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Effects of Incentives and Penalties on Farmers' Willingness and Behavior to Separate Domestic Waste-Analysis of Farm Household Heterogeneity Based on Chain Multiple Intermediary Effects

Shi-Wen Chen, Sen-Wei Huang *, Jing Chen, Ke-Yang Huang and You-Xing He

School of Public Administration, Fujian Agriculture and Forestry University, Fuzhou 350002, China

* Correspondence: hsw@fafu.edu.cn

Abstract: It is important to investigate the influence of incentives and penalties on farmers' willingness and behavior towards domestic waste separation and the mechanism of influence. It is helpful for the government to formulate policies to guide farmers to actively participate in domestic waste separation, solve the problem of rural domestic waste pollution, and improve the effectiveness of rural waste separation management. By using the public data of 2020CLES, we analyzed the influence of incentives and penalties on farmers' willingness and behavior towards domestic waste separation by using the Probit model, based on the technology acceptance model, using a chain of multiple mediating effects. The results are as follows. Firstly, the net effect of incentives and penalties on farmers' willingness and behavior to separate household waste was 6.86%, and the net effect of separation behavior was 33.37%. Relatively speaking, the strengthening effect of incentives and penalties on farmers' domestic waste sorting behavior is stronger than the promotion effect on farmers' domestic waste sorting intention. Secondly, perceived ease of use and perceived usefulness had significant chain mediating effects, with perceived ease of use having the strongest mediating effect. Thirdly, the incentives and penalties have a stronger effect on promoting the willingness of female farmers, elderly farmers, and farmers with low education to separate domestic waste. Finally, the influence of individual and household characteristics of farmers on their willingness and behavior to separate household waste varies. Accordingly, suggestions for improving the willingness and behavior of farmers to separate domestic waste are proposed in the following aspects: improving the reward and punishment system, making good use of market instruments, and increasing farmers' awareness level and value recognition of domestic waste separation.

Keywords: rural household waste; sorting intention; sorting behavior; incentives and penalties; technology acceptance model; chain multiple mediating effects; heterogeneity



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1. Introduction

Waste separation has become an inevitable way to realize the reduction, resourcefulness, and harmlessness of rural waste [1]. In 2019, the production of rural domestic waste in China was 299 million tons, compared with 180 million tons in 2017, and the production of rural domestic waste in China showed a rapid growth trend. Moreover, about 30% to 40% of domestic waste is not effectively treated each year, which has brought a negative impact on the rural habitat environment [2], and hindered rural revitalization. The current treatment method of rural domestic garbage is first collected centrally by the village garbage disposal point, and then loaded by garbage collection vehicles to the village and transferred to the county and city garbage treatment plants for centralized treatment. However, due to the weak awareness of environmental protection and low willingness of waste classification among farmers, the waste collection method has gradually evolved into mixed collection with low waste classification effect [3]. Moreover, this mixed collection method not only

increases the workload of waste treatment plants in districts and counties that are already overloaded [4], but also causes waste of resources and is prone to breeding mosquitoes and diseases, which endanger farmers' health. In response, the central government has issued several policy documents to emphasize the source management of rural household waste. For example, in October 2016, the "Health China 2030" plan issued by the State Council of the CPC Central Committee proposed to "comprehensively strengthen the treatment of rural garbage." In December 2021, the General Office of the CPC Central Committee and the General Office of the State Council issued the "Five-Year Plan for the Improvement of Rural Habitat Environment". In December 2021, the General Office of the CPC Central Committee and the General Office of the State Council issued the "Five-Year Action Plan for the Improvement of Rural Habitat Environment (2021–2025)", which emphasized "promoting the classification, reduction, and utilization of rural domestic waste".

As a necessary element of rural environmental pollution management [5], farmers' willingness to sort domestic waste and their sorting behavior are related to the effectiveness of rural waste sorting management. However, for farmers, whether they participate in various environmental management depends on their own interests [5]. Then, can the government increase farmers' willingness to separate their household waste and motivate them to do so by implementing incentives and penalties to increase the benefits they can get from separating household waste and the losses they incur if they do not separate their household waste? In addition, relevant studies have shown that there may be a discrepancy between the public's willingness to sort waste and their sorting behavior [6]. Taking effective measures to promote the unification of sorting willingness and sorting behavior is an effective way to improve farmers' participation in domestic waste sorting and solve the problem of rural domestic waste pollution [7]. Therefore, it is necessary to investigate the influence of reward and punishment measures on farmers' willingness and behavior towards domestic waste sorting. This is of great practical significance to break the dilemma of rural domestic waste sorting management and improve the rural habitat.

2. Literature Review

At present, a lot of research has been conducted and many results have been obtained around the willingness or sorting behavior of farmers' domestic waste. At the level of theory application, ABC theory (Attitude-context-behavior theory) [8], TPB theory (Theory of Planned Behavior) [9], NAM theory (Normative activation theory) [10], and social interaction theory [1] have been applied by many scholars to the study of farmers' domestic waste sorting intention or sorting behavior. At the level of sorting willingness, Liu Jiyao et al. [11] analyzed the influence of pollution cognition and village emotion on farmers' domestic waste sorting willingness using research data from 863 households in four counties in Shaanxi Province, and found that both pollution cognition and village emotion had a facilitating effect on farmers' domestic waste sorting willingness. Tang Hongsong [12] found that environmental cognition, human capital quality, physical capital, economic capital, and social status had a positive effect on farmers' willingness to separate domestic waste, while human capital quantity had a negative effect. Jiang Lina and Zhao Xia [4] explored the influence path of institutional environment on villagers' willingness to separate domestic waste through a stepwise regression test coefficient method and found that institutional environment could indirectly influence villagers' willingness to separate domestic waste through environmental benefit perception and community identity. Using the stepwise regression test coefficient method, Jia Yajuan and Zhao Minjuan [13] found that responsibility consciousness plays a mediating role in the influence of environmental pollution perception on rural residents' willingness to separate household waste. At the level of sorting behavior, Cui Yafei and Bluemling B [14] empirically examined the influencing factors of farmers' domestic waste disposal behavior and their effects, and found that habitual inspiration and external perceptual behavioral control were the main influencing factors on farmers' domestic waste sorting behavior. Jia Yajuan and Zhao Minjuan [15] argued that enhancing farmers' pollution perception of domestic waste and improving their institutional trust,

