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Sustainable Development of Rural Human Settlements in the Information Age: Can Internet Use Drive Farmers to Participate in Garbage Classification?

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Abstract: Garbage classification is significant to alleviate the pressure of household waste management in rural areas and promote green development. Based on the micro survey data of 2228 households in rural areas of Jiangsu Province, this paper discusses the impact of internet use on the garbage classification's willingness and behavior based on the planned behavior theory. The results show that: (1) There is a deviation between willingness and behavior. Ninety percent of the surveyed farmers were willing to do garbage classification, but the garbage classification rate was only 53%. (2) Internet use has a positive effect on the willingness and behavior of farmers to classify garbage, and it can promote the willingness to change behavior and reduce the deviation between willingness and behavior. Specifically, internet use increased by 1 unit, the probability of farmers having neither willingness nor behavior, having both willingness and behavior, and only having willingness but not having the behavior decreased by 5.4%, increased by 13%, and decreased by 7.5%, respectively. (3) Further analysis according to different internet access methods shows that mobile internet access and mixed internet access can have a positive impact on farmers' willingness and behavior in relation to garbage classification, while computer internet access has no significant impact on farmers' willingness and behavior in relation to garbage classification. (4) Internet use can enhance farmers' willingness and behavior in relation to garbage classification by improving their knowledge, behavioral, and environmental cognition. Specifically, the mediating effects of knowledge, behavioral, and environmental cognition on willingness were 71.48%, 21.72%, and 40.49%, respectively, and the mediating effects on behavior were 89.47%, 8.89%, and 18.81%, respectively. Based on this, this paper puts forward the policy recommendations of strengthening the hardware and software construction of the internet, adopting diversified propaganda methods of garbage classification, and improving the social supervision and restraint mechanism.

Keywords: internet use; garbage classification willingness; garbage classification behavior; bivariate probit model

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Citation: Xu, D.; Qing, C.; Chen, Y.; He, J.; Zhang, F. Sustainable Development of Rural Human Settlements in the Information Age: Can Internet Use Drive Farmers to Participate in Garbage Classification? *Agriculture* **2023**, *13*, 846. https://doi.org/10.3390/agriculture13040846

Academic Editor: Efstratios Loizou

Received: 30 December 2022
Revised: 11 March 2023
Accepted: 15 March 2023
Published: 10 April 2023

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1. Introduction

In the context of rural revitalization, the Chinese government attaches great importance to the problem of rural human settlement environment. With the improvement in farmers' living standards and economic incomes, farmers' material consumption continues to increase, and the generation and emission of rural garbage also increases sharply [1]. According to the Report on the Development Trends and Investment Strategy Planning of China's Rural Waste Treatment Industry (2021–2027), China's rural household garbage reached 299 million tons in 2019, with an annual growth rate of 8–10% [2]. China has become a significant garbage producer in the world [3]. Presently, domestic garbage treatment in most areas is mainly based on discarding, mixed landfill, and incineration [4].

However, a large number of pollutants generated in the process of landfill or incineration will cause severe pollution to the surface, groundwater, soil, air, and other environments if not correctly disposed of [5]. Garbage classification, as a pro-environment behavior, is the first step to minimizing the harmful impact of garbage on the environment [6]. Nowadays, China has started a large-scale garbage classification campaign [7], and its garbage disposal capacity has been dramatically improved. However, the garbage treatment or recovery rate is still low, especially in rural areas [8]. It also exposes the problems of farmers' weak awareness of household garbage classification, low enthusiasm, and non-standard classification [9,10]. One of the crucial reasons is that farmers lack access to adequate garbage classification information, which signifies the "digital divide" faced by farmers. Therefore, garbage classification, as an environmental protection concept and behavior, is highly likely to be affected by internet use.

At present, digital construction in rural areas continues to develop, and farmers' internet access conditions have been improved. According to statistics, by June 2021, the number of rural internet users in China has increased to 297 million, and the internet penetration rate in rural areas has increased to 59.2 percent. The information screen market formed by the internet exerts a subtle influence on farmers' access to information and the shaping of their living habits and values [11,12]. Currently, the discussion on the promoting effect of internet use on rural development mainly focuses on labor employment, consumer decision-making, welfare level, and agricultural production [13–15]. With the increasing popularity of environmental protection issues, research on the impact of internet use on rural households' environmental protection behaviors is also rising [16,17]. However, in general, few researchers are focusing on garbage classification. In particular, there is a lack of literature based on household data to study whether internet use affects farmers' participation in garbage classification. Based on this, using the micro survey data in rural areas of Jiangsu Province in China, the Bivariate Probit model was used to analyze the willingness and behavior of farmers to classify garbage in the same framework. This paper analyzes the impact of internet use on farmers' willingness and behavior in relation to garbage classification. This paper not only verified the influence of internet use on farmers' garbage classification willingness and behavior and the deviation between the two, but also discussed its mechanism from the perspective of farmers' garbage classification cognition. It is expected to provide decision makers with a reference for adjusting and improving the domestic garbage classification policy and promoting the development of rural human settlements.

