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A study of the driving factors of the intention and behavioral deviations of rural residents in waste classification

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Introduction: The deviation between the stated intentions and actual actions of rural residents regarding waste classification constitutes a significant impediment to the effective implementation of environmental management strategies in rural areas. It is therefore recommended that steps be taken to reduce the deviation between the stated intentions and actual behaviors of rural residents. Doing so will help to reinforce environmental governance in rural communities and provide the necessary support for rural revitalization.

Methods: This study establishes an analytical framework for examining the deviation between the internal perceived efficacy and external environmental policies among rural residents. The relationship between intention and behavior can be classified into three distinct scenarios: "intention with behavior," "intention without behavior," and "no intention with behavior." Furthermore, an empirical analysis is conducted using survey data collected by Nanjing Agricultural University in the China Land Economic Survey in June and July 2021.

Result: The results show that 1) the perceived efficacy has a significant positive influence on the deviation between the intention and behavior of rural residents in domestic waste classification, while the environmental policy has a significant negative effect on it; 2) the guiding policy has a significant negative moderating effect on the influence of perceived efficacy on the deviation between the intention and behavior of rural residents and the situation of "with intention and without behavior," while the reward–punishment policy has a significant positive moderating effect on the influence of perceived efficacy on "without intention and behavior;" 3) the perceived efficacy has a masking effect on the impact of environmental policies on the deviation between the intention and behavior or "with intention and without behavior" of rural residents and a partial mediating effect on the impact of the environmental policy on "with intention and behavior" or "without intention and behavior."

Discussion: In consideration of these findings, the study proposes policy recommendations that emphasize the interconnectivity of the government, village collective organizations, and rural residents. The recommendations include the implementation of environmental policies and initiatives designed to enhance rural residents' awareness of waste classification.

KEYWORDS

waste classification, intention and behavior, deviation, perceived efficacy, environmental policy

1 Introduction

The report presented at the 20th National Congress of the Communist Party of China identified the crucial objective of comprehensive rural revitalization, with ecological revitalization being identified as a pivotal link in this process (Chen et al., 2024). The effective management of rural domestic waste has a direct impact on the wellbeing of 556 million rural residents and the success of rural revitalization efforts. As a consequence of economic development, there has been a notable transformation in the lifestyle of rural residents, resulting in a more intricate assortment of waste materials and, consequently, a more challenging process of waste classification. At present, centralized processing models, such as "household collection–village transportation–township/county transportation–county/district/city processing," have notably enhanced sanitation conditions in rural regions. However, this model can only achieve overall waste reduction and is unable to dispose of special wastes that require recycling or harmless treatment (such as batteries and expired drugs) on-site. Instead, this practice may result in the secondary pollution of soil, groundwater, and air while increasing the processing costs of the local government, thereby posing long-term implementation difficulties (Nurul et al., 2024). Therefore, implementing waste classification from the source is crucial for maximizing the role of waste management.

As the primary stakeholders in rural waste management, rural residents possess the potential to enhance the rural ecological environment and facilitate the resolution of waste management issues (Ross, 2022). Domestic waste classification from the perspective of rural residents has consistently been a topic of academic interest, with a particular focus on the intentions and behaviors of households in waste classification. Concerning intention, the prevailing view among scholars is that ecological cognition and the presence of government or village institutions are the primary factors influencing the intention of rural residents to classify waste (Prayitno et al., 2022; Ren et al., 2022; Xie et al., 2022). Regarding the categorization of waste, the primary factors influencing the behavior of rural residents are village regulations, social capital, and so forth (Dong et al., 2023a; Guo et al., 2023; David et al., 2024). However, the majority of studies have only conducted a one-way analysis of the intentions or behaviors of rural residents in waste sorting, thereby failing to take into account the consistency and differences between them (Dong et al., 2023b). A substantial body of field research has demonstrated that despite their verbal assertions to the contrary, rural residents often fail to implement effective waste management practices. This deviation between the stated intentions and actual behaviors has been identified as a significant challenge in the field of rural waste management (Li et al., 2024). The Chinese Ministry of Agriculture and Rural Affairs in 2019 reported that 93.4% of rural residents expressed support for plastic film recycling. However, the actual participation rate was only 59.3% (Shi and Zhang, 2022). Similarly, a survey on the promotion of biopesticides in India revealed that approximately one-third of rural residents expressed willingness to utilize biopesticides; yet, the actual usage rate was only 3% (Pray and Nagarajan, 2012). This suggests that there is a deviation between the intention and behavior, with the former not necessarily translating into the latter. Bagde et al. (2016) observed this phenomenon and referred to it as a "deviation between intention and behavior." If this deviation persists over time, it may prove challenging for policy tools to effectively address the underlying issue (Meng et al., 2023). Consequently, an investigation into the factors influencing the deviation between the intention and behavior concerning waste classification and the means of enhancing consistency between them represents an efficacious strategy for addressing the challenges inherent to rural waste management.

Currently, the research field on the intention–behavior deviation of rural residents mainly focuses on sustainable agricultural practices (Sui and Gao, 2023), farmland protection (Wang et al., 2023), pesticide management (Li et al., 2022), rural housing development (Xia et al., 2024), and environmental protection (Meng et al., 2023). The factors influencing the deviation between the intention for environmental governance and the actual behavior of rural residents primarily encompass objective elements, such as policy frameworks and digital literacy (Suhardiman et al., 2023; Li et al., 2024), and subjective factors, including social trust and norms (Zhang Y. et al., 2023; Chen et al., 2024). The aforementioned studies offer valuable insights for analyzing the factors influencing the deviation between the intention and behavior of rural residents in domestic waste classification. However, certain limitations still exist that need to be addressed. First, there is a paucity of scholarly research on the phenomenon of deviation in the context of domestic waste classification. Second, few studies have comprehensively examined the combined impact of the objective and subjective factors on deviation. Third, previous studies have been limited to the dichotomous measurement of "deviation or no deviation," without any additional exploration of the four distinct situations of deviation, namely, "with intention and without behavior," "with behavior and without intention," "with intention and behavior," and "without intention and behavior." However, the deviation is not only a matter of "neither 0 nor 1" but also reflects the level of participation among rural residents. According to the dichotomy measurement method, the first two scenarios are considered "deviation" and require improvement, while the latter two are categorized as "non-deviation" and do not necessitate any changes. Nevertheless, "without intention and behavior" from rural residents also signifies their minimal involvement in rural waste management issues, which warrants attention. Therefore, when addressing different types of deviation displayed by individuals, it is essential to consider their underlying impact mechanisms based on specific circumstances.