social participation, and social norms could improve their domestic waste sorting level. Based on microdata from 327 rural households in Guanzhong region, Shen Jing et al. [16] used structural equations to find that the stronger the willingness of farmers to sort domestic waste, the more they could show specific sorting behaviors. Both Wang Xiaonan [17] and Lv Weixia [18] used a stepwise regression test coefficient method to examine the mediating effects that existed between class identification, sense of environmental value and mobilization methods, and public waste sorting behavior. At the level of sorting preference, Jia Yajuan and Zhao Minjuan [19] examined farmers' preference for source separation of domestic waste based on the dual perspective of social capital and environmental concern, and found that institutional trust, interpersonal trust, and environmental concern levels all enhanced their sorting preference. At the level of farmers' willingness to participate in domestic waste management, Kaining Zhu et al. [20] concluded that both income level and trustworthiness of village cadres had positive effects on farmers' willingness to pay for domestic waste management, and the higher the income level of farmers, the higher their willingness to participate in rural domestic waste management. Jia Yajuan and Zhao Minjuan [21] found that both environmental concern and institutional trust contributed to farmers' willingness to participate in rural household waste management and willingness to pay, while institutional trust also strengthened the contribution of environmental concern to farmers' willingness to pay. At the level of consistency between sorting willingness and sorting behavior, Jia Yajuan and Zhao Minjuan [22], based on a comparison between pilot and non-pilot areas in Shaanxi, found that both the implementation of rural household waste sorting management pilot and the level of environmental concern had positive effects on farmers' sorting willingness and behavior. In addition, many scholars have explored the relationship between incentives and punishments and farmers' willingness to sort domestic waste or sorting behavior. Firstly, for punishment measures, Jiang Pei [23] summarized the experience of rural villages in central Zhejiang Province in exploring waste separation and disposal for many years, and concluded that discipline and punishment could promote the formation of villagers' waste separation behavior habits, and thus strengthen their separation behavior. Secondly, for incentive measures, Wang Ying et al. [24] proposed that economic incentives have positive effects on farmers' domestic waste sorting behaviors. Finally, for supervisory measures, Tang Lin et al. [25] argued that supervision by village cadres and cleaners restrained farmers' behaviors and thus motivated them to actively participate in centralized domestic waste disposal.

In summary, although many studies have been conducted in the literature on the willingness and behavior of farmers to separate household waste, there are still some improvements to be made. (1) At the level of research content, there are few studies that focus on the willingness and behavior of farmers to separate household waste, and the existing literature often studies the willingness and behavior of separation separately. In addition, there are few studies on the relationship between incentives and punishments and the influence mechanism between farmers' willingness and behavior to separate household waste, and there is a lack of relevant empirical studies. (2) At the level of research objects, many scholars usually consider farmers as a homogeneous group when studying farmers' willingness or behavior to separate household waste, ignoring the heterogeneity of farmers in general. (3) At the research perspective level, at present, the research theories applied to farmers' domestic waste sorting willingness or sorting behavior mainly include planned behavior theory, normative activation theory, and ABC attitude theory, etc. Few articles have applied the technology acceptance model to the study of farmers' domestic waste sorting willingness or sorting behavior. The former is to analyze individual willingness or behavior from the perspective of subjective consciousness, while the latter is to explain the mechanism of individual willingness or behavior more systematically, from the perspective of combining internal and external factors. (4) At the level of research methods, many articles use stepwise regression test coefficient methods to test the mediating effect, but the chain multiple mediation method is applied to analyze the influence mechanism of farmers' willingness or behavior to separate household waste. While the former ignores

the simultaneous existence of multiple mediating variables and the influence relationship between mediating variables, the latter compensates for this shortcoming and allows us to derive the total mediating effect and the optimal influence path. In view of this, we take into account the heterogeneity of farmers and use the 2020CLES public data to empirically examine the relationship between incentives and penalties and farmers' willingness and behavior to separate their household waste. This study provides a reliable theoretical basis for improving farmers' willingness to separate household waste and strengthen their behavior, and provides a practical reference for the implementation of incentive and punishment measures and a policy reference for rural household waste management.

3. Theoretical Analysis and Research Hypothesis

3.1. Analysis of the Impact of Incentives and Penalties on Farmers' Willingness and Behavior to Separate Domestic Waste

Individuals' environmental behavior is directly or indirectly influenced by external contextual factors [25]. In rural areas, extrinsic contextual factors are manifested in the external environment, including the rural human environment and the policy and institutional environment [26]. It has been shown [27] that the implementation of environmental policies helps farm households to exhibit pro-environmental behavior. Rural domestic waste management is a typical component of rural environmental remediation, and thus it is difficult to internalize the welfare loss caused by domestic waste pollution into a market price through market mechanisms [27]. Pigou [28] proposed that the government can internalize the externalities of environmental pollution through taxation and subsidies, which also provides a theoretical basis for government policy intervention at the level of environmental governance. Thus, environmental policies promote farmers' participation in rural environmental remediation by changing the benefits and costs of their participation; Min et al. [29] argue, based on microeconomic theory, that village implementation of habitat remediation measures can motivate farmers to actively participate in habitat remediation by reducing the environmental remediation costs they pay, thus reducing the likelihood that they will litter everywhere. In addition, the implementation of the system also directly affects the willingness of farmers to participate in habitat improvement by affecting their incentive structure [30], and waste separation, as an important part of rural habitat improvement, rewards, and punishments can directly affect farmers' willingness to separate household waste through the role of the system. The study of Jiang Lina and Zhao Xia [4] also showed that a good institutional environment has a facilitating effect on villagers' willingness to separate household waste. Shangyan et al. [31] found that both incentive and penalty policies increased farmers' willingness to use agricultural waste resourcefully. Based on the above analysis, the following hypothesis is proposed:

H1: *Rewards and punishments have a positive effect on both the willingness and behavior of farmers to separate domestic waste.*

3.2. Analysis of Mediating Effects Based on Technology Acceptance Model

The Technology Acceptance Model (TAM), first proposed by Professor Davis in 1989 [32], is a theory based on the core concepts of perceived ease of use and perceived usefulness, where external variables influence individuals' intentions or behaviors by affecting perceived ease of use and perceived usefulness. TAM has been applied by many scholars in the study of individuals' willingness to adopt the behavior of something [33,34], which combines external and internal factors to explain and predict individuals' willingness or behavior more comprehensively. Therefore, in this paper, we investigate the mechanism of the influence of incentives and penalties on farmers' willingness and behavior to separate household waste based on the technology acceptance model.

Perceived ease of use refers to how easy or difficult farmers think it is to sort their household waste. Farmers judge whether domestic waste sorting is easy to perform based on their knowledge of information related to domestic waste sorting, and if it is easy, farmers are likely to develop a positive willingness to sort domestic waste and implement

sorting. Kang Jia-ning et al. [7] proposed that whether farmers understand the standards and requirements of domestic waste sorting, it is an important influencing factor on their willingness to sort domestic waste; Liu Yu et al. [2] found that information intervention can improve the effect of domestic waste sorting for rural residents, and this experiment helped rural residents understand the knowledge about domestic waste sorting to improve the accuracy of their waste sorting, stimulate their willingness to sort, and promote their formation of the strategy of sorting behavior, which shows that farmers' knowledge of domestic waste sorting is an important prerequisite for strengthening their waste sorting behavior. Raymond J. Gamba's [35] study concluded that relevant sorting knowledge is the most important predictor of sorting behavior. Paula Vicente [36] found that household waste sorting information was an important factor influencing people's motivation and persistence in sorting.