2. Literature Review

The research on rural household garbage classification is reviewed, mainly including two dimensions: the macro level and micro level. From the macro level, scholars have studied the effectiveness of environmental policies in different countries or regions and proposed different governance models [18–20]. In addition, different macro policies such as environmental regulation and publicity policies are also important factors affecting public participation in garbage classification [2,21]. From a micro perspective, families are usually regarded as the primary source of household garbage, and garbage classification by farmers at the source is considered a meaningful way to solve the rural garbage problem [22]. Therefore, scholars pay more attention to the influencing factors of household garbage classification willingness or garbage classification behavior, which mainly include individual, situational, and psychological cognition factors. Among individual factors, gender, income, cadre, and other characteristics will impact farmers' garbage classification willingness [23]. Among situational factors, social capital, market incentives, and consumption habits can effectively promote garbage classification [3,24,25]. Among the psychological cognition factors, environmental cognition, attitude, subjective norms, and other factors also significantly impact farmers' garbage classification willingness and behavior [26,27].

However, most current studies are one-sided on residents' garbage classification willingness or behavior. In fact, farmers often have a high willingness to garbage classification,

but demonstrate less behavior in relation to garbage classification. From the existing studies, scholars have proposed and confirmed the gap between garbage classification willingness and behavior [28] and further analyzed the factors affecting the inconsistency between the two. Their research found that the factors affecting willingness and behavior were not consistent [29]. In addition, some scholars also pay attention to the factors that affect the contradiction between residents 'garbage classification willingness and classification behavior, and they propose that garbage classification knowledge, incentives, and recycling facilities can promote the transformation from willingness to behavior [23,30].

This paper mainly studies the impact of internet use on household garbage classification, which is relatively lacking in the literature. In the existing research, some scholars only focus on willingness in relation to garbage classification. For example, Ai et al. [31] found that teenagers' use of social media can increase their willingness in relation to garbage classification through mediating effects such as subjective and objective knowledge and the perception of the importance of garbage classification. In addition, Liu et al. [11] found that farmers' internet use can effectively improve their garbage classification willingness and that the impact of different internet access methods is heterogeneous. Of course, some scholars also pay attention to willingness and behavior in relation to garbage classification at the same time. For example, Zhu et al. [32] proposed that the improvement of farmers' digital literacy level can help narrow the difference between willingness and behavior in relation to garbage classification. Ma et al. [33] also proposed that the use of the internet can not only motivate people to classify garbage, but also improve their willingness to classify garbage.

In summary, although there are concerns about the impact of internet use on garbage classification, most of them focus on the impact of internet use on garbage classification willingness. However, the will and behavior are unified, and understanding how to convert the farmers' will into behavior is an effective measure to improve the level of garbage classification [34]. Therefore, this paper will use the representative data of Chinese farmers to explore the impact of internet use on farmers' garbage classification willingness and behaviors and seek to supplement the existing literature. First of all, most existing research subjects of garbage classification are urban residents; this paper, however, focuses on farmers, which can enrich existing research to a certain extent. Secondly, garbage classification and recycling compose a complex decision-making process. In this paper, willingness and behavior in relation to garbage classification are taken into consideration, and the bivariable probit model is adopted to conduct an empirical study. Compared with the previous single logit or probit model, it can better handle the internal relationship between willingness and behavior and accurately depict the relationship between variables. Finally, limited studies have focused on the influence of internet use on garbage classification willingness or behavior. However, these studies have yet to analyze the mechanism of the influence between the two deeply. On this basis, this paper makes further analysis of the intermediary mechanism.

3. Theoretical Analysis and Research Hypothesis

The theory of planned behavior proposes that individual behavior depends on behavioral willingness, and behavioral willingness is affected by three factors: individual behavior attitude, subjective norm, and perceived behavioral control [35]. Generally speaking, the more positive an individual's attitude toward a certain behavior, the more positive the subjective norm, and the stronger the perceived behavioral control, the greater the individual's behavioral willingness will be, thus affecting the individual's behavior. As a comprehensive economic system based on information technology, the internet is essentially a medium for information exchange and communication, which is hugely influential in shaping the public's value orientation on hot topics and mobilizing participation [36]. First, when farmers browse information on the internet, they often receive all kinds of ecological and environmental information. In particular, online media tend to report negative news to attract attention. In this process, farmers will understand the harm to the

ecological environment and their health caused by the non-classification of garbage, thus generating environmental emotional resonance and environmental crisis awareness [37]. Farmers will adopt more efficient, green, and environmentally friendly lifestyles to avoid risk. At the same time, environmental protection helps to improve the health of individuals and thus their ability to earn income, which may induce positive environmental protection attitudes [16]. When the individual's subjective attitude of participating in garbage classification is more positive, the willingness of garbage classification will also be higher, and the possibility of classification behavior will be greater. Secondly, when farmers interact through social media, it not only promotes the exchange of environmental news and habits, but also enriches the social network [6]. In addition, with the increase in social networks, individuals will imitate others' environmental protection behaviors (that is, they will have the mentality of following). The social identity gained at this time will help to enhance farmers' subjective norms on environmental protection and further promote their cheerful environmental protection willingness and behaviors [4]. In addition, in real life, farmers are bound to be affected by external pressures when making decisions on household garbage classification and disposal. Public moral pressure, such as the appeal of environmental activists on the internet and public service advertisements, also helps to enhance farmers' subjective norms about environmental protection, thus promoting positive environmental protection willingness and behaviors. Finally, the internet can weaken information asymmetry and reduce the cost of information searches and transactions. At this time, farmers' difficulties in garbage classification and treatment will be reduced, and it will be easier to overcome obstacles such as money, time, energy, and space distance for garbage classification and treatment [32].

