609	73.1
	High school and junior college	175	21.1
	Bachelor's degree or above	49	5.8
Annual *per capita* income	Less than 10,000 RMB	206	24.7
	10–30,000 RMB	441	52.9
	More than 30,000 RMB	186	22.4

2.3 Data analysis procedure

The structural equation models were applied to assess the proposed TPB model in this study. Structural equation model is suitable for situations with many variables and complex model relationships (Nusair and Hua, 2010; Ma et al., 2020), and it was widely used for the intention and behavior study for different topics (Crossler et al., 2014; Zhang et al., 2020; Sayed and Tang, 2021), including domestic waste classification (Ma et al., 2020; Shen et al., 2020; Zhang et al., 2022). There are five latent variables that are measured by observable variables in this study, compared to other method, such as Ordinary least squares (OLS) (ElHaffar et al., 2020), structural equation can help to measure the unobservable constructs

and specify the structural paths between latent constructs and indicators. We employed the Statistical Program for Social Sciences (SPSS 26.0) and structural equation modeling by utilizing AMOS (24.0) software for data analysis.

3 Results

3.1 Test of the model fit

For structural equation models, reliability and validity testing are important steps to ensure the reliability of data and the rationality of model construction. Cronbach's alpha coefficient

TABLE 2 Sample reliability test and validity test.

Variable	AT	SN	BI	BEH	PE
AT	0.518				
SN	0.128	**0.778**			
BI	0.563	0.315	**0.592**		
BEH	0.246	0.264	0.300	**0.615**	
PE	0.361	0.356	0.280	0.263	**0.691**
$\sqrt{AVE}$	**0.720**	**0.882**	**0.770**	**0.784**	**0.831**
CA	0.633	0.912	0.729	0.723	0.824
CR	0.761	0.913	0.811	0.826	0.869
Mean value	4.420	3.803	4.410	3.580	3.610

Notes: AT, attitude; SN, subjective norm; BI, behavioral intention; BEH, behavior; PE, publicity and education; AVE , average variance extracted; CA, Cronbach's alpha coefficient and CR, Combined reliability. Crosswise elements are the square root of the variance extracted. Off-diagonal elements are the correlations among constructs. The bold numbers on the diagonal are the AVE values of the corresponding variables.

TABLE 3 Integral fitting coefficient.

Project/Index	x^2/df	RMSEA	GFI	AGFI	CFI	IFI	TLI
Ideal value	<3	<0.05	>0.9	>0.9	>0.9	>0.9	>0.9
CPE model	2.978	0.049	0.963	0.945	0.969	0.969	0.959
NCPE model	3.293	0.053	0.970	0.950	0.971	0.971	0.960

Notes: CPE model represents the model including the variable Publicity and education, and NCPE represents a model without Publicity and education.

(CA) and combined reliability (CR) were used to test the reliability of the data. The validity test can prove the rationality of model construction from three aspects: convergent validity, discriminant validity and construct validity. The specific indicators in Tables 2, 3 prove that the reliability of the data and the rationality of the model in this study have passed the test.

CA and CR indicators of all variables are greater than the ideal value of 0.6, that is, the reliability of the sample data is acceptable (Podsakoff et al., 2003). In addition, in Table 2, the bold numbers on the diagonal are the AVE values of the corresponding variables. AVE values of all variables are greater than 0.5, indicating that the convergent validity is ideal (Anderson and Gerbing, 1988). The correlation coefficients of the five variables are all smaller than the corresponding square root of AVE, indicating that each variable has a certain correlation and a certain degree of discrimination at the same time. This shows that discriminant validity is ideal (Hair et al., 2009). Finally, according to the suggestion of Hair et al. (2009), the fitting coefficients in Table 3 reflect that the overall fitting of the CPE and NCPE model are good and the construct validity is ideal.