Perceived usefulness refers to the benefits that farmers believe can be generated after sorting domestic waste. Farmers subjectively judge whether sorting domestic waste can play a role in improving the rural environment and promoting rural social development, i.e., whether it is useful or not. If it is useful, farmers may have a positive intention to sort domestic waste and implement sorting. For individual farmers, separating household waste can reduce the risk of disease from mixed waste and improve their living environment. Farmers who are motivated by the behavior of improving their social welfare [37] will show a positive willingness to separate household waste. Jia Yajuan et al [38] concluded that rural residents' psychological perception of household waste pollution has a facilitating effect on their willingness to separate. Fanny Li et al. [39] suggested that the more farmers perceive the benefits of participating in environmental remediation, such as environmental improvement, the more they respond and participate. Stewart Barr et al. [40] showed that residents' perceptions of the benefits and perceptions of waste separation determined whether they would separate their household waste. Chantal SGuin [41] showed that perceptions of environmental health risks could predict people's waste separation behavior.

However, farmers do not usually take the initiative to understand and learn information related to domestic waste sorting, but need to be driven to grasp information related to domestic waste sorting through the external driver of government policy intervention [42], i.e., rewards and punishments can be one of the ways to enhance farmers' perceived ease of use and perceived usefulness of domestic waste sorting. Li Wei et al. [43] argued that when policy propaganda is conducted for a certain aspect of information, it affects individuals' perceptions of a certain aspect, which in turn affects their related willingness or behavior. Ding et al. [44] suggested that official information as an external stimulus can enhance residents' knowledge and thus drive them to engage in related behavioral activities. That is, the rewards and punishments implemented by the government may influence a farmers' knowledge of domestic waste separation and their environmental values of domestic waste separation, i.e., the perceived ease of use and perceived usefulness of domestic waste separation. In addition, there is no clear definition of external variables in TAM, and its selection has to be combined with specific research contexts. Combined with existing studies [26,30], incentives and penalties, as specific elements of the policy system, clearly fit the selection of external variables in TAM. As mentioned earlier, rewards and penalties have positive effects on both perceived ease of use and perceived usefulness, and both perceived ease of use and perceived usefulness have effects on farmers' willingness and behavior to separate household waste. Therefore, this paper predicts that the implementation of incentives and penalties will enhance farmers' perceived ease of use and perceived usefulness, which in turn will enhance their willingness and behavior to separate household waste. Based on this, the following hypothesis is proposed:

H2: *Both perceived ease of use mediated the effect of incentives and penalties on a farmers' willingness and behavior to separate household waste.*

H3: *Both perceived usefulness mediated the effect of incentives and penalties on a farmers' willingness and behavior to separate domestic waste.*

In addition, according to value perception theory, the level of an individual's perception of a certain behavior affects his or her value perception of that thing, which in turn affects individual willingness or behavior [45]. The results of Igarria et al. [46] showed that perceived ease of use was the main factor explaining perceived usefulness; the results of Zhou Yihu et al. [47] were similar. The results of Yihu Zhou et al. [47] also showed that perceived ease of use can influence perceived usefulness. Based on the above analysis, the following hypothesis is proposed:

H4: Both perceived ease of use and perceived usefulness play a chain mediating role in the effect of incentives and penalties on farmers' willingness and behavior to separate household waste.

According to the above hypothesis, the theoretical framework diagram in this paper is shown in Figure 1.

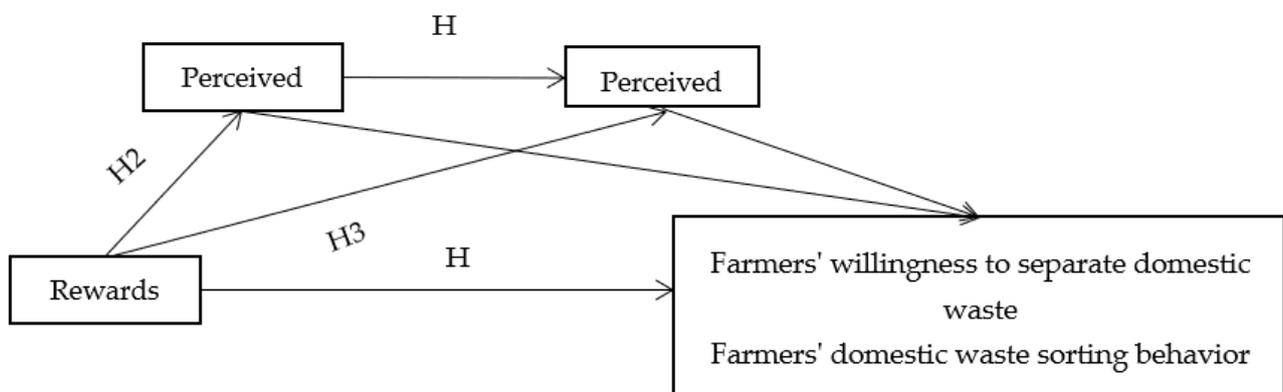


Figure 1. Theoretical analysis framework.

4. Data Sources, Variable Descriptions and Model Settings

4.1. Data Sources

The data used in the paper are from CLES 2020, a field research data in Jiangsu Province by a team from Nanjing Agricultural University, and the questionnaire covers land market, agricultural production, rural industry, ecological environment, poverty eradication, and rural finance. Meanwhile, Jiangsu Province is in the critical period of urban and rural domestic waste classification and management battle. The research adopts PPS sampling, and 2 districts and counties are selected in each of the 13 prefecture-level cities in Jiangsu Province, making a total of 26 research districts and counties. A total of 2 sample townships are selected in each district and county, 1 administrative village is selected in each township, and 50 farming households are randomly selected in each village. The total sample was 52 administrative villages and 2600 farming households. After excluding outliers and poor quality questionnaires with too much missing information, the number of valid questionnaires applicable to this study was 2506.

4.2. Variable Description

4.2.1. Explained Variables

The explanatory variables are farmers' willingness to sort domestic waste and farmers' domestic waste sorting behavior, referring to the measurement indicators of farmers' willingness to sort domestic waste and sorting behavior, as mentioned in the study by Jia Yajuan and Zhao Minjuan [22]. The questions: "Are you willing to sort domestic waste?" and "Do you carry out domestic waste separation and disposal?" are to be used as indicators to measure the explanatory variables.

4.2.2. Explanatory Variables

In the paper, incentives and penalties are the explanatory variables, and perceived ease of use and perceived usefulness are the mediating variables. Drawing on the study by Pei Jiang et al. [23], the question, "Regarding the separation of rural household waste,

does the government implement incentives and penalties?” is used in the paper to be used as an indicator of reward and punishment measures. Referring to the study of Yihu Zhou et al. [47] on measuring indicators of perceived ease of use and perceived usefulness, the paper uses the question: “Do you understand rural household waste separation?” and “Do you agree that waste separation has a positive effect on the improvement of rural environment?” as indicators of perceived ease of use and perceived usefulness, respectively.