The "value-belief-norm" theory believes that individual values will affect individual beliefs, and then affect individual norms, and finally affect residents' environmental behaviors [38]. The values actually belong to individual cognitive factors, and previous studies have shown that individual cognition of things will affect individual willingness and behavior [39]. Therefore, this paper believes that the internet can enhance and promote farmers' garbage classification willingness and behavior by improving their garbage classification cognition. Specifically, this paper will evaluate from three aspects of knowledge cognition, behavior cognition, and environmental cognition. Firstly, the internet has built a good platform for the knowledge sharing of environmental protection-related laws and garbage classification, which helps farmers to enhance their understanding of garbage classification and enhance farmers' knowledge cognition of garbage classification. Secondly, the social capital enhanced via the internet helps to enhance farmers' subjective norms of environmental protection, thus farmers will pay more attention to the evaluation of their own environmental protection actions and enhance their behavioral cognition of garbage classification. Finally, the positive effects on the environment and society obtained by farmers through the internet and their own environmental protection behaviors also help to cultivate farmers' perception of environmental benefits and enhance farmers' environmental cognition. When farmers internalize their cognition and consciousness of garbage classification [40], they will eventually enhance their environmental protection belief by influencing their value orientation. According to the theory of "value-belief-norm", belief has a direct and effective effect on behavior [41], and the enhancement of environmental protection belief is obviously conducive to improving the possibility of residents to classify garbage. Based on this (Figure 1), this paper proposes the following hypothesis:

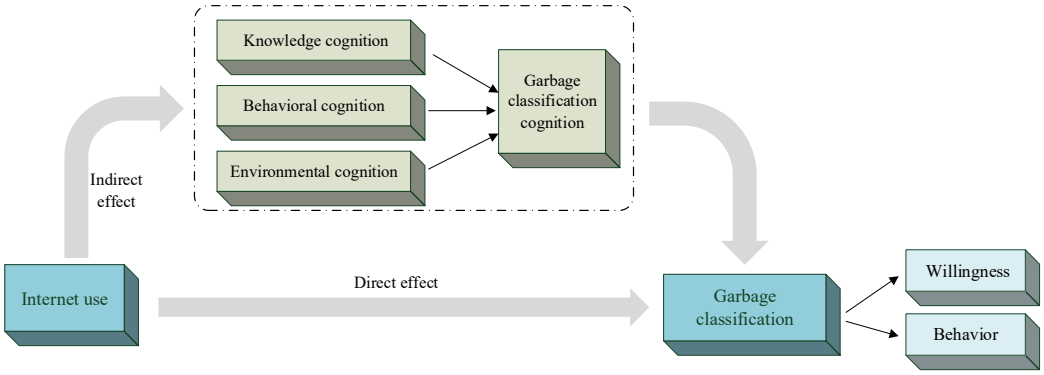


Figure 1. Theoretical mechanism diagram.

H1: *Using the internet can improve and promote farmers' garbage classification willingness and behavior.*

H2: *Using the internet can enhance and promote the willingness and behavior of garbage classification by improving the knowledge cognition of farmers.*

H3: *Using the internet can enhance and promote the willingness and behavior of garbage classification by improving the behavioral cognition of farmers.*

H4: *Using the internet can enhance and promote the willingness and behavior of garbage classification by improving the environmental cognition of farmers.*

4. Research Design

4.1. Data Sources

This article uses data from the 2021 China Land Economic Survey (CLES). This survey covers several aspects, including green development, rural governance, and rural construction. It employs the PPS (Probability Rate to Size Sampling) method to collect data from 2420 rural households in 13 prefecture-level cities of Jiangsu Province. The investigation process is as follows: Firstly, two sample counties were randomly selected in each district city. Secondly, two sample towns were selected in each county, and finally, one administrative village was selected in each town. In addition, 50 farmers were randomly selected in each village for interview. According to the research needs, this paper conducted the variable processing and screening of database data, and finally retained 2228 samples.

4.2. Variable Selection

4.2.1. Explained Variable

Domestic garbage refers to the solid garbage generated in the daily life of residents or in the activities of providing services to residents [42]. The willingness of garbage classification in this paper refers to the attitude on the environmental behavior of household garbage classification, that is, whether farmers are willing to classify household garbage. For behavior in relation to garbage classification, this paper considers that garbage classification refers to the behavior of classifying garbage according to standards before placing and handling. In this paper, the independent variables are farmers' willingness and behavior in relation to garbage classification. With willingness in relation to garbage classification, the value is assigned to 1, otherwise to 0; with behavior in relation to garbage classification, the value is assigned to 1, or otherwise to 0.

4.2.2. Key Explanatory Variable

The key explanatory variable in this paper is farmers' internet use. If farmers use the internet, the value is 1; otherwise, the value is 0.

4.2.3. Mediation Variable

The intermediate variable of this paper is garbage classification cognition, which mainly includes knowledge, behavioral, and environmental cognition. Referring to the studies of Liu et al. [43] and Peng et al. [16], this paper uses the questions "Do you understand the classification of rural household garbage?", "Do you think household garbage classification can be appreciated and praised?", and "Do you agree that household garbage classification plays a positive role in improving the rural environment?". Furthermore, all of them were measured using a 5-point Likert scale.