3.2 Gap between intention and behavior

First, the mean of five variables were calculated based on SPSS 24.0 software. As shown in Table 2 attitudes and behavioral intentions had the highest mean values of 4.42 and 4.41, respectively. Subjective norms (3.803) and publicity and education (3.610) took second place. The mean value of behavior

is the lowest, which is 3.58. Besides, comparing the average value of behavioral intention and behavior, we find that the average value of behavioral intention (4.374) is much greater than that of behavior (3.103). This intuitively shows that there is a certain gap between behavioral intention and behavior. To further test whether this phenomenon is statistically significant, we conducted a paired sample t-test on these two variables.

Table 4 shows the t-test results of the pairing of variables behavior intention and behavior. The average values of the nine pairs were all greater than 0, the total average difference was 0.838, and all passed the significance level of 0.1%. This shows that differences appear between behavioral intention and behavior in the process of waste classification. This finding is consistent with the classification situation in other areas (Zhang et al., 2020).

3.3 Hypothesis testing

To test the above hypothesis and the correlation between variables, we used AMOS 24.0 for structural equation modeling. The results of CPE model are shown in Figure 3. The correlation coefficient between attitude, subjective norms and behavioral intention is positive and significant at the 0.1% level, so the Hypothesis H1 and Hypothesis H2 are valid. Similarly, behavioral intention ($p < 0.01$) and subjective norms ($p < 0.001$) were positively correlated with behavior, supporting Hypothesis H3 and Hypothesis H4. On the whole, the relationship between the main variables in TPB theory has

TABLE 4 Paired sample _t_-test.

Pairing item	Mean	Std. Deviation	95% confidence interval		T-value	_p_-value
			Lower	Upper		
BI1 - BEH1	0.561	1.391	0.466	0.655	11.635	***
BI1 - BEH2	1.134	1.547	1.029	1.240	21.166	***
BI1 - BEH3	0.812	1.525	0.708	0.915	15.357	***
BI2 - BEH1	0.682	1.328	0.592	0.772	14.822	***
BI2 - BEH2	1.256	1.487	1.155	1.357	24.367	***
BI2 - BEH3	0.933	1.451	0.834	1.031	18.551	***
BI3 - BEH1	0.447	1.308	0.358	0.536	9.853	***
BI3 - BEH2	1.020	1.493	0.919	1.122	19.725	***
BI3 - BEH3	0.697	1.496	0.596	0.799	13.457	***