4.2.3. Control Variables

Combined with existing studies, respondents’ personal characteristics and family characteristics were selected as control variables, as detailed in Table 1.

Table 1. Description of Variable Settings and Definitions.

Variable Category	Variable Name	Meaning	Average Value	Standard Deviation
Dependent variable	Farmers’ willingness to separate domestic waste	Are you willing to sort your household waste? No = 0, Yes = 1	0.903	0.297
	Farmers’ domestic waste sorting behavior	Do you separate your household waste for disposal? No = 0, Yes = 1	0.484	0.500
Independent variable	Rewards and penalties	Regarding the separation of rural household waste, has the government implemented incentives and penalties? No = 0, Yes = 1	0.201	0.401
Intermediate variables	Perceived ease of use	Do you know about rural household waste separation? Have not heard of it = 1, just heard of it, not quite sure = 2, know a little = 3, know more = 4, know very much = 5	3.105	1.132
	Perceived usefulness	Do you agree that separation of domestic waste has a positive effect on the improvement of the rural environment? Don’t agree at all = 1, Don’t agree much = 2, Generally = 3, Agree more = 4, Agree completely = 5	4.212	0.990
Control variables	Gender	Female = 0, Male = 1	0.702	0.458
	Age	Respondents’ age	61.031	11.314
	Account Type	Whether the respondent is an agricultural household? No = 0, Yes = 1	0.955	0.206
	Education level	Number of years of education of the respondent	6.928	3.927
	Health Status	Respondents’ self-identified health status. Incapacity = 1, poor = 2, medium = 3, good = 4, excellent = 5	3.910	1.075
	Receiving agricultural technology education or training status	Did the respondent have education or training in agricultural technology? No = 0, Yes = 1	0.305	0.461

Table 1. Cont.

Variable Category	Variable Name	Meaning	Average Value	Standard Deviation
	Number of permanent household members	Number of respondents' households residing for 6 months and above throughout the year	3.221	1.663
	cadre households	Is anyone in the respondent's family an officer? No = 0, Yes = 1	0.149	0.356
	Party member households	Is there anyone in the respondent's family who is a member of the Party? No = 0, Yes = 1	0.297	0.457
	Five guaranteed households, low-income households or disabled households	Is the respondent's household insured, underinsured or disabled? No = 0, Yes = 1	0.074	0.261
	Ethnic Minority Households	Is the respondent's household a minority household? No = 0, Yes = 1	0.033	0.180
	Religious beliefs	Is anyone in the respondent's household a believer? No = 0, Yes = 1	0.062	0.242

4.3. Research Methodology

Since the questions regarding farmers' willingness to sort domestic waste and sorting behavior are dichotomous variables, the Probit regression model is chosen to analyze the influence of incentives and penalties on farmers' willingness to sort domestic waste and their behavior, and the regression model is as follows:

$$Y^* = \alpha_0 + \alpha_1 AP + \alpha_2 \text{Controls} + \theta \quad (1)$$

$$PE = \beta_0 + \beta_1 AP + \beta_2 \text{Controls} + \theta' \quad (2)$$

$$PU = \gamma_0 + \gamma_1 AP + \gamma_2 PE + \gamma_3 \text{Controls} + \theta'' \quad (3)$$

$$Y^* = \delta_0 + \delta_1 AP + \delta_2 PE + \delta_3 PU + \delta_4 \text{Controls} + \theta''' \quad (4)$$

In Equations (1)–(4), Y^* are unobservable latent variables, including farmers' willingness to sort domestic waste and farmers' domestic waste sorting behavior, controls denote control variables, AP, PE, and PU are reward and punishment measures, perceived ease of use, and perceived usefulness, respectively. $\alpha_0, \beta_0, \gamma_0$, and δ_0 denote constants, and $\theta, \theta', \theta''$, and θ''' denote random disturbance terms.

5. Analysis of Results

5.1. Analysis of Baseline Regression Results

In the paper, the effect of incentives and penalties on farmers' willingness and behavior to separate household waste was tested based on Equation (1), using stata software, and the test results are shown in Table 2. It can be seen that with the introduction of control variables, the values of Log likelihood, LR chi2, and Pseudo R2 were improved, indicating that the explanatory power of the model is increasing. The following analysis is based on regression 2 and regression 4.

In both regression 2 and regression 4, rewards and punishments have a significant positive effect on farmers' willingness and behavior to separate household waste, and both pass the significance test at the 1% level with regression coefficients of 0.580 and 0.931, respectively. On the one hand, punishments have a restraining effect on farmers' behavior. Farmers may face penalties in the form of fines and criticism for not separating household

waste, which in turn causes direct losses to farmers. The reputation and public influence of farmers who are punished will also be reduced. This results in a higher private marginal cost for farmers who do not separate their household waste, higher than the social marginal cost. Therefore, when farmers consider that penalties may cost them more than the cost of separating their household waste, their willingness to separate household waste will increase in order to avoid being penalized, making them more likely to do so. On the other hand, incentives have a motivating effect on farmers' behavior. Farmers may receive rewards in the form of material and praise for sorting their household waste, which in turn brings direct benefits to the farmers. The reputation and public influence of farmers who are rewarded will increase. This results in a higher private marginal benefit for farmers who perform household waste sorting, which is higher than the social marginal benefit. Therefore, when farmers consider that the incentive may make them receive higher benefits than the environmental benefits they get from others, who separate their household waste for free, their willingness to separate household waste will increase in order to receive the incentive, making them more likely to separate their household waste. The above analysis verifies hypothesis H1, which states that incentives and penalties can promote farmers' willingness and behavior to separate household waste by increasing their benefits and costs. Relatively speaking, rewards and punishments have a stronger effect on enhancing farmers' domestic waste sorting behavior than on promoting farmers' willingness to sort domestic waste.

Among the control variables, age had a statistically significant negative effect on farmers' domestic waste sorting behavior at the 1% level, indicating that the older the farmers were, the less likely they were to sort domestic waste for disposal, which is consistent with the findings of Jia Yajuan and Zhao Minjuan et al. [15]. Increasing age causes a decrease in farmers' physical strength, health status, learning ability, and motivation to learn [48], such that farmers are more likely to be confused and agitated by how to properly sort household waste, which in turn reduces their waste sorting behavior. The higher the literacy level of farmers, the more they understand the significance of domestic waste sorting to the rural environment and villagers. In the process of their education, their level of domestic waste sorting knowledge is improving, which helps them to form and sustain their sorting behavior habits [6], so the higher the literacy level of farmers, the higher their willingness to sort household waste and the more likely they are to sort household waste. Health status has a statistically significant positive effect on farmers' willingness to separate household waste at the 10% level, indicating that the healthier the farmers are, the more willing they are to separate household waste. The healthier the farmers are, the more likely they are to devote their energy and physical strength to domestic waste sorting. Agricultural technology education or training status had a significant positive effect on farmers' willingness and behavior to separate household waste at the 1% and 5% statistical levels, respectively. Farmers with agricultural education or training understand the importance of environmental protection in rural areas, and once domestic waste pollutes rural land or water resources, farmers' planting or breeding harvests and drinking water safety will be affected, so the stronger their willingness to separate, the more likely they are to separate. The number of permanent household residents has a significant negative effect on farmers' domestic waste sorting behavior at the 10% statistical level, indicating that the higher the number of permanent household residents, the lower the likelihood that farmers will sort their domestic waste. The increase in the number of permanent household members will lead to an increase in the types and quantities of waste produced by farmers' households on a daily basis, which in turn increases the difficulty of waste separation, for which farmers will need to pay more time costs for waste separation. There is a statistically significant negative effect of households with five guarantees, low-income households, or households with disabilities on farmers' willingness and behavior of waste separation at the 10% level. This group of farmers is still in the stage of solving family life problems due to their low income, and they do not consider investing labor costs and time costs into domestic waste sorting. Religious beliefs have a statistically significant negative effect on