4.2.4. Control Variable

Many studies have found that the demographic and family characteristics of respondents can affect individual environmental decision-making behavior [7]; this paper controls the personal characteristics of farmers (age, gender, years of education, health status, cadre) and family characteristics (number of permanent population, number of labor force, basic family income). The definition and value assignment of specific variables are shown in Table 1.

Table 1. Description of variable assignment and descriptive statistics.

Categories	Variables	Variable Meaning and Assignment	Mean	Sd
Dependent variable	Garbage classification willingness	Whether farmers are willing to separate garbage	0.90	0.30
	Garbage classification behavior	Whether the farmer conducts garbage classification	0.53	0.50
Independent variable	Internet use	Whether farmers use the internet	0.46	0.50
Mediation variable	Knowledge cognition	Do you understand the classification of rural household garbage? (1 = never heard of, 5 = well understood)	3.21	1.17
	Behavioral cognition	Can household garbage classification be appreciated and praised? (1 = strongly disagree, 5 = strongly agree)	4.15	0.86
	Environmental cognition	Do you agree that household garbage classification plays a positive role in improving the rural environment? (1 = strongly disagree, 5 = strongly agree)	4.26	0.94
Control variable	Age of head of household	Actual age (years)	63.49	10.54
	Gender of the head of household	Male = 1, female = 0	0.92	0.26
	The education level of the household head	Years of education (years)	7.25	3.66
	Health of householder	1 = incapacity to work; 2 = difference; 3 = medium; 4 = good; 5 = best	4.00	1.10
	Cadre	1 = Yes, 0 = no	0.16	0.36
	Number of the household labor force	Number of workers aged 16–64	2.45	1.46
	Basic household income	Unit: Yuan	7.88	3.69
	Permanent resident population	Unit: Person	3.06	1.60

4.3. Model Selection

4.3.1. Bivariate Probit Model

This paper needs to examine the impact of internet use on farmers' willingness and behavior in relation to classifying garbage. According to the theory of planned behavior, individual willingness impacts individual behavior, and the strengthening of individual

willingness is conducive to implementing individual behavior. That is, there is a specific relationship between will and behavior. Therefore, if probit regression is performed on farmers' garbage classification willingness and garbage classification behavior, there may be a correlation between random disturbance terms of the two probit equations [44], which leads to efficiency loss. The bivariate probit model should be used for estimation. The bivariate probit model is all based on the basic probit model:

$$Prob(Y = 1) = \int_{-\infty}^{\beta X} \varnothing(t)dt = \frac{e^{\beta X}}{1 + e^{\beta X}} \quad (1)$$

Since there are two related equations, we set them as:

$$y_1^* = \beta_1' x_1 + \varepsilon_1, \text{ if } y_1^* > 0, \ y_1 = 1; \text{ otherwise, it is } 0 \quad (2)$$

$$y_2^* = \beta_2' x_2 + \varepsilon_2, \text{ if } y_2^* > 0, \ y_2 = 1; \text{ otherwise, it is } 0 \quad (3)$$

where $E(\epsilon_1) = E(\epsilon_2) = 0$, $Var(\epsilon_1) = Var(\epsilon_2) = 1$, $Cov(\epsilon_1, \epsilon_2) = \rho$.

Household garbage classification willingness and behavior are mutually influenced by each other, and both are affected by the same independent variables. Therefore, farmer garbage classification willingness and garbage classification behavior are regarded as two dependent variables of the bivariate probit model. Then, the factors that affect household garbage classification willingness and behavior are tested. We set two dependent variables as garbage classification willingness (Y^0) and garbage classification behavior (Y^1):

$$Y^0 = \begin{cases} 1, \text{ Having garbage classification willingness} \\ 0, \text{ Not having garbage classification willingness} \end{cases},$$

$$Y^1 = \begin{cases} 1, \text{Having garbage classification behavior} \\ 0, \text{Not having garbage classification behavior} \end{cases}$$

Therefore, for the dependent variables (Y^0, Y^1) of the bivariate probit model, we can acquire four cases: (1, 0), (1, 1), (0, 0), and (0, 1). That is, having garbage classification willingness without behavior, having garbage classification willingness and behavior, not having garbage classification willingness and no behavior, and not having garbage classification willingness but having behavior.

4.3.2. Endogeneity Test

Considering that the endogeneity problem may be caused by the bidirectional causal relationship between internet use and farmers 'garbage classification willingness (behavior), this paper uses the instrumental variable method to solve the problem. Referring to the processing idea of Deng et al. [45], this paper selected "the proportion of farmers using the internet in the village" as an instrumental variable for testing. On the one hand, the higher the internet usage rate in the village, the more people around the individual that will use the internet. The same group effect will affect the individual's internet usage decision [46], thus satisfying the correlation condition. On the other hand, because the internet usage data is at the village level, it often does not impact farmers' willingness and behavior in relation to sorting garbage, which satisfies the homogeneity condition. Therefore, this paper selects the proportion of internet use as an instrumental variable for IV-probit estimation to reduce the bias of the results caused by the endogeneity problem.