FIGURE 3
Hypothesis test results. Notes: *$p < 0.05$, **$p < 0.01$, and ***$p < 0.001$.
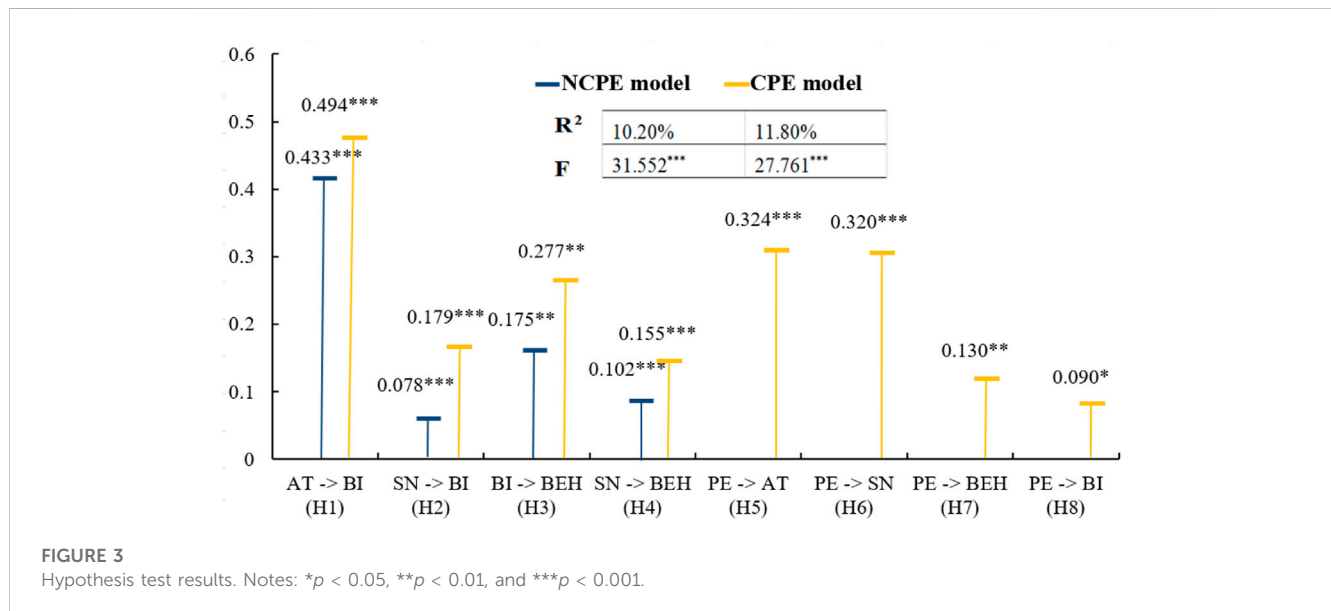
been verified again in CPE model. As an additional variable in addition to TPB theory, the positive correlation between publicity and education and other variables has also been tested. Among them, the correlation between publicity and education, attitude and subjective norms passed the significance test at the 0.1% level ($p < 0.001$), Hypothesis H5, and Hypothesis H6 were supported. Additionally, Hypothesis H7 and Hypothesis H8 passed significance levels of 5% and 1%, respectively. In summary, all the hypotheses proposed in this study have been verified, which once again proves the effectiveness of the model.

In addition, Figure 1 indicates that attitude, subjective norms and behavioral intentions can be used as intermediate variables in all paths from publicity and education to behavior. Therefore, to further test whether the mediating effect of the model exists, we use bootstrap methods for validation, as suggested by Bollen and

Stine (1990), MacKinnon et al. (2004), and others. Different from the step-by-step test method, the bootstrap method is simple, efficient and suitable for models with multiple mediating effects. The test results are shown in the following table:

In Table 5, the path ind is the non-standard test result given by the model, and stdind is the corresponding standard test result. Referring to the conclusion of Hayes and Preacher (2010), when the upper and lower limits of the confidence interval are both positive or negative at the same time, the mediating effect is significant. There is no zero value for the non-standard test and standard test in both bias-corrected and percentile confidence intervals. Therefore, the mediating effects of attitude, subjective norm and behavior intention in this model are significant. Effect values for specific pathways can be found in Table 5. This mediating effect demonstrates that subjective norms is more likely to convert intention into behavior through increasing social norm.

TABLE 5 Bootstrap test of mediating effect.

Path	Effect value	SE	Bias-corrected 95%CI			Percentile 95%CI		
			Lower	Upper	p	Lower	Upper	p
ind1	0.037	0.021	0.009	0.094	0.007	0.007	0.088	0.010
ind2	0.066	0.025	0.025	0.123	0.003	0.021	0.118	0.006
ind3	0.013	0.007	0.003	0.035	0.005	0.002	0.031	0.012
ind4	0.021	0.015	0.003	0.067	0.014	0.001	0.056	0.034
stdInd1	0.028	0.015	0.007	0.068	0.007	0.005	0.065	0.010
stdind2	0.050	0.018	0.018	0.088	0.003	0.016	0.086	0.006
stdind3	0.010	0.005	0.003	0.025	0.004	0.002	0.023	0.012
stdind4	0.016	0.011	0.002	0.048	0.015	0.001	0.041	0.034

Notes: ind1, PE→AT→BI→BEH; ind2, PE→SN→BI→BEH; ind3, PE→BI→BEH, and ind4, PE→SN→BEH.