farmers' domestic waste sorting behavior at the 10% level. Religious beliefs have a negative effect on the general trust of residents and give them a lower sense of social justice [49]. Religious farmers invariably transmit these negative effects and negative emotions to their family members, making their family members reluctant to communicate and interact with other non-religious farmers, which will reduce the level of interpersonal trust of their family members, which in turn will reduce the level of household waste sorting by their family members [15], and reduce the sorting behavior of their family members.

Table 2. Regression results of farmers' willingness to separate domestic waste and separation behavior.

Variables	Willingness to Classify		Classification Behavior	
	Return 1	Return 2	Return to 3	Return 4
Rewards and penalties	0.650 *** (0.115)	0.580 *** (0.119)	0.953 *** (0.067)	0.931 *** (0.070)
Gender		0.064 (0.083)		−0.027 (0.062)
Age		−0.005 (0.004)		−0.011 *** (0.003)
Account Type		0.010 (0.187)		0.072 (0.128)
Education level		0.049 *** (0.011)		0.032 *** (0.008)
Health Status		0.060 * (0.034)		0.030 (0.026)
Receive agricultural technology education or training statuses		0.274 *** (0.091)		0.125 ** (0.059)
Number of permanent household members		−0.025 (0.022)		−0.028 * (0.016)
cadre households		0.023 (0.123)		0.052 (0.080)
Party member households		0.137 (0.093)		0.056 (0.064)
Five guaranteed households, low-income households or disabled households		−0.206* (0.124)		−0.196 * (0.103)
Ethnic Minority Households		0.101 (0.209)		0.144 (0.146)
Religious beliefs		−0.004 (0.145)		−0.196 * (0.110)
Constant term	1.212 *** (0.037)	0.932 *** (0.370)	−0.217 *** (0.028)	0.092 (0.263)
Log likelihood	−786.549	−741.770	−1653.784	−1585.124
LR chi2	38.82	121.03	214.24	306.28
Prob > chi2	0.000	0.000	0.000	0.000
Pseudo R2	0.024	0.075	0.061	0.088

Note: ***, **, * denote $p < 0.001$, $p < 0.05$, $p < 0.1$, respectively, and standard errors are in parentheses (same below).

5.2. Robustness Tests

To verify the robustness of the benchmark regression results, the following three methods are used in the paper to carry out robustness tests.

(1) Exclusion of sample method. In order to reduce the bias of the study results caused by the respondents who were not in agricultural households, the non-agricultural households were excluded from the sample before regression. In order to reduce the bias of the results due to the respondents who were not in agricultural households, the regressions were conducted after excluding the non-agricultural households from the sample. The results are shown in Table 3. Regression 5 and regression 8 represent the regression results after excluding the non-agricultural household samples, which indicate that the incentives and penalties still positively affect the willingness and behavior of farmers to separate

garbage, indicating that the results of the baseline regression are reliable. Regression 6 and regression 9 represent the results after excluding the non-agricultural household sample and then excluding the sample of elderly people over 65 years old, indicating that the incentive and punishment measures have a significant positive impact on farmers' willingness and behavior to separate household waste at the 1% statistical level, indicating that the results of the baseline regression are reliable.

(2) Considering the differences in regression models. The original data are tested for robustness using OLS (Ordinary least square) models in the paper. The results of regression 7 and regression 10 in Table 3 show that both incentives and penalties still have significant effects on farmers' willingness and behavior to separate household waste, and the direction of the effect remains unchanged, which is consistent with the results of the baseline regression model.

Table 3. Robustness tests: exclusion sample method and replacement model method.

Variables	Willingness to Classify			Classification Behavior		
	Return to 5 (Subsample)	Return to 6 (Subsample)	Return to 7 (OLS)	Return to 8 (Subsample)	Return to 9 (Subsample)	Return to 10 (OLS)
Rewards and penalties	0.603 *** (0.122)	0.476 *** (0.147)	0.070 *** (0.015)	0.931 *** (0.071)	0.970 *** (0.091)	0.334 *** (0.024)
Constant term	0.840 ** (0.325)	0.632 (0.475)	0.805 *** (0.059)	0.161 (0.237)	−0.064 (0.335)	0.518 *** (0.095)
Control variables	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
Log likelihood	−714.072	−380.222		−1513.398	−882.232	
LR chi2	113.57	50.83		289.77	183.11	
Prob > chi2	0.000	0.000		0.000	0.000	
Pseudo R2	0.074	0.063	0.044	0.087	0.094	0.115

Note: ***, ** denote $p < 0.001$, $p < 0.05$, respectively, and standard errors are in parentheses.

(3) Consideration of omitted variables. Despite the addition of individual and household characteristics as control variables in the baseline regression model, there are still some key variables omitted, resulting in biased results. In this paper, we refer to the studies of Ni-Fen Li et al. [39], Xue-Ting Wang et al. [50], Ya-juan Jia, and Min-Juan Zhao [15], and try to introduce the variables of farmers' cognitive characteristics, local attachment, interpersonal trust and institutional trust as control variables into the baseline regression equation. The question "Do you know about rural habitat improvement? Not heard of it = 1, just heard of it, not sure = 2, know a little = 3, know a lot = 4, know a lot = 5" and "How do you think the habitat environment of your village is? No pollution = 1, slight pollution = 2, moderate pollution = 3, severe pollution = 4" were used to supplement the omitted variables of farmers' cognitive characteristics. The questions "Your satisfaction with the prosperity of industry in your village", "Your satisfaction with the ecological livability of your village", "Your satisfaction with the rural civilization of your village", and "Your satisfaction with the effectiveness of governance in your village" were used. "Your satisfaction with the effectiveness of governance in your village", with the values of "very dissatisfied = 1, less satisfied = 2, average = 3, more satisfied = 4, very satisfied = 5", were used to supplement the missing local attachment variables. The questions "trust in relatives", "trust in neighbors", and "trust in village officials" were all assigned the values of "trust = 1, relatively distrust = 2, average = 3, relatively trust = 4, completely trust = 5" were used to supplement the omission of interpersonal trust and institutional trust variables. The results of the test are shown in Table 4. Regressions 11–12 show that after controlling for the above possible omitted variables, the incentives and penalties still positively affect farmers' willingness and behavior to separate household waste.