4.3.3. Mediation Effect Model

Referring to the test procedure of an intermediary effect [47], this paper intends to use the stepwise regression method to test and explain the "how" of farmers' internet use on

their willingness and behavior of garbage classification. The specific estimation equation is as follows:

$$P(Y_i = 1) = \Phi(\beta_0 + \beta_1 IU_i + \beta_2 C_i + \varepsilon_i) \quad (4)$$

$$M_i = \gamma_0 + \gamma_1 IU_i + \gamma_2 C_i + \mu_i \quad (5)$$

$$P(Y_i = 1) = \Phi(\rho_0 + \rho_1 IU_i + \rho_2 M_i + \rho_3 C_i + \tau_i) \quad (6)$$

In the above equation, Y_i represents garbage classification willingness or garbage classification behavior, IU_i represents internet use, M_i is an intermediary variable representing various cognitions of farmers, and β_1, γ_1, ρ_1, ρ_2 are parameters to be estimated.

5. Analysis of Results

5.1. Describe the Statistical Analysis

As shown in Table 1, the share of farm households using the internet is 46%. The proportion of farmers willing to carry out garbage classification is 90%. In comparison, the proportion of farmers participating in garbage classification is 53%, which is far less than that of farmers with garbage classification willingness. Indicating that farmers with garbage classification willingness do not have garbage classification behavior simultaneously, there is a particular deviation between garbage classification willingness and behavior. Specifically, as shown in Figure 2, in the overall sample, 53% of the farmers have both willingness and behavior of garbage classification, 0.3% of the farmers have neither willingness nor behavior, 9.7% of the farmers have behavior without willingness, and 37% of the farmers have willingness without behavior. Moreover, the proportion of farmers using the internet in the above groups was 54%, 33%, 26%, and 38%, respectively.

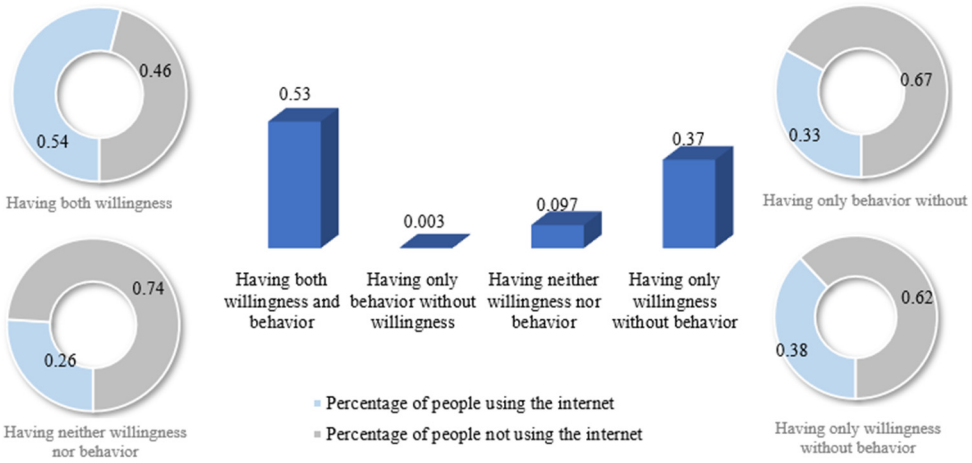


Figure 2. Depicts the statistical plot.

Regarding the control variables, the average age of the surveyed farmers was 63.49 years old, and the average years of education was 7.25 years. The proportion of male household heads reached 92%, the average health level was good, 16% were cadres, the average household labor force was 2.45, and the permanent population was 3.06.

5.2. Analysis of the Influence of Internet Use on Farmers' Garbage Classification Willingness and Behavior

The estimation results based on the bivariate probit model show that internet use has a positive impact on farmers' garbage classification willingness and behavior, and it is significant at the 1% statistical level. (Table 2). That is, using the internet can simultaneously improve willingness and behavior in relation to garbage classification by farmers, and H1 is verified. It coincides with the research results of Liu et al. [11] and Ma et al. [33] that

affirmed that the internet is an essential factor in bridging the willingness and behavior of rural residents in garbage classification.

Table 2. Estimation results of the impact of internet use on farmers' willingness and behavior in relation to garbage classification.

Variables	Garbage Classification Willingness		Garbage Classification Behavior	
	Coefficient	Std. Err	Coefficient	Std. Err
Internet use	0.341 ***	(0.083)	0.324 ***	(0.060)
Age of head of household	−0.002	(0.005)	−0.009 ***	(0.003)
Gender of the head of household	0.064	(0.136)	0.052	(0.104)
The education level of the household head	0.031	(0.032)	0.075 ***	(0.026)
Health of householder	0.031 ***	(0.011)	0.009	(0.008)
Number of the household labor force	0.036	0.029	−0.001	0.022
Basic household income (logarithm)	0.012	0.011	0.011	0.008
Permanent resident population	0.025	0.027	0.066 ***	0.019
Cadre	0.428 ***	0.128	0.298 ***	0.078
athrho	1.024 *** (0.081)			
Wald test (p value)	0.000			
Log pseudolikelihood	−2023.4978			
chi2	177.214			
N	2228			

Note: *** indicate significance levels of 1%.

Among the control variables, the influencing factors of garbage classification willingness and behavior are inconsistent, consistent with the findings of scholars such as Chen et al. [28] and Kang et al. [23]. Specifically, whether the household head is a cadre has a significantly positive impact on willingness and behavior in relation to garbage classification. Indicating that as the village leader, the cadre has a higher willingness to perform garbage classification and puts the willingness into action, so the probability of having both willingness and behavior in relation garbage classification becomes high. The education level of household heads significantly impacts their garbage classification willingness, which may be because educated farmers are more likely to understand the benefits of garbage classification, so they have a high willingness. However, they cannot adopt behavior due to the lack of their conditions or the restrictions of the external environment. The age of the household head has no significant effect on farmers' willingness to garbage classification but does impact their behavior. It may be because garbage classification, a new environmental protection method in recent years, requires a certain amount of mental and physical energy to learn and practice. For farmers, especially the elderly, it is difficult to change their living habits and learn new garbage classification knowledge, so they may not classify garbage.