In the empirical analysis presented in this paper, the relationship between intentions to classify waste and the subsequent actions of rural residents is divided into three distinct categories: "with intention and without behavior," "with intention and behavior," and "without intention and behavior." In rural areas, imperfect waste classification facilities, insufficient publicity and education, and the lack of effective incentive mechanisms result in a deviation between the expressed intention of rural residents to classify waste and their actual practice, i.e., "with intention and without behavior" (Rossi et al., 2023). When rural residents are aware of environmental protection and have a clear intention to classify waste and sufficient resources, they are willing to engage in the practice

of waste classification. In practice, when rural residents are aware of environmental protection and have a clear intention to separate waste and are supported by sufficient resources and conditions, they tend to practice garbage separation in their daily lives. This is an example of "with intention and behavior" (Wu et al., 2023). In rural areas, due to long-established habits and cultural traditions, rural residents are accustomed to the traditional way of garbage disposal. They often hold a resistant or skeptical attitude toward waste classification and often will not take the initiative to adopt the behavior of waste classification. Consequently, they rarely take the initiative to adopt this behavior, which can be described as "without intention and behavior" (Zhang et al., 2024). Given the limited number of cases "with behavior and without intention," it is challenging to identify a representative and typical situation. Consequently, this particular case will not be discussed in the following empirical analysis.

In light of the aforementioned limitations and the current context, this article aims to contribute to the existing body of literature on the subject matter by utilizing 2021CLES micro-survey data of rural residents. This paper endeavors to analyze the relationship between the intention and behavior from the perspective of rural residents and elucidate the deviation between the intention and behavior of rural residents in domestic waste classification. The subjective factor is the perceived efficacy of rural residents, while the objective factor is environmental policies. To be more precise, this involves three key steps: 1) developing a theoretical framework, utilizing a binary probit model to assess the impact of environmental policies and perceived efficacy on the deviation between intention and behavior, and examining the connections and distinctions among different deviation scenarios; 2) categorizing environmental policies into guiding and reward–punishment policies, using moderation effect models and mediation effect models to examine the mechanism through which environmental policies and perceived efficacy influence the deviation between intention and behavior; and 3) the Internet as an instrumental variable was utilized to solve the endogenous problem, and specific countermeasures and suggestions for rural residents in different situations of deviation were proposed to promote the transformation of rural residents from "with intention and without behavior," "with behavior and without intention," or "without intention and behavior" to "with intention and behavior" and improve the effect of rural waste management.

Regarding potential contributions that may exist, first, this study may have made a significant contribution to the field of rural resident waste classification by conducting a thorough examination of the three deviation situations between the classification intentions and behaviors of residents. Second,, this study provides a comprehensive analysis of the joint impact mechanisms of subjective and objective influencing factors on the intention and behavior of rural residents in waste classification. The use of a substantial and dependable sample of field research data yields conclusions with substantial reference value. Moreover, practical insights are put forth to advance rural waste classification initiatives and enhance governance efficacy when examining the impact of perceived efficacy and environmental policies on the intention of rural residents to classify waste.

2 Theoretical analysis and research hypothesis

In order to study the deviation of pro-environmental intentions and behaviors of individuals, it is first necessary to understand the mechanism behind their behaviors (Momenpour et al., 2024). Scholars have proposed a variety of theories in the related literature to explain the internal mechanisms and deep reasons behind the deviation of the pro-environmental intentions and behaviors of individuals.

The concept of self-efficacy, initially proposed by Bandura (1977), is predicated on the notion that the level of confidence of an individual in their ability to perform a given task influences their subsequent actions. When sorting waste, rural residents may have the intention to engage in such activities, yet may experience uncertainty regarding their ability to perform the sorting, that is, they may perceive their efficacy to be low. This may result in a deviation between the intention and subsequent behavior of the rural resident. Conversely, the norm activation theory (Schwartz, 1977) posits that the higher the concern of the individual for the outcome of the behavior, and greater the perceived responsibility for it, the greater the likelihood that the individual's norms will be activated, and the greater the congruence between intention and behavior. Furthermore, the theory of planned behavior allows for the examination of the impact of the environmental policy on rural resident intention to classify domestic waste and the underlying behavioral deviations. First, rural resident attitudes toward the waste classification policy may influence their intention to comply; yet, this may not necessarily translate into actual behavior (Ajzen, 1991). Second, the perceptions of individuals in their social environment toward the environmental policy may also affect their intention to participate. Third, the residents' perceived ease of implementing environmental policies, the resources required, and the availability of support also influence their behavior. The efficacy of a policy represents a key factor in understanding the will–behavior deviation in the context of residential waste sorting as it serves to moderate the observed behavior. In a comparable field of water conservation, incentive policies can markedly and adversely impact the will–behavior deviation of rural residents, while government subsidies also serve to moderate the influence of subjective norms.

The pro-environmental behaviors of individuals can be influenced not only by their internal factors but also by external factors. To illustrate this point, the responsible environmental behavior model put forth by Hines et al. (1987) substantiates that environmental behavior is shaped by behavioral intentions and situational factors, which, in turn, are influenced by variables such as environmental knowledge and environmental attitudes. The attitude–behavior–context (ABC) theory, as proposed by Guagnano et al. (1995), posits that individual environmental behavior (B) is a function of the interaction between internal attitude factors (A) and external contextual factors (C). A study conducted in the United States revealed that an individual's recycling behavior is influenced by both their attitudes and the presence of recycling bins in the actual context. This concept is consistent with the widely used ABC theory in numerous fields,

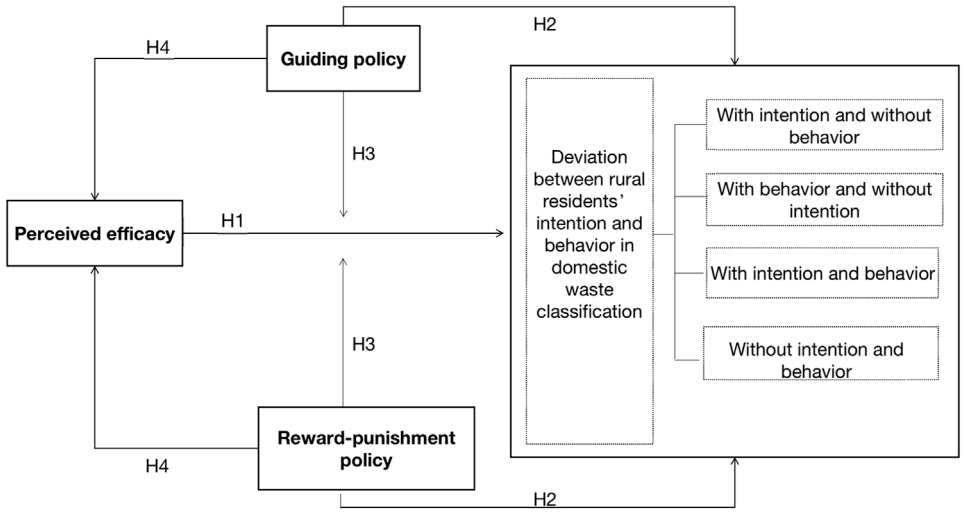

FIGURE 1
Framework of theoretical analysis.

thereby validating the moderating effect of contextual factors on the relationship between environmental attitudes and behaviors. In situations where contextual factors are conducive to environmentally conscious behavior, the correlation between environmental attitudes and behaviors will be significantly strengthened. Among these factors, situational elements may encompass government regulations and community expectations, while attitudes can reflect specific perceptions generated by the particular situation. However, the ABC theory does not provide a comprehensive analysis of the processes involved in the formation of attitudes and the mechanisms through which attitudes influence behavior. In light of these considerations, Wang (2012) put forth the consciousness–context–behavior system model, which postulates that consciousness precedes behavior, and that the relationship between consciousness and behavior is moderated by situational factors. This model permits an examination of the dimensional structure and interactive effects of conscious variables and an exploration of the dimensional structure and moderating effects of situational variables. It signifies a notable advancement from the ABC theory model. Subsequent studies have empirically tested this model and verified in a Chinese cultural context that resource conservation consciousness has a significant effect on resource conservation behavior while also identifying a significant moderating effect of the situation on the relationship between consciousness and behavior (Wang, 2013).