Table 4. Robustness tests: considering omitted variables.

Variables	Willingness to Classify	Classification Behavior
	Return to 11 (Add Variable 9)	Return to 12 (Add Variable 9)
Rewards and penalties	0.515 *** (0.128)	0.848 *** (0.072)
Environmental conditions	0.078 (0.067)	−0.100 ** (0.049)
Understanding the extent of habitat improvement	0.198 *** (0.035)	0.155 *** (0.025)
Industrial prosperity satisfaction	0.023 (0.042)	0.014 (0.031)
Ecological livability satisfaction	−0.008 (0.064)	0.139 *** (0.048)
Satisfaction with the civilization of the countryside	0.026 (0.062)	−0.024 (0.050)
Satisfaction with the effect of governance	0.026 (0.062)	0.052 (0.046)
Relative Trust	−0.024 (0.060)	−0.058 (0.045)
Neighborhood Trust	0.115 * (0.064)	0.035 (0.048)
Trust of village officials	0.093 (0.059)	0.031 (0.044)
Constant term	−0.421 (0.501)	−0.716 ** (0.359)
Control variables	Controlled	Controlled
Log likelihood	−701.131	−1519.931
LR chi2	182.18	383.28
Prob > chi2	0.000	0.000
Pseudo R2	0.115	0.112

Note: ***, **, * denote $p < 0.001$, $p < 0.05$, $p < 0.1$, respectively, and standard errors are in parentheses.

5.3. Endogeneity Test

Although the results of regressions 2 and 4 suggest that incentives and penalties positively affect farmers' willingness and behavior to separate household waste, the estimation results may be biased by the endogeneity problem of the regression model. Moreover, it is not possible to observe the difference between the willingness and behavior of farmers affected by incentives and penalties when they are not affected by incentives and penalties at the same time. Therefore, in order to reduce bias, the propensity score matching (PSM) method proposed by Rosenbaum and Rubin [51] is used to match the sample into treatment and control groups to obtain a "clean" average treatment effect from the influence of incentives and penalties, thus making the conclusions more robust. The findings are more robust. The results are shown in Table 5. k-nearest neighbor matching ($K = 4$), k-nearest neighbor matching within caliper ($K = 4$, caliper = 0.01), caliper matching (caliper = 0.01), kernel matching, local linear regression matching, and martingale matching all passed the 1% significance test, indicating that after correcting for bias, the incentives and penalties still had a significant positive effect on farmers' willingness and behavior to separate household waste. The mean of the average treatment effect of these six matching methods was the effect of incentives and penalties on farmers' willingness and behavior to separate household waste, and the values were 0.0686 and 0.3337, respectively, indicating that excluding other factors, incentives and penalties significantly increased farmers' willingness and behavior to separate household waste by 6.86% and 33.37%, respectively.

Table 5. PSM test results.

	Willingness to Classify			Classification Behavior		
	Average Treatment Effect	Standard Error	T-Test Value	Average Treatment Effect	Standard Error	T-Test Value
k-nearest neighbor matching (K = 4)	0.067 ***	0.013	5.06	0.343 ***	0.025	13.49
Caliper within k nearest neighbor matching (K = 4, caliper = 0.01)	0.067 ***	0.013	5.09	0.344 ***	0.026	13.48
Caliper Matching (Caliper = 0.01)	0.063 ***	0.018	3.52	0.329 ***	0.033	10.05
Nuclear matching	0.069 ***	0.011	6.29	0.338 ***	0.022	15.05
Partial linear regression matching	0.070 ***	0.018	3.93	0.323 ***	0.033	10.16
Martens matching are	0.076 ***	0.013	6.04	0.325 ***	0.025	13.09

Note: *** denote $p < 0.001$.

5.4. Chain Multiple Intermediary Effect Analysis

The results are shown in Table 6. The coefficients of the variables in regressions (13) to (16) are significant at 1%, 5%, and 10% respectively, and the signs of the coefficients are positive. This indicates that the incentives and penalties have a positive impact on farmers' willingness and behavior to separate household waste through three paths: perceived ease of use, perceived usefulness, and perceived ease of use in combination with perceived usefulness. In the path of incentives and penalties → perceived ease of use → willingness to sort, the mediating effect is the product of the coefficient of incentives and penalties, 0.673 in regression 13, and the coefficient of perceived ease of use, 0.346 in regression 15, is 0.2329. In the path of incentives and penalties → perceived usefulness → willingness to sort, the mediating effect is the product of the coefficient of incentives and penalties, is 0.149 in regression 14 and the coefficient of perceived usefulness is 0.370 in regression 15. In path reward and punishment → perceived ease of use → perceived usefulness → categorization intention, the chain mediating effect is the product of the coefficient of reward and punishment, 0.673 in regression 13, and the coefficient of perceived ease of use, 0.203 in regression 14, and the coefficient of perceived usefulness, 0.370 in regression 15, which is 0.0505.

Table 6. Chain multiple intermediary regression results.

	Return to 13	Return to 14	Return to 15	Return to 16
Dependent Variable	Perceived Ease of Use	Perceived Usefulness	Willingness to Classify	Classification Behavior
Rewards and penalties	0.673 *** (0.055)	0.149 ** (0.061)	0.300 ** (0.130)	0.714 *** (0.073)
Perceived ease of use		0.203 *** (0.023)	0.346 *** (0.039)	0.445 *** (0.029)
Perceived usefulness			0.370 *** (0.035)	0.053 * (0.029)
Control variables	Controlled	Controlled	Controlled	Controlled
Pseudo R2	0.084	0.037	0.218	0.169

Note: ***, **, * denote $p < 0.001$, $p < 0.05$, $p < 0.1$, respectively, and standard errors are in parentheses.

The overall mediating effect of 0.3385 (0.2329 + 0.0551 + 0.0505) is obtained by adding up the above mediating effects. Among them, the mediating effect of perceived ease of use was the largest, at 23.29%, indicating that the path of incentives and punishments enhancing farmers' perceived ease of use and thus their willingness to separate household waste was

the most significant. It was the most important psychological influence mechanism among the three paths of incentives and punishments affecting farmers' willingness to separate household waste. The chain mediation model of incentives and punishments on farmers' willingness to separate household waste can be obtained, and the relationship and influence coefficients between the variables of the model are shown in Figure 2.