5.3. Analysis of the Influence of the Internet on Farmers' Garbage Classification Willingness and Behavior Deviation

The benchmark regression results show that farmers' willingness and behavior in relation to garbage classification are affected by internet use. However, only some farmers were willing to classify garbage and finally adopted garbage classification behavior. What factors affect the transformation of farmers' garbage classification willingness into actual behavior? Furthermore, what are the effects of these factors on the deviation between the two? Answering these questions can clarify the influence of internet use on the deviation between farmers' garbage classification willingness and behavior and provide an empirical reference for the proposal of policy enlightenment in this paper. There were four conditions of farmers' willingness and behavior of garbage classification, that is, having neither willingness nor behavior (0,0); having only behavior without willingness (0,1); having only willingness without behavior (1,0); and having both willingness and behavior (1,1).

Therefore, based on the bivariate probit model, this paper further calculated the marginal effects of internet use on farmers' garbage classification willingness and behavior under these four conditions and analyzed the influence of an explanatory variable on the deviation between their willingness and behavior.

The regression results show (Table 3) that internet use significantly negatively impacts farmers who do not have both willingness and behavior in relation to garbage classification, and positively impacts farmers who have both willingness and behavior in relation to garbage classification. Specifically, for each unit increase in internet use, the probability of not having garbage classification willingness and behavior at the same time decreased by 5.4%, while the probability of having garbage classification willingness and behavior at the same time increased by 13%. It shows that internet use can promote farmers participation in garbage classification, reduce the deviation between farmers 'garbage classification willingness and behavior, and promote the transformation from willingness to behavior. Suppose the explanatory variables significantly impact the choice of farmers who only have the willingness of garbage classification but do not have the behavior; in that case, it may be a factor that causes the deviation between willingness and behavior. The results show that internet use has a significant impact on the farmers who only have the willingness to do garbage classification but not the classification behavior. Specifically, if internet usage increases by 1 unit, the probability that the farmer only has the willingness of garbage classification but does not have the behavior of garbage classification decreases by 7.5%.

Table 3. Analysis the results of the deviation of willingness and behavior in relation to farmers' garbage classification.

Variables	(0,0)		(0,1)		(1,0)		(1,1)	
	Marginal Effect	**Std. Err**	**Marginal Effect**	**Std. Err**	**Marginal Effect**	**Std. Err**	**Marginal Effect**	**Std. Err**
Internet use	−0.054 ***	0.012	−0.001	0.001	−0.075 ***	0.022	0.130 ***	0.023
Age of head of household	0.000	0.001	−0.000	0.000	0.003 ***	0.001	−0.004 ***	0.001
Gender of the head of household	−0.010	0.021	−0.000	0.001	−0.011	0.037	0.021	0.041
The education level of the household head	−0.005	0.005	0.000	0.000	−0.024	0.010	0.029 ***	0.010
Health of householder	−0.005 ***	0.002	−0.000 **	0.000	0.001	0.003	0.004	0.003
Number of the household labor force	−0.005	0.004	−0.000	0.000	0.006	0.008	0.000	0.009
Basic household income (logarithm)	−0.002	0.002	−0.000	0.000	−0.002	0.003	0.004	0.003
Permanent resident population	−0.004	0.004	−0.000	0.000	−0.022 ***	0.007	0.026 ***	0.008
Cadre	−0.066 ***	0.019	−0.002	0.001	−0.052 *	0.031	0.120 ***	0.031

Note: ***, **, and * indicate significance levels of 1%, 5%, and 10%, respectively.

Among the control variables, the results of this paper are consistent with those of Chen et al. [28], and the influencing factors of farmers' garbage willingness and behavior are not consistent. Household heads as cadres can reduce the probability that farmers do not have the willingness and behavior of garbage classification, and that they only have the willingness but not have behavior of garbage willingness, and increase the probability that farmers have willingness and behavior in relation to garbage classification. The older the head of the farm household is, the higher the probability of having willingness but not having behavior, and the lower the probability of having both willingness and behavior. The higher the household permanent population, the lower the probability that farmers only have willingness and not behavior, and the higher the probability that farmers have both willingness and behavior in relation to garbage classification.

5.4. Endogeneity Test

The results in Table 4 show that the internet use rate of villages significantly affects the internet use of rural households, following the correlation characteristics of instrumental variables. The F-value of the first stage is 68.38, which is higher than the critical value of 10. The Wald endogeneity test p-value and AR test p-value were all less than 0.01 in the test of weak instrumental variables in the IV-probit model, which excluded the problem of weak instrumental variables. The selected instrumental variables in this paper are reasonable, and the original model has endogeneity problems. The results show that after eliminating the endogeneity, the impact of internet use on farmers' garbage classification and behavior is still significantly positive at the 1% confidence level, and the regression coefficients are 0.986 and 2.262.

Table 4. Results of the endogeneity test.