3.4 Impact of publicity and education

The results of the mediation effect show that publicity and education not only directly affect the waste classification behavior of farmers, but also indirectly promote waste classification behavior through subjective norms, attitudes, and behavioral intentions. To further see the impact of publicity and education on intention and behavior gap, we performed similar work on the NCPE model. After excluding the variable of publicity and education, we find that the construct validity of the NCPE model is not as ideal as that of the CPE model (see Figure 3). Moreover, to prove that publicity and education can promote the convergence of behavioral intention and behavior, we compared the results of NCPE and CPE models. The R^2 and F values and significant results of the two models can be found in Figure 3. As seen from the table, the R^2 after regression of the NCPE model is 10.2%. After adding publicity and education, R^2 rose to 11.8%, and the p-value was less than 0.001. This shows that not only was the structural validity improved but also the explanatory power of the model was higher. The R^2 of the new model is larger than that of the NCPE model in multivariate regression analysis and the p-value is less than 0.05, which indicates that publicity education can reduce the gap between intention and behavior (Wang et al., 2019).

4 Discussion and implication

There are some differences between urban and rural areas for waste classification. One main reason may be the different characteristics of residents in different areas (such as education level, social relations, etc.). Compared with urban residents, the living area in rural regions is more compact, and neighborhood relationships are closer. Farmers' waste classification behavior will be more supervised by their relatives, friends and neighbors, which has a strong role in the promotion of subjective norms. In addition, compared with urban residents, farmers' knowledge and educational levels are limited. Many farmers do not understand the negative externalities caused by the non-classification of waste, so the role of personal moral norms may not be as strong as subjective norms in rural areas (Zhang et al., 2019; Wang et al., 2020).

The gap between intention and behavior is reflected not only in waste classification but also in various fields, such as health, psychology, business, and traffic safety (Yu et al., 2018; Wang et al., 2020; Wang and Mangmeechai, 2021). These studies show that factors affecting behavior and intention gap are mainly concentrated on external conditions, such as knowledge, facilities, and policy incentives. The current research on the relationship between intention and behavior in rural waste classification is still insufficient, much more work is needed to help the classification policy implementation.

The findings of this study also have important enlightenment for the promotion of household waste classification in rural China. Given the positive impact of subjective norms, local government and village committees can take appropriate measures to strengthen farmers' subjective norms. For example, strengthening mutual supervision among neighbors by publicizing the red and black lists.

Given the generally low education level in rural areas and the slow speed of news dissemination, the government should strengthen publicity and education for older farmers. For example, banners can be posted in the village community, slogans can be displayed, and brochures can be developed and distributed free of charge. For illiterate villagers, media, the WeChat platform and other information channels can be used to disseminate knowledge of waste classification. These measures can help farmers acquire more knowledge of waste classification, understand its positive significance, change their attitude, and promote the convergence of intention and behavior.

5 Conclusion

Based on the status of farmers' domestic waste classification in southern Jiangsu Province, this paper studied the influencing factors of farmers' intention and behavior towards domestic waste classification. Based on TPB model, we found that the attitude of farmers toward waste classification positively related to their intention to classify waste. At the same time, the subjective norms, it will not only strengthen farmers' intention to classify waste but also promote the classification behavior of farmers in their daily lives.

A gap between farmers' intention and actual behavior for domestic waste classification has been proved. The results indicate that although the waste classification policy has been implemented for some time, farmers have not completely converted their high intention into actual classification behavior. Promoting publicity and education can help to narrow the gap, and the local government should put more effort to conduct related activities.

As one of the most developed regions in China, both successes and failures, can inspire waste classification in other rural areas. The findings of this study can provide some references for the convergence of farmers' intentions and behavior to help implement waste classification in rural areas. In future studies, more characteristics of farmers and more influencing factors can be considered to make the results more supportive for managers to formulate and adjust related policies.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the participants was not required to participate in this study in accordance with the national legislation and the institutional requirements.

Author contributions

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fenvs.2023.1045816/full#supplementary-material

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