The above theoretical analysis demonstrates that the intention of rural residents to engage in waste classification and related behaviors are influenced by both internal factors, such as perceived efficacy and cognition, and external factors, including environmental policies. In light of the aforementioned theoretical results and research, this paper presents a theoretical analysis framework, entitled "The Deviation of Perceived Efficacy and Environmental Policy on the Intention and Behavior of Rural Residents in Domestic Waste Classification," with the objective of exploring the deviation of the intention and behavior of rural residents in domestic waste classification. The analytical framework is shown in Figure 1.

2.1 Direct effect of perceived efficacy and environmental policy

Environmental consciousness serves as an intrinsic driver for individuals to engage in environmentally friendly behaviors (Gao et al., 2024), exerting a substantial influence on the waste management practices of rural residents (Costa et al., 2021). Concurrently, environmental awareness is a multifaceted and complex subject, intricately linked to individuals' perceptions and experiences of environmental issues (Jelena et al., 2021). The subsequent factor to be considered is the attitude, values, and behavior of the individual toward the environment (Matiiuk et al., 2023). When evaluating environmental awareness, the environmental attitude of the individual is typically the initial point of consideration (Sun et al., 2022). The perceived efficacy of waste classification among rural residents is reflective of their environmental attitudes, which is analogous to the concept of "perceived usefulness" in the technology acceptance model (TAM). This signifies the cognitive evaluation of rural residents regarding the ecological advantages that would be derived from the implementation of waste classification. The stronger the belief held by rural residents in the positive impact of environmental protection on rural environments, the more robust their perception of ecological efficacy (Xu et al., 2022). Consequently, this enhances their intention to engage in pro-environmental actions and adopt waste classification behaviors. For example, Róisín et al. (2022) indicated that in Ireland and Italy, consumers' perception of the sustainability, practicality, and healthiness of fruits and vegetables significantly influences their intention to consume them. In light of the aforementioned evidence, we put forth the following research hypotheses:

H1: Perceived efficacy negatively affects the deviation between the intention and behavior of rural residents in domestic waste classification.

H1a: Perceived efficacy negatively affects "with intention and without behavior" of rural residents in domestic waste classification.

H1b: Perceived efficacy positively affects "with intention and behavior" of rural residents in domestic waste classification.

H1c: Perceived efficacy negatively affects "without intention and behavior" of rural residents in domestic waste classification.

Environmental policy plays a pivotal role in regulating China's urban and rural environmental challenges, offering guidance not only for monitoring the growth of various industries but also serving as the foundation for achieving environmental sustainability (Huang et al., 2024). From an environmental sustainability perspective, an environmental policy is defined as a series of mandatory or guiding preventive, normative, and incentive measures implemented by the government to maintain the ecosystem balance or address environmental problems. These policies are typically implemented concurrently, encompassing a range of approaches tailored to specific objectives. One strategy used by the government to disseminate environmental policies is through the use of publicity measures, such as lectures and the distribution of informational materials (Chen Q. et al., 2023). The dissemination of information in a particular manner has been demonstrated to influence individual psychological factors (Vicente et al., 2021). In other words, government publicity can engender a more intuitive appreciation among rural residents of the importance of waste classification and a more nuanced understanding of the potential benefits, costs, and feasibility of waste classification (Huang and Shen, 2016). It can evoke feelings of guilt among rural residents for failing to practice waste classification or, conversely, feelings of pride for their efforts in doing so (Yang et al., 2021). This can then lead to an increase in enthusiasm among rural residents to implement waste classification. Conversely, the government enforces environmental regulations through the use of incentives and disincentives, including material rewards or economic penalties, criticism and education, and honorary titles (Huang and Zhong, 2023). The stimulus–response theory posits that external stimuli are the primary drivers of individual behavior (Jia et al., 2021). When the government clearly rewards and punishes waste classification behaviors, the incentive and constraint effect can internalize the positive externalities generated by rural residents' waste classification and the negative externalities generated by their non-waste classification. This can stimulate the waste classification behavior of rural residents and reduce the possibility of deviation between waste classification intention and behavior. In light of the aforementioned considerations, the following research hypotheses are proposed:

H2: Guiding and reward–punishment policies negatively affect the intention and behavior of rural residents in domestic waste classification.

H2a: Guiding and reward–punishment policies negatively affect "with intention and without behavior" of rural residents in domestic waste classification.

H2b: Guiding and reward–punishment policies positively affect "with intention and behavior" of rural residents in domestic waste classification.

H2c: Guiding and reward–punishment policies negatively affect "without intention and behavior" of rural residents in domestic waste classification.

2.2 Regulatory effect of environmental policy

In the field of scholarly discourse, the ABC theory and the consciousness–situation–behavior integration model are gaining recognition as valuable conceptual frameworks for comprehending the interplay between the environmental policy context and public environmental behavior (Kong and Yuen, 2022). Both models highlight the role of situational factors in influencing the relationship between environmental attitudes and behaviors. When situational factors are favorable, individuals are expected to adopt pro-environmental behaviors that are relatively inexpensive and yield greater comprehensive benefits, which is conducive to promoting the transformation of individuals' intentions to participate into actual behaviors. Zepeda and Deal (2009) indicated that the prevalence of large chain stores as dominant entities in the organic food supply chain fosters a negative perception among consumers, thereby increasing their propensity to procure organic products from minor local markets. This indicates that the environmental policies implemented by the government can not only positively influence waste classification behavior but also serve as a regulatory factor between individual environmental attitudes and waste classification (Jin et al., 2021). Additionally, they can encourage rural residents to transform their waste classification intentions into actual waste classification behaviors. In light of the aforementioned evidence, the following research hypotheses are proposed:

H3: Environmental policy strengthens the negative effect of perceived efficacy on the deviation between the intention and behavior of rural residents in domestic waste classification.

H3a: Environmental policy strengthens the negative effect of perceived efficacy on "with intention and without behavior" of rural residents in domestic waste classification.