Variables	Internet Use		Garbage Classification Willingness		Garbage Classification Behavior	
	Coefficient	Std. Err.	Coefficient	Std. Err.	Coefficient	Std. Err.
Internet usage rate	0.757 ***	0.068				
Internet use			0.986 ***	0.381	2.262 ***	0.325
Control variables	Yes		Yes		Yes	
chi2			58.093		122.271	
The first-stage F value			68.38		68.38	
Wald test (*p* value)			6.68 (0.0098)		48.52 (0.0000)	
Weak IV AR Test (*p* value)			6.83 (0.0090)		70.79 (0.0000)	
N			2228			

Note: ***, **, and * indicate significance levels of 1%, 5%, and 10%, respectively.

5.5. Robustness Test

Since the no bivariate regression model is similar to the bivariate probit model, this paper relaxes the assumption that internet use is related to the disturbance term in willingness and behavior. It then uses the probit model to test its robustness. According to the robustness test results in Table 5, the implications implied by the regression results of the probit model are consistent with the benchmark regression results of the bivariate probit model. That is, internet use can affect farmers' willingness and behavior in relation to garbage classification to a certain extent. The higher the level of internet use, the higher the probability of farmers' willingness and behavior in relation to garbage classification at the same time.

Table 5. Results of the robustness test.

Variables	Garbage Classification Willingness				Garbage Classification Behavior			
	Coefficient	Std. Err.	Marginal Effect	Std. Err.	Coefficient	Std. Err.	Marginal Effect	Std. Err.
Internet use	0.331 ***	0.086	0.055 ***	0.014	0.325 ***	0.022	0.123 ***	0.022
Control variables	Yes				Yes			
chi2	74.706				142.710			
Pseudo R2	0.0510				0.0467			
N	2228				2228			

Note: ***, **, and * indicate significance levels of 1%, 5%, and 10%, respectively.

5.6. Heterogeneity Analysis of Different Internet Access Modes

In addition, according to the different internet access modes of farmers, this paper further divided internet use into three internet access modes: mobile internet access, computer internet access, and mixed internet access in order to further analyze the influence

of different internet access channels on farmers 'garbage classification willingness and behavior. The estimation results are shown in Table 6. Mobile internet has a positive and significant impact on farmers' willingness and behavior in relation to garbage classification, indicating that the farmers' use of mobile internet can still improve their willingness and behavior for participating in household garbage classification. Secondly, computer access to the internet does not have a significant impact on farmers' willingness and behavior in relation to household garbage classification, which may be due to the low popularity of computers and the high threshold for use. On the one hand, fewer households in rural areas use computers and they can only use them in fixed locations. On the other hand, computer access to the internet often requires users to have certain knowledge and skills, hindering the dissemination efficiency of domestic garbage classification information based on computer access to the internet. Finally, the mixed internet access mode also had a positive impact on the garbage classification and behavior of farmers, possibly because the influence of internet use on garbage classification willingness and behavior was more affected by the mobile internet access mode. The characteristics of simple operation and convenient access of smart phones are easier to be accepted and used by farmers.

Table 6. Estimation results of the influence of different online ways on farmers' willingness and behavior in relation to garbage classification.

Access to the Internet	Garbage Classification Willingness	Garbage Classification Behavior	Garbage Classification Willingness	Garbage Classification Behavior	Garbage Classification Willingness	Garbage Classification Behavior
Mobile internet access	0.342 *** (0.085)	0.232 *** (0.059)				
Computer internet access			−0.281 (0.198)	0.166 (0.162)		
Mixed internet access					0.649 * (0.376)	0.509 *** (0.166)
Control variables	Yes		Yes		Yes	
athrho	1.036 *** (0.081)		1.028 *** (0.081)		1.033 *** (0.081)	
Wald test (p value)	0.000		0.000		0.000	
Log pseudolikelihood	−2029.494		−2039.4788		−2035.9522	
chi2	145.567		164.712		142.394	

Note: ***, **, and * indicate significance levels of 1%, 5%, and 10%, respectively.

5.7. Mechanism Analysis

According to the theoretical analysis, internet use can improve farmers' garbage classification cognition, then improve and promote farmers' garbage classification willingness and behavior. The verification test results are shown in Table 7. In terms of knowledge cognition, according to Model 1, internet use can significantly affect knowledge cognition. Furthermore, internet use and knowledge cognition were used to jointly test the willingness and behavior of farmers 'garbage classification. The results show that internet use is significantly correlated with garbage classification willingness, and knowledge cognition is significantly correlated with garbage classification willingness (Model 2). Internet use and garbage classification behavior, and knowledge cognition and garbage classification behavior, are also significantly correlated (Model 3). Therefore, the mediating effect of knowledge cognition on the impact of internet use on farmers' garbage classification willingness and behavior was significant, and had a partial mediating effect. Specifically, the mediating effect of knowledge cognition on farmers' garbage classification willingness was 71.48%, and the mediating effect of knowledge cognition on farmers' garbage classification behavior was 89.47%. Similarly, behavioral cognition and environmental cognition also have partial mediating effects. Specifically, the mediating effects of behavioral cognition and environmental cognition on farmers' garbage classification willingness were 21.72% and 40.49%, and the mediating effects of behavioral cognition and environmental cognition on farmers 'garbage classification behavior were 8.89% and 18.81%.

Table 7. Analysis of the mediating effect of garbage classification willingness and behavior.