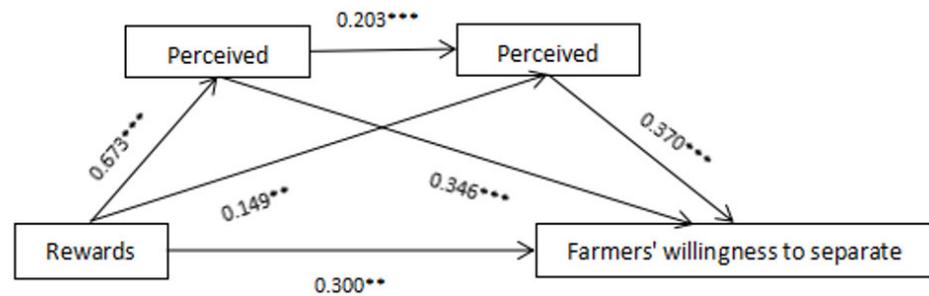


Figure 2. Model of the influence of incentives and penalties on the willingness to separate domestic waste. Note: ***, ** denote $p < 0.001$, $p < 0.05$, respectively.

Correspondingly, in path reward and punishment \rightarrow perceived ease of use \rightarrow categorical behavior, the mediating effect is the product of the coefficient of 0.673 for reward and punishment in regression 13 and the coefficient of 0.445 for perceived ease of use in regression 16, which has a value of 0.2995. In path reward and punishment \rightarrow perceived usefulness \rightarrow categorical behavior, the mediating effect is the product of the coefficient of 0.149 for reward and punishment in regression 14 and the coefficient of 0.053 for perceived usefulness. In path reward and punishment \rightarrow perceived ease of use \rightarrow perceived usefulness \rightarrow categorical intention behavior, the chain mediating effect is the product of the coefficient 0.673 of reward and punishment in regression 13 and the coefficient 0.203 of perceived ease of use in regression 14 and the coefficient 0.053 of perceived usefulness in regression 16, which has a value of 0.0072.

The overall mediating effect of 0.3146 ($0.2995 + 0.0079 + 0.0072$) is obtained by adding up the above mediating effects. Among them, the mediating effect of perceived ease of use remained the largest, reaching 29.95%, indicating that the path of incentives and punishments enhancing farmers' perceived ease of use and then strengthening farmers' domestic waste sorting behavior was the most significant, and was the most important psychological influence mechanism among the three paths of incentives and punishments affecting farmers' domestic waste sorting behavior. The chain mediation model of incentives and punishments on farmers' domestic waste sorting behavior can be obtained, and the relationships and influence coefficients between the variables of the model are shown in Figure 3.

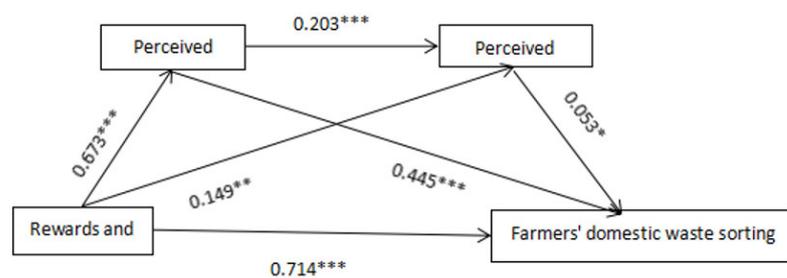


Figure 3. Model of the influence of incentives and penalties on the willingness to separate domestic waste. Note: ***, **, * denote $p < 0.001$, $p < 0.05$, $p < 0.1$, respectively.

5.5. Differential Effects of Incentives and Penalties on Farmers' Willingness and Behavior to Separate Household Waste under Different Gender, Age and Education Level Groupings

The following considers the possible differences in the effects of incentives and punishments on the willingness and behavior of household waste separation for farmers of

different genders, ages, and education levels. According to Zhu Run et al. [42], farmers with 9 or more years of education in the sample were defined as “farmers with high education level”, and farmers with less than 9 years of education in the sample were defined as “farmers with low education level”. According to Tang, Lin et al. [25], farmers aged 60 and above in the sample were defined as “older farmers”, and farmers aged below 60 in the sample were defined as “younger farmers”. The results of the regressions from regression 17 to regression 28 show that there is a significant positive effect of incentives and penalties on farmers’ willingness to separate household waste for both male and female farmers, young and old farmers, and farmers with low and high education levels, which again proves that the baseline regression results are robust. At the same time, the following interesting phenomena were found. The results are shown in Table 7.

The results of regressions 17–18 show that the regression coefficients of incentives and punishments increased from 0.528 in regression 17 to 0.744 in regression 18, respectively, indicating that women’s willingness to classify is more influenced by incentives and punishments.

A possible explanation is that the female group spends more time in the village compared to males and thus is more influenced by the institutional environment of their village and thus has a higher willingness to participate in habitat improvement [30]. Thus, incentives and penalties have a greater impact on their willingness to separate household waste.

The results of regressions 19–20 show that the regression coefficients of reward and punishment measures increase from 0.362 in regression 19 to 0.784 in regression 20, respectively, and the significance level also increases from 5% to 1%, indicating that the willingness to classify elderly people is more influenced by reward and punishment measures. Possible explanations are: on the one hand, the rural labor outflow makes the elderly group spend equally more time in the village than the younger group; on the other hand, the elderly, who have to live in their own village for a long time, will value their reputation in the village collective more, and at the same time, they can get rewards to subsidize their living through domestic waste sorting, so the influence of rewards and punishments on their willingness to sort domestic waste is stronger.

The results of regressions 21–22 show that the regression coefficients of incentives and penalties decrease from 0.713 in regression 21 to 0.329 in regression 22, respectively, and the significance level also decreases from 1% to 10%, indicating that the willingness of low educated farmers to sort is more influenced by incentives and penalties. The possible explanation is that the environmental awareness of the low-education group is not strong, and their initiative of waste sorting is weaker, so they need to rely more on the system to mobilize their willingness to sort, so the influence of reward and punishment measures on their willingness to sort domestic waste is stronger.

Table 7. Estimated results of the effects of incentives and penalties on farmers’ willingness and behavior to separate garbage under different gender, age, and education level subgroups.

Variables	Willingness to Classify					
	Return to 17 (Male Group)	Return to 18 (Female Group)	Return to 19 (Younger Group)	Return to 20 (Aged Group)	Return to 21 (Low Education Group)	Return to 22 (Highly Educated Group)
Rewards and penalties	0.528 *** (0.139)	0.744 *** (0.240)	0.362 ** (0.167)	0.784 *** (0.172)	0.713 *** (0.151)	0.329 * (0.197)
Constant term	0.783 * (0.463)	1.676 ** (0.711)	0.992 ** (0.447)	0.423 (0.298)	1.510 *** (0.465)	0.871 (0.578)
Control variables	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
Log likelihood	−486.024	−245.665	−257.287	−479.234	−523.776	−212.674
LR chi2	67.69	65.93	29.02	85.56	56.85	36.60
Prob > chi2	0.000	0.000	0.000	0.000	0.000	0.000
Pseudo R2	0.065	0.118	0.053	0.082	0.052	0.079

Table 7. Cont.