H3b: Environmental policy strengthens the positive effect of perceived efficacy on "with intention and behavior" of rural residents in domestic waste classification.

H3c: Environmental policy strengthens the negative effect of perceived efficacy on "without intention and behavior" of rural residents in domestic waste classification.

2.3 Mediating effect of perceived efficacy

Prior to making decisions, rural residents will evaluate the comprehensive income of their decision-making behavior based on their comprehension of environmental protection behavior, with the objective of pursuing efficiency optimization and income maximization. In this process, in addition to the pursuit of maximizing economic benefits, rural residents will also consider environmental benefits and derive satisfaction from ecological rationality (Chen et al., 2022). This indicates that the perception of ecological efficacy will also influence the behavioral decisions of rural residents. In practice, rural residents seldom proactively seek to

learn about waste classification; rather, they obtain this knowledge through government policy initiatives (Zhao et al., 2023). It has been demonstrated that government departments can effectively enhance the value perception of the environmental behavior of rural residents by organizing environmental behavior training (Atinkut et al., 2020). In addition to government training, government publicity activities and reward and punishment measures can also affect the value perception of rural residents, which, in turn, affects their intention to classify domestic waste (Chen S. et al., 2023). It can be reasonably assumed that, when other conditions remain unchanged, an increase in government publicity and reward and punishment measures on waste classification will result in a greater volume of official information being received by rural residents, an enhanced understanding of and emphasis on waste classification, a stronger perception of ecological efficacy, and a greater probability of consistency between intention and behavior. In light of the aforementioned evidence, this paper puts forth the following research hypotheses:

H4: Guiding and reward–punishment policies indirectly affect the deviation between the intention and behavior of rural residents in domestic waste classification through perceived efficacy.

H4a: Guiding and reward–punishment policies indirectly affect "with intention and without behavior" of rural residents in domestic waste classification through perceived efficacy.

H4b: Guiding and reward–punishment policies indirectly affect "with intention and behavior" of rural residents in domestic waste classification through perceived efficacy.

H4c: Guiding and reward–punishment policies indirectly affect "without intention and behavior" of rural residents in domestic waste classification through perceived efficacy.

3 Data source, variable setting, and model description

3.1 Data source

The data presented in this paper were collected through the China Land Economic Survey (CLES) conducted by a research team from Nanjing Agricultural University in 2021. The survey encompasses a comprehensive range of topics, including land markets, agricultural production, rural industry, ecological environment, poverty alleviation, and rural finance. It is highly compatible with the research theme of "Waste Separation and Behavioral Dissonance of Agricultural Households." The CLES encompasses a multitude of domains, including the land market, rural industry, ecological environment, poverty alleviation, and rural finance. These areas align closely with the overarching theme of the study, "Waste Separation and Behavioral Divergence among Rural Residents." The research encompasses 13 prefecture-level cities in Jiangsu Province, using the PPS sampling method. This entails selecting two districts and counties in each prefecture-level city and two villages in each district and county. This results in a total of 52 administrative villages and 2,420 rural residents. This approach offers a more comprehensive response to the actual situation of rural areas in Jiangsu Province and even the whole of eastern China. Using a series of data processing techniques, including variable screening, the exclusion of cases with insufficient sample size, the elimination of missing values, and the handling of outliers, a total of 2,368 valid questionnaires were obtained, providing a robust foundation for the study (Gao et al., 2024).

Furthermore, a multicollinearity test was conducted on all explanatory variables. When the variance inflation factor (VIF) exceeded 10 for a given variable, it indicated the presence of multicollinearity (Sturman et al., 2022). Due to space limitations, this paper only presents the results of the multicollinearity test with "perceived effectiveness" as the explanatory variable (Table 1). The results demonstrate that the VIF of all variables is less than 1.5, indicating the absence of multicollinearity between the perception of effectiveness and other explanatory variables. This observation substantiates the satisfactory fit of the model.

3.2 Variable settings and basic description statistics

3.2.1 Variable settings and basic description statistics

In the context of agricultural domestic waste classification, the intention and behavior of rural residents serve as pivotal determinants of the efficacy of the policy. Consequently, the independent variable is defined as "the deviation between rural residents' intention and behavior in domestic waste classification," which is classified as a binary decision problem. In light of the prevailing practice of express packaging disposal and the pre-survey, this study posed the question "Are you willing to classify domestic waste?" to gauge rural residents' intention to classify domestic waste (Zhang et al., 2023). The classification behavior is defined by the question "Are you willing to classify domestic waste for disposal?" The responses to both questions are coded as "yes = 1; no = 0." There are four possible relationships between rural residents' intention and behavior: "with intention and without behavior," "without intention and with behavior," "with intention and behavior," and "without intention and behavior." The first two have a deviation between rural residents' intention and behavior, and the value is 1, while the last two have no deviation between rural residents' intention and behavior, and the value is 0. In addition, there are only six samples of "without intention and with behavior" in the survey data. The test efficiency is insufficient and cannot fully represent the overall situation, so it is not included in the discussion.

3.2.2 Dependent variable

This paper uses environmental policy and perceived efficacy as the core explanatory variables. Among the aforementioned variables, environmental policy is reflected by two indicators: guiding policy and reward–punishment policy. A guiding policy tool that is particularly effective is publicity and education. Environmental policies must be based on the knowledge of rural residents about such policies. The transmission of information on waste classification, popularization of related knowledge, and guidance of concepts can effectively guide rural residents to improve their attitudes and behaviors toward the classification of

TABLE 1 Results of the multicollinearity test.

Dependent variable	Independent variable	Collinearity test statistics	
		VIF	1/VIF
Perceived efficacy	Guiding policy	1.09	0.919680
	Reward–punishment policy	1.09	0.921551
	Gender	1.47	0.679395
	Age	1.15	0.871116
	Education degree	1.38	0.723087
	Health condition	1.16	0.864544
	Household size	1.06	0.945933
	Five-guarantee household	1.05	0.953796
	Distance from town	1.01	0.987483
	Average VIF	1.16	

domestic waste. Therefore, the question "Does the government publicize the rural domestic waste classification?" is selected to reflect the guiding policy. The use of rewards and penalties as a policy tool represents a combination of incentives and constraints that are, to a certain extent, mandatory. This approach can produce a more direct effect on the process of rural household living waste classification, motivating rural residents to comply with the rules of waste classification and ensuring the effective implementation of the policy. Consequently, the question "Regarding the rural domestic waste classification, does the government implement reward and punishment measures?" is posed. To reflect the reward–punishment type of policy, the combination of the two must be determined to ascertain whether the environmental policy is implemented. The answer is "yes = 1; no = 0." The concept of perceived efficacy can be defined as a subjective judgment and cognitive process. In this context, it is particularly relevant to consider the views of rural residents, who are both direct participants in and beneficiaries of domestic waste classification. Perceived efficacy is a subjective judgment and cognitive process. Rural residents are direct participants and beneficiaries of domestic garbage classification. Their views on the relationship between waste classification and environmental improvement can directly reflect their perception of the effectiveness of waste classification. Therefore, the question "Do you agree that the classification of domestic garbage plays a positive role in the improvement of the rural environment?" was selected. Accordingly, the question "Do you agree that domestic waste classification plays a positive role in improving the rural environment?" was selected to reflect the perception of its effectiveness. The responses to this question were as follows: the respondents were asked to indicate their level of agreement with the statement on a 5-point Likert scale, where 1 = completely disagree, 2 = disagree, 3 = agree, 4 = strongly agree, and 5 = completely agree (Heo et al., 2022).

3.2.3 Control variable

These include individual characteristics, such as gender, age, education degree, and health condition, and household characteristics, such as the household size, the presence of five-guarantee households, and the distance from the nearest town. Individual characteristics, including gender, age, culture, and household size, have been observed to exert a discernible influence on the intention and behavior of rural residents concerning the classification of waste. Specifically, there may be differences in the roles of rural residents of different genders in the household. Females usually take on more household chores and, therefore, may pay more attention to waste classification (Romano et al., 2022). There may be differences in the degree of acceptance of new things among rural residents of different ages. The younger population may be more likely to accept the concept of environmental protection. Rural residents with higher levels of literacy usually have a stronger awareness of waste classification and the ability to understand the policy. Those with poorer health may have more difficulty in implementing waste classification, which indirectly affects their intention and behavior. The implementation of waste classification is often challenging, which can indirectly affect the intention and behavior of rural residents. The size of the population may influence the generation and types of household waste, which can subsequently impact the intention and behavior of rural residents to separate waste. Five-guarantee households often face economic and financial challenges, which can make it more difficult to carry out waste classification. Additionally, rural areas that are farther away from towns and cities often experience a poor flow of information, which can lead to more serious environmental problems (Su et al., 2023). The introduction of control variables is intended to facilitate a more comprehensive and nuanced examination of the deviation between the stated intention of rural residents to separate waste and their actual behavior.

The meanings and descriptive statistics of the above variables are shown in Table 2.

3.3 Model setting

Considering the deviation between the intention and behavior of rural residents in domestic waste classification, they were

TABLE 2 Variable settings, meanings, and basic description statistics.

Type	Variable	Meaning	Mean	STD
Dependent variable	Deviation	Is there any deviation between the intention and behavior? If no = 0; if yes = 1	0.38	0.49
Independent variable	Guiding policy	Does the government publicize the rural domestic waste classification? If no = 0; if yes = 1	0.85	0.36
	Reward–punishment policy	Regarding the rural domestic waste classification, does the government implement reward and punishment measures? If no = 0; if yes = 1	0.26	0.44
	Perceived efficacy	Do you agree that domestic waste classification plays a positive role in improving the rural environment? Completely disagree = 1, disagree = 2, agree = 3, strongly agree = 4, and completely agree = 5	4.26	0.95
Control variable	Gender	Female = 0; male = 1	0.73	0.45
	Age	Respondent's age	62.11	11.46
	Education degree	Respondent's years of education	7.19	3.97
	Health condition	Incapacity = 1, poor = 2, medium = 3, good = 4, and excellent = 5	4.05	1.05
	Household size	The number of respondents living in their families for 6 months a year and above	3.05	1.61
	Five-guarantee household	If no = 0; if yes = 1	0.06	0.23
	Distance from town	Distance from your home to the town center (li)	9.00	8.99

determined to be discrete variables, and their values of 0 and 1 were set. The probit model was adopted for empirical analysis (Coussement et al., 2014). The particular regression model is constructed as indicated by Equation 1.

$$Prob(Y_i = 1) = \beta_0 + \beta_1 Policy_i + \beta_2 Perception_i + \beta_3 Control_i + \varepsilon, \quad (1)$$

where Y_i indicates whether there is a deviation between the intention and behavior in domestic waste classification for the i rural resident; $Policy_i$ refers to the government policy on the domestic waste classification; $Perception_i$ represents rural resident perceived efficacy on domestic waste classification; $Control_i$ is a control variable; β_1, β_2, and β_3 are the regression coefficients; and ε is the stochastic disturbance.

3.3.1 Regulatory effect model

In order to examine the influence of environmental policy on the perceived efficacy and intention of rural residents to classify waste and engage in behavioral deviation, a model of the regulatory effect of environmental policy is presented as Equation 2.

$$Prob(Y_i = 1) = \beta_0 + \beta_1 Policy_i + \beta_2 Perception_i + \beta_3 Policy_i \times Perception_i + \beta_4 Control_i + \varepsilon_i. \quad (2)$$

In this context, the interaction term $Policy_i \times Perception_i$ between environmental policy and perceived efficacy is used to elucidate the moderating effect of environmental policy on the relationship between perceived efficacy and deviation.

3.3.2 Mediating effect model

In order to ascertain whether rural residents' perceived efficacy mediates the relationship between environmental policies and their waste sorting intentions and behavioral biases, a mediated effects model of perceived efficacy was constructed. In this model, perceived efficacy is expressed as Equation 3, while the mediating effect model of perceived efficacy on environmental policy and waste classification intention and behavior is expressed as Equation 4.

$$Perception_i = \gamma_0 + \gamma_1 Policy_i + \gamma_2 Control_i + \eta_i. \quad (3)$$

$$Prob(Y_i = 1) = \delta_0 + \delta_1 Policy_i + \delta_2 Perception_i + \delta_3 Control_i + \xi_i. \quad (4)$$

In this model, γ_0, γ_1, γ_2, δ_0, δ_1, δ_2, and δ_3 are the same and indicate the regression coefficients. η_i and ξ_i are the random error terms.

4 Results and analysis

4.1 Analysis of baseline regression results

4.1.1 Analysis of the direct effect of perceived efficacy and environmental policy

The results of model 1 indicate that the perceived efficacy has a significant positive influence on the deviation between the intention and behavior in domestic waste classification at the 1% statistical level. This suggests that as the perceived efficacy of the rural residents increases, the likelihood of deviation also increases. In particular, the results of model 3, model 5, and model 7 indicate that perceived efficacy has a statistically significant positive influence on the "with intention and without behavior" and "with intention and behavior" categories and a statistically significant negative influence on the "without intention and behavior" category. This indicates that an elevated perceived efficacy of domestic waste classification exerts a more pronounced influence on the intention and behavior in domestic waste classification. However, the effect of this perception on actual individual behavior is less pronounced than that on individual intention. Consequently, it is possible to observe both substantial and minor discrepancies between the

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TABLE 3 Results of baseline regression.