Variables	Classification Behavior					
	Return to 23 (Male Group)	Return to 24 (Female Group)	Return to 25 (Younger Group)	Return to 26 (Aged Group)	Return to 27 (Low Education Group)	Return to 28 (Highly Educated Group)
Rewards and penalties	0.936 *** (0.080)	0.935 *** (0.137)	0.934 *** (0.105)	0.942 *** (0.095)	0.945 *** (0.091)	0.967 *** (0.109)
Constant term	0.251 (0.332)	−0.314 (0.481)	−0.846 *** (0.278)	−0.357 (0.232)	0.353 (0.355)	0.174 (0.368)
Control variables	Controlled	Controlled	Controlled	Controlled	Controlled	Controlled
Log likelihood	−1100.839	−470.421	−664.726	−9911.420	−912.687	−667.802
LR chi2	236.54	91.19	138.84	127.41	143.58	133.22
Prob > chi2	0.000	0.000	0.000	0.000	0.000	0.000
Pseudo R2	0.097	0.088	0.095	0.065	0.073	0.091

Note: ***, **, * denote $p < 0.001$, $p < 0.05$, $p < 0.1$, respectively, and standard errors are in parentheses.

6. Discussion

In the paper, based on the research and analysis of the 2020 CLES survey data about the rural areas in each city of Jiangsu Province, the influence of incentives and penalties on the willingness and behavior of farmers' domestic waste separation is analyzed using the Probit model; based on the technology acceptance model, the chain multiple mediating effects are used to analyze the influence mechanism of incentives and penalties on the willingness and behavior of farmers' domestic waste separation, based on the heterogeneity of farmers. Finally, the effects of gender, age, and education level on the relationship between incentives and penalties and farmers' willingness and behavior to separate household waste are discussed. In this regard, the main marginal contributions of the article are as follows: (1) it explores both willingness and behavior, and enhances the practical application value of incentives and penalties. (2) it expands the application area of the technology acceptance model, and increases the research perspective and theory of research related to farmers' domestic waste sorting. (3) it increases the research methodology of research related to farmers' domestic waste sorting, and more fully explores the influence of incentives and penalties on farmers' domestic waste sorting. The mechanism of incentives and punishments on farmers' willingness and behavior of domestic waste sorting is more fully explored.

Overall, the results of the article are overall similar to those of Tang-Lin [27] and Min-Shi et al. [28], but the article still has some shortcomings: (1) the question items of the reward and punishment measure variables are too subjective and dichotomous, which makes it difficult to comprehensively characterize the reward and punishment measures. (2) the chain multiple mediation effect is not supported by robustness tests and endogeneity discussions. (3) the implementation costs of the reward and punishment measures are not considered. Possible considerations for future studies include the following: First, design incentives and penalties of different strengths (amounts) and types (material and spiritual) to examine the impact of incentives and penalties on farmers' domestic waste separation. Second, finding instrumental variables to solve possible endogeneity problems of the model. Third, to enhance the dialogue of classical literature and consider the issue of transaction costs from the perspective of institutional economics.

7. Conclusions and Policy Implications

In this paper, using 2506 micro-survey data of farm households in Jiangsu Province, using Probit model, based on technology acceptance model, and with full consideration of farm household heterogeneity, we analyzed the impact, influence mechanism, and variability of incentives and penalties on farm households' willingness and behavior of domestic waste separation, and the main findings of the study are as follows:

Firstly, rewards and punishments have a significant positive effect on farmers' willingness and behavior to separate domestic waste. When other factors are excluded, rewards

and punishments significantly increase farmers' willingness to separate domestic waste by 6.86% and significantly strengthen their sorting behavior by 33.37%.

Secondly, incentives and penalties can also influence farmers' willingness and behavior to separate household waste through three paths: perceived ease of use, perceived usefulness, and the linkage between perceived ease of use and perceived usefulness. Among them, the mediating effect of perceived ease of use is the largest, with 23.29% and 29.95%, respectively.

Thirdly, there are path differences in the effects of incentives and punishments on farmers' willingness to separate domestic waste, as shown by the fact that incentives and punishments have a greater promoting effect among farmers in the female group, the old age group, and the low education group. In contrast, there is no path difference between incentives and penalties on farmers' domestic waste sorting behavior, as shown by the fact that incentives and penalties do not have different reinforcing effects on farmers' sorting behavior depending on their gender, age, and education level.

Fourth, Among the individual characteristics of farmers, the education or training status and education level of agricultural technology significantly and positively influenced their classification intention and behavior, the health status significantly and positively influenced their classification intention, and the age significantly and negatively influenced their classification behavior. The household characteristics of the five-guarantee households, low-guarantee households, or households with disabilities significantly and negatively influenced farmers' willingness and behavior to be classified, and the number of permanent household members and religious beliefs significantly and negatively influenced farmers' classification behavior.

Based on the above findings, this paper suggests: Firstly, Improving the reward and punishment system. By improving the reward and punishment system of rural household waste classification, farmers are motivated to actively participate and given appropriate punishment for non-participants. Practice has proved that the rewards and punishments, such as public announcement of rewards and subsidies, role models and honorary titles, as well as notices, criticism and education, fines, and cancellation of some public benefits, can be adopted to give full play to the role of rewards and punishments in promoting farmers' willingness and behavior in domestic waste separation; at the same time, the implementation of rewards and punishments should be combined with individual characteristics of farmers, such as gender, age, and education, so as to fully mobilize the motivation of female, old, and low-education farmers.

At the same time, the implementation of incentives and punishments should take into account the individual characteristics of farmers, such as gender, age, and education, to fully mobilize the enthusiasm of female, old, and low-education farmers, and then play their leading and demonstration role through family and community channels to drive the enthusiasm of the rest of family members and villagers to separate domestic waste. Secondly, making good use of market instruments. Monetary incentives need to be appropriate in order to prevent farmers from focusing too much on material rewards and ignoring the real meaning of waste separation, as well as reducing the burden for government finance. Therefore, new incentives should be explored continuously; in addition, a payment mechanism for domestic waste disposal can be established, linking individual payment to the amount of domestic waste produced, so that farmers can realize that waste management does not only depend on the government, but that they also have to take corresponding responsibilities and obligations, thus increasing their sense of social responsibility and promoting their participation in domestic waste separation. Thirdly, Improving farmers' awareness and value recognition of domestic waste separation. Through the Internet, brochures, public activities, and other publicity and education channels, the knowledge of domestic waste classification can be widely popularized to strengthen farmers' understanding of domestic waste classification and improve their recognition level and precise classification ability; at the same time, the content of publicity and education should also emphasize the protective effect of domestic waste classification on the rural environment,

in order to form specific behavioral attitudes toward domestic waste classification and thus increase participation. At the same time, the content of publicity and education should also emphasize the role of domestic waste separation in protecting the rural environment, in order to form specific behavioral attitudes toward domestic waste separation and increase the endogenous motivation of domestic waste separation, and form long-term stable willingness and behavior of domestic waste separation.

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