Variable	Y_1 Deviation		Y_2 With intention and without behavior		Y_3 With intention and behavior		Y_4 Without intention and behavior	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Guiding policy	−0.377***	0.831***	−0.369***	0.811***	0.802***	0.306	−0.537***	−0.653**
	(0.079)	(0.308)	(0.079)	(0.308)	(0.088)	(0.329)	(0.095)	(0.323)
Reward–punishment policy	−0.723***	−0.195	−0.725***	−0.229	0.802***	1.150***	−0.459***	−1.473***
	(0.070)	(0.344)	(0.070)	(0.347)	(0.068)	(0.325)	(0.123)	(0.454)
Perceived efficacy	0.107***	0.373***	0.111***	0.370***	0.111***	0.025	−0.390***	−0.451***
	(0.030)	(0.067)	(0.030)	(0.067)	(0.030)	(0.074)	(0.036)	(0.073)
Sex	−0.088	−0.087	−0.075	−0.074	0.127*	0.121*	−0.062	−0.058
	(0.066)	(0.067)	(0.066)	(0.067)	(0.068)	(0.068)	(0.095)	(0.096)
Age	0.014***	0.014***	0.013***	0.013***	−0.017***	−0.017***	0.009**	0.009**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)
Education degree	0.005	0.003	0.003	0.002	0.008	0.007	−0.032***	−0.030***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.012)	(0.012)
Health condition	−0.062**	−0.059**	−0.063**	−0.060**	0.050*	0.048*	0.036	0.039
	(0.028)	(0.028)	(0.028)	(0.028)	(0.028)	(0.028)	(0.040)	(0.041)
Household size	−0.028	−0.028	−0.030*	−0.031*	0.044**	0.044**	−0.052*	−0.055**
	(0.017)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.027)	(0.027)
Five-guarantee household	−0.098	−0.086	−0.115	−0.103	−0.077	−0.082	0.303*	0.312**
	(0.121)	(0.121)	(0.121)	(0.121)	(0.125)	(0.125)	(0.155)	(0.156)
Distance from town	−0.002	−0.001	−0.002	−0.001	−0.002	−0.002	0.009**	0.008**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)
Perceived efficacy × guiding policy		−0.310***		−0.302***		0.126		0.029
		(0.076)		(0.076)		(0.081)		(0.085)
Perceived efficacy × reward–punishment policy		−0.116		−0.109		−0.081		0.254**
		(0.077)		(0.077)		(0.073)		(0.107)
LR chi^2	240.92	262.49	238.61	258.84	476.89	480.41	273.30	279.73
Prob > chi	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Log likelihood	−1,414.11	−1,403.33	−1,412.39	−1,402.27	−1,356.87	−1,355.11	−580.29	−577.07
Pseudo-R^2	0.0785	0.0855	0.0779	0.0845	0.1495	0.1495	0.1906	0.1951

Note: ***, **, and * represent that coefficients of independent variables are significant at the 1%, 5%, and 10% levels, respectively.

intention and behavior among different rural residents. It is, therefore, assumed that H1b and H1c are verified while H1 and H1a are not.

Table 3 presents the effects of environmental policy and perceived efficacy on the deviation, classified as "with intention and without behavior," "with intention and behavior," and "without intention and behavior," respectively. Model 1, model 3, model 5, and model 7 illustrate these effects. The estimation results of model 1 indicate that guiding policies and reward–punishment policies exert a significantly negative influence on the deviation between intentions and behaviors pertaining to domestic waste classification, with a statistical level of impact reaching 1%. In other words, the greater the government efforts to disseminate information and implement rewards and punishments, the lower the probability of deviation. In particular, the findings of model 3, model 5, and model 7 indicate that, at the 1% statistical level, the guiding policy and reward–punishment policy exert a notable negative impact on the "with intention and without behavior" and "without intention and behavior" categories and a pronounced positive influence on the "with intention and behavior" category. The results indicate that an

increase in the frequency of government publicity and rewards and punishments will lead to a higher intention and behavior among rural residents to participate in the classification of domestic waste and a corresponding reduction in the probability of "with intention and without behavior" and "without intention and behavior." It can be posited that when the scope of publicity for relevant policies on domestic waste classification is more extensive and the rewards and punishments are more substantial, rural residents attach greater importance to domestic waste classification, possess a deeper understanding of professional classification knowledge, and are more aware of the significance of recycling resources. Furthermore, with more favorable expectations of the outcomes of implementing domestic waste classification, they are more inclined to cooperate with the implementation of policies. The probability of a deviation between their intention to classify and recycle and their actual behavior is also reduced. It can thus be assumed that H2, H2a, H2b, and H2c have been verified.

4.1.2 Influencing analysis of control variables

The results of model 1, model 3, model 5, and model 7 given in Table 3 indicate that gender has a statistically significant influence on the intention and behavior associated with domestic waste classification. At the 1% statistical level, age is found to have a positive effect on the deviation between intention and behavior in domestic waste classification. Specifically, age has a significantly positive effect on the "with intention and without behavior" category and a significantly negative effect on the "with intention and behavior" category. At the 5% statistical level, health status was found to have a negative effect on the deviation between intention and behavior in domestic waste classification. Specifically, age has a significant negative influence on the "with intention and without behavior" category and a significant positive influence on the "with intention and behavior" category. The effect of the permanent population on "with intention and without behavior" and "with intention and behavior" is statistically significant at the 1% level, with the signs indicating negative and positive influences, respectively. The education level; whether the household is a five-guarantee household, a low-income household, or a disability-insured household; and the distance from town have no significant influence on the intention and behavior in domestic waste classification.

4.1.3 Analysis of the regulatory effect of environmental policy

The interaction terms between perceived efficacy and environmental policy, as derived from model 1, model 3, model 5, and model 7, respectively, are given in Table 3 for models 2, 4, 6, and 8. The results demonstrate that the guiding policy exerts a significant negative regulatory influence on the perceived efficacy deviation and perceived efficacy "with intention and without behavior." The reward–punishment policy has a significant positive regulatory effect on the perceived efficacy "without intention and behavior," indicating that the factors affecting the deviation between intention and behavior in domestic waste classification are not independent and parallel variables. Furthermore, the interaction between government environmental policy and rural residents' perceived efficacy is of significant consequence. It can be posited that as the government implements more publicity and reward–punishment measures on domestic waste classification, the level of popularization among the public increases. Consequently, rural residents gain a deeper understanding of the positive role and importance of domestic waste classification. Furthermore, more rural residents who feel a sense of belonging to their local area express a desire for an improved rural environment. This, in turn, increases the likelihood of implementing waste classification, reducing the probability of "with intention and without behavior" and "without intention and behavior." It was thus demonstrated that hypotheses H3 and H3a were verified while H3b and H3c were not.

4.2 Robustness test

To ascertain the reliability of the baseline regression results, two methods were used to conduct a robustness test, the results of which are given in Table 4. The first four models used a method of sample elimination. From the perspective of the duration of residence of the surveyed rural residents in the village, the sample dataset includes individuals who have not resided in rural areas for the entirety of the observation period. To mitigate the impact of classification inconsistencies introduced by respondents who did not reside in rural areas, samples from this group were excluded, and the regression analysis was then conducted. Models 5–8 used the method of replacing the core dependent variables. In this paper, new environmental policy variables and perceived efficacy variables were constructed, and environmental policy was replaced by guiding policy variables and reward–punishment policy variables. Regarding waste classification, if no policy is in place in the township where the rural resident resides, the value is 1; if one policy is in effect, the value is 2; and if both the guiding policy and the reward–punishment policy are in place, the value is 3. The perceived efficacy is replaced by the perceived efficacy; if the score for the perceived efficacy of domestic waste classification is 4 or 5, the value is 1; and if the score is 1, 2, or 3, the value is 0.

The findings of models 1–4 indicate that environmental policy and perceived efficacy continue to exert a significant influence on the deviation between the intentions and actual practices of rural residents with regard to domestic waste classification. The impact on the "with intention and without behavior," "with intention and behavior," and "without intention and behavior" categories is largely consistent with the findings of the baseline regression analysis. The results of models 5–8 indicate that environmental policy and perceived efficacy exert a significant influence on the deviation between the intentions and behaviors of rural resident in domestic waste classification. Furthermore, the results pass the 1% significance test, thereby corroborating the reliability of the baseline regression results (Doğan et al., 2021).

4.3 Analysis of the mediating effect and masking effect of perceived efficacy

To further examine the internal mechanism of perceived efficacy influencing the deviation between the intentions and behaviors of rural residents regarding domestic waste classification, a regression test was conducted on the mediating effect of perceived efficacy, as shown in Table 5. As indicated by scholars (Valente et al., 2023), in the analysis of the mediating effect, a deviation between the coefficient of indirect and direct effects may result in a masking

TABLE 4 Results of the robustness test.

Variable	Models 1–4 (subsample)				Models 5–8 (alternation)			
	Y_1	Y_2	Y_3	Y_4	Y_1	Y_2	Y_3	Y_4
Guiding policy	−0.334***	−0.324***	0.785***	−0.561***				
	(0.082)	(0.082)	(0.091)	(0.097)				
Reward–punishment policy	−0.726***	−0.730***	0.813***	−0.487***				
	(0.072)	(0.072)	(0.071)	(0.126)				
Perceived efficacy	0.117***	0.119***	0.103***	−0.390***				
	(0.031)	(0.032)	(0.031)	(0.037)				
Environmental policy					−0.586***	−0.586***	0.799***	−0.466***
					(0.048)	(0.048)	(0.050)	(0.069)
Perceived efficacy					0.446***	0.472***	0.339***	−1.062***
					(0.085)	(0.086)	(0.088)	(0.093)
Control variable	Controlled							
LR chi^2	224.84	222.74	445.96	262.59	245.06	244.24	478.27	286.90
Prob > chi	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Log likelihood	−1,327.80	−1,326.49	−1,273.54	−557.71	−1,412.04	−1,409.57	−1,356.18	−573.49
Pseudo-R^2	0.0781	0.0775	0.1490	0.1906	0.0798	0.0797	0.1499	0.2001

TABLE 5 Results of mediating/masking effects of perceived efficacy.

Variable	Y_1 Deviation		Y_2 With intention and without behavior		Y_3 With intention and behavior		Y_4 Without intention and behavior	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Guiding policy		Controlled		Controlled		Controlled		Controlled
Reward–punishment policy	Controlled		Controlled		Controlled		Controlled	
Control variable	Controlled							
Sobel test	0.016**	0.005*	0.017***	0.005*	0.016***	0.005*	−0.033***	−0.009**
Goodman[1]	0.016**	0.005*	0.017***	0.005*	0.016***	0.005*	−0.033***	−0.009**
Goodman[2]	0.016***	0.005*	0.017***	0.005*	0.016***	0.005*	−0.033***	−0.009**
a coefficient	0.426***	0.121**	0.426***	0.121**	0.426***	0.121**	0.426***	0.121**
b coefficient	0.038***	0.038***	0.040***	0.040***	0.038***	0.038***	−0.077***	−0.077***
Indirect effect	0.016**	0.005*	0.017***	0.005*	0.016***	0.005*	−0.033***	−0.009**
Direct effect	−0.147***	−0.237***	−0.144***	−0.237***	0.271***	0.275***	−0.124***	−0.038**
Total effect	−0.130***	−0.233***	−0.127***	−0.233***	0.287***	0.280***	−0.157***	−0.047***
Proportion of the masking effect	10.9%	2.1%	11.8%	2.1%				
Proportion of the mediating effect					5.6%	1.8%	21.0%	19.1%

Note: Proportion of the masking effect = $\left|\frac{\text{Indirect effct}}{\text{Direct effect}}\right|$; proportion of the mediating effect = $\frac{\text{Indirect effect}}{\text{Total effect}}$.

effect, whereas a similar coefficient would indicate a partial mediating effect (Loh and Ren, 2022). The results of models 1–4 given in Table 5 demonstrate that regarding the impact of environmental policy on the deviation between the intentions and behaviors of rural residents, the perceived efficacy exerts a masking influence, with effect sizes of 10.9%, 2.1%, 11.8%, and 2.1%, respectively. These findings have been validated through the Sobel test, the Goodman[1] test, and the Goodman[2] test. Once the

impact of perceived efficacy is incorporated, the combined effect of models 1–4 is greater than the direct effect. This implies that the influence of guiding policy and reward–punishment policy on the deviation between the intentions and actions of rural residents, and the effect of intentions without actions, is amplified. This suggests that when the government disseminates pertinent information about waste classification and implements reward–punishment measures, the perceived efficacy of rural residents on waste classification can be enhanced. Furthermore, it can foster greater awareness of the value of waste classification in enhancing the rural environment, thereby enhancing the consistency between intention and behavior. The results of models 5–8 given in Table 5 demonstrate that perceived efficacy plays a mediating role in the effect of environmental policy on "with intention and behavior" and "without intention and behavior," with effect sizes of 5.6%, 1.8%, 21.0%, and 19.1%, respectively. These findings have been validated through the Sobel test, Goodman[1] test, and Goodman[2] test. It was determined that the government publicity and reward–punishment policy on waste classification can not only directly influence the consistency of the intention and behavior of rural residents but also indirectly enhance the consistency of the intention and behavior of rural residents by improving the perceived efficacy. It can, therefore, be assumed that H4, H4a, H4b, and H4c are valid.

5 Conclusion and discussion

Since the conclusion of the 20th century, environmental policies have played a pivotal role in the examination of the intentions and behaviors of rural residents regarding waste classification (Tan et al., 2024). Presently, the environmental governance policies enacted by the Chinese government have demonstrated preliminary efficacy, thereby enhancing public perception of their effectiveness. Consequently, a more profound and comprehensive integration of environmental policies will assist in reducing the deviation between the intentions and behaviors of rural residents regarding waste sorting, thereby facilitating the implementation of policy instruments (Gao et al., 2024).

This study used micro-survey data from 2,368 rural residents to examine the influence and underlying processes of environmental policies and perceived efficacy on the deviation between the intentions and behaviors of rural residents regarding household waste classification. The primary research findings are as follows.

First, the perceived efficacy of the policies in question has a significant positive influence on the deviation between the intentions and actions of rural residents in the context of domestic waste classification. In particular, the data suggest that perceived efficacy has a positive influence on "with intention and without behavior" and "with intention and behavior" and a negative influence on "with intention and behavior." The results of previous studies (Yan et al., 2020; Suphim and Songthap, 2024) are also similar to our findings. They found that the introduction of perceived efficacy could better promote farmers' intention to engage in pro-environmental behaviors. The stronger the perceived efficacy of farmers to the environment, the more it can change the correlation between their intention and behavior and promote their pro-environmental behavior. This indicates that rural resident perceived efficacy of environmental policies can greatly stimulate their intention and behavior of waste sorting and improve the consistency of their intention and behavior.

Second, according to research analysis, the guiding policy and the reward–punishment policy have a significant negative influence on the deviation between the intention and behavior of rural residents in domestic waste classification. Among them, the environmental policy has a negative influence on "with intention and without behavior" and "with intention and behavior" and a positive influence on "with intention and behavior." Scholars from other countries and regions have obtained similar research results (Clay and King, 2019; Suh, 2019; Estacio et al., 2024; Yang et al., 2024). They found that environmental policies can significantly enhance the awareness of individuals and have a significant effect on the generation of their intention and behavior. This indicates that environmental policies can increase the consistency of the willingness and behavior of rural residents to separate waste.

Third, policy guidance exerts a significant negative moderating influence on perceived efficacy in the context of "intention without behavior," while reward–punishment policies demonstrate a notable positive moderating impact on perceived efficacy in the context of "intention with behavior." This suggests that policy guidance has the potential to heighten the ecological awareness of rural residents regarding garbage classification, thereby minimizing the deviation between their intention and actual behavior. Furthermore, reward and punishment policies are capable of substantially bolstering the perceived efficacy of rural residents in waste classification, consequently fostering both intention and action toward proper waste management. This finding is similar to the results obtained by previous researchers (Staub and Clarkson, 2021; Pang et al., 2022; He et al., 2023; Gurbuz, 2024).

Fourth, perceived efficacy plays a masking role in the effect of environmental policy on the deviation between the intention and behavior of rural residents in domestic waste classification or "with intention and without behavior" and plays a partial mediating role in the effect of environmental policy on "with intention and behavior" or "without intention and behavior." Researchers (Budhathoki et al., 2020; Kang and Kim, 2021; Jin et al., 2022) have found similar results in other related studies. They found a significant indirect effect of efficacy perceptions between policies and intentions and behaviors of individuals. This suggests that environmental policies can further influence rural residents who are "with intention and without behavior" by increasing their own perceived efficacy, which leads them to take practical actions. In addition, environmental policy has the potentials to influence rural residents who are "with intention and behavior," as well as those who are "without intention and behavior," based on the perceived efficacy of rural residents.

6 Enlightenments and limitations

The rural living environment, which provides the material conditions for the production and livelihood of rural residents, constitutes the fundamental guarantee for the functioning of rural society (Yeneneh et al., 2021). In the nascent stages of rural development in China, most domestic waste could naturally degrade without necessitating specific policy intervention. However, with the advancement of the rural economy and society and the enhancement of the living standards of rural residents, in the absence of technical means and the failure of government entities, a phenomenon known as "garbage surrounding villages" frequently arises in rural areas (Wang

et al., 2024). Consequently, central and local governments have successively issued various policy documents to promote solutions to address issues related to rural environmental pollution and support ecological revitalization. In light of these developments, to reinforce the motivation of rural residents to segregate waste and guarantee uniformity in their conduct, we derive the following policy insights based on the conclusions above.

The rural living environment is an organic whole, comprising a multitude of interrelated subjects, including the government, village organizations, and rural residents. In light of the above point, it is crucial to emphasize the coherence of governance measures regarding waste classification. Particular attention should be paid to the macro-level (government), meso-level (village collective organizations), and micro-level (rural residents) as the three governing bodies (Zhang et al., 2024). First, the government must consider the impact of guiding policies and reward–punishment policies on the deviation between the intentions and actions of rural residents regarding domestic waste classification. The government should use a variety of strategies to disseminate information about domestic waste classification. These strategies may include door-to-door notifications, broadcasting, voluntary initiatives, and group notifications. Additionally, the government should implement educational programs that are adaptable to the needs of rural residents and foster an understanding and acceptance of the value of waste classification. Conversely, the use of village funds to procure essential daily necessities as rewards for those who adhere to waste classification can encourage their participation. Furthermore, the simultaneous implementation of criticism and persuasion tactics, coupled with photograph documentation and publicity, can effectively deter non-compliant behavior among rural residents (Zhao et al., 2024).

Second, for rural residents who are both willing and able to comply with waste classification regulations, the government should implement a combination of publicity, reward, and punishment measures. These measures should be designed to enhance the perceived efficacy of such rural residents in waste classification while also leveraging their role as role models for other rural residents. Concurrently, China's distinctive culture exerts a more pronounced impact on individual decision-making processes, particularly when influenced by the collective ethos of peer intergenerational groups (Zheng et al., 2024). The actions of a few individuals can serve as a model for others, leading to the adoption of a practice by surrounding groups. This could include organizing "experience-sharing meetings of outstanding villagers' representatives" to guide rural residents who are willing but unable to comply with the regulations, as well as those who are unwilling to comply, toward learning from the actions of these exemplary rural residents.

Ultimately, for rural residents who are "without intention and behavior," it is imperative that society advocates for the implementation of waste-sorting practices. This will foster a lifestyle that prioritizes environmental conservation. To achieve this, the government can implement a one-to-one responsibility system, assigning special personnel to rural households. These personnel will explain to rural residents the benefits of participating in domestic waste classification for the benefit of the planet and humanity. They will also explain the drawbacks of non-participation. Furthermore, the potential of government publicity and perceived efficacy to influence rural residents who are "without intention and behavior" should be fully leveraged. Concurrently, the conceptual framework and policies must be operationalized within village collective organizations to facilitate the implementation of rural waste classification initiatives and foster an atmosphere of waste classification.

This study has certain limitations that should be addressed in future research. First, the data sample used only pertains to Jiangsu Province and may not accurately represent variations among rural areas in China. Second, our study did not include comparisons with additional developed or underdeveloped countries or regions. Therefore, additional comprehensive research is warranted when more abundant data become available.

Data availability statement

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

Author contributions

JZ: conceptualization, formal analysis, investigation, methodology, resources, software, supervision, validation, visualization, and writing–original draft. QY: data curation and writing–review and editing. QC: funding acquisition, project administration, and writing–review and editing.

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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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