Variables	Internet Use → Knowledge Cognition n → Garbage Classification Willingness and Behavior			Internet Use → Behavioral Cognition → Garbage Classification Willingness and Behavior			Internet Use → Environmental Cognition → Garbage Classification Willingness and Behavior		
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**	**Model 9**
	Knowledge Cognition	**Garbage Classification Willingness**	**Garbage Classification Behavior**	**Behavioral Cognition**	**Garbage Classification Willingness**	**Garbage Classification Behavior**	**Environmental Cognition**	**Garbage Classification Willingness**	**Garbage Classification Behavior**
Internet use	0.549 *** (0.085)	0.200 ** (0.090)	0.179 *** (0.063)	0.187 ** (0.089)	0.321 *** (0.086)	0.312 *** (0.059)	0.311 *** (0.090)	0.307 *** (0.088)	0.302 *** (0.060)
Knowledge cognition		0.444 *** (0.037)	0.528 *** (0.028)						
Behavioral cognition					0.396 *** (0.041)	0.154 *** (0.032)			
Environmental cognition								0.444 *** (0.036)	0.196 *** (0.029)
Control variables		Yes			Yes			Yes	
athrho		0.864 *** (0.084)			1.017 *** (0.083)			1.023 *** (0.086)	
Wald test (*p* value)		0.0000			0.0000			0.0000	
Log pseudolikelihood		157.441			243.228			232.206	
Chi2	341.352	560.568		81.716	255.588		99.153	315.867	
N		2228			2228			2228	

Note: ***, **, and * indicate significance levels of 1%, 5%, and 10%, respectively. Proportion of mediating effect = (indirect effect/total effect) ×100% (Proportion of mediating effect of knowledge cognition on internet use and garbage classification willingness: (0.549 × 0.444)/0.341 = 71.48%; proportion of mediating effect of knowledge cognition on internet use and garbage classification behavior: (0.549 × 0.528)/0.324 = 89.47%; proportion of mediating effect of behavioral cognition on internet use and garbage classification willingness: (0.187 × 0.396)/0.341 = 21.72; proportion of mediating effect of behavioral cognition on internet use and garbage classification behavior: (0.187 × 0.154)/0.324 = 8.89%; proportion of mediating effect of environmental cognition on internet use and garbage classification willingness: (0.311 × 0.444)/0.341 = 40.49%; proportion of mediating effect of environmental cognition on internet use and garbage classification behavior: (0.311 × 0.196)/0.324 = 18.81%).

The above analysis verifies the influence path of "internet use-garbage classification cognition-garbage classification willingness and behavior," and H2, H3, and H4 hold. This conclusion is consistent with the research results of Peng et al. [16] and Stern et al. [4]. They proposed that the internet can reduce the gap between residents' environmental protection attitude and environmental protection behavior as well as the gap between environmental protection literacy and environmental protection behavior. It is also proposed that the inducing mechanism of internet use on environmental protection attitude and environmental protection literacy comes from risk cognition and knowledge reserving.

6. Conclusions and Policy Recommendations

With increasing attention being directed to the problem of garbage around the world, garbage classification has become an essential part of sustainable development. Based on the survey data of 2228 farmers in Jiangsu province collected by the 2021 China Land Economic Survey, this paper systematically investigated the influence of farmers' internet use on domestic garbage classification willingness and behavior. Furthermore, this paper extended the analysis from the perspective of farmers' garbage classification cognition and discussed the relationship between internet use and the differences between classification willingness and behavior. The results show that: (1) the overall proportion of farmers using the internet is low: 46%. The number of farmers participating in garbage classification (53%) was less than those willing to do garbage classification (90%). There was a particular deviation between garbage classification willingness and behavior. (2) Internet use consistently and significantly positively impacts farmers' garbage classification willingness and classification behavior. It can promote the transformation of farmers' garbage classification willingness to behavior and reduce the deviation between willingness and behavior. Specifically, when internet use increased by 1 unit, the probability of farmers not having the willingness and behavior of garbage classification, having both the willingness and behavior of garbage classification, and only having the willingness of garbage classification but not having the behavior of garbage classification decreased by 5.4%, increased by 13%, and decreased by 7.5%, respectively. (3) Further analysis according to different internet access methods shows that mobile internet access and mixed internet access can have a positive impact on farmers' willingness and behavior in relation to garbage classification, while computer internet access has no significant impact on farmers' willingness and behavior in relation to garbage classification. (4) The mechanism analysis shows that the internet and garbage classification willingness, and internet use and garbage classification behavior, all have partial mediating effects on garbage classification cognition. Specifically, internet use can continuously improve their knowledge, behavior, and environmental cognition, thereby improving and promoting their garbage classification willingness and behavior.

Based on this, this paper makes the following suggestions: First, we need to strengthen the hardware and software development of the internet. Hardware construction refers to strengthening internet infrastructure in rural areas, opening up the last kilometer of green environmental protection information to villages and households, increasing internet usage, and narrowing the digital divide between urban and rural areas. It is worth mentioning that, because the development of the internet in different regions is not the same, it is necessary to formulate plans according to local conditions in different regions. For example, the central and eastern regions can deeply tap the value of the internet, promote the whole chain digital management of garbage classification, and improve the digital governance ability of rural environments. For the western region, it is necessary to continuously improve the construction of information infrastructure, increase network terminal equipment, and improve the coverage rate of broadband. Moreover, we can promote the popularization of smart phones in rural areas through measures such as mobile phones going to the countryside, broadband speed setup and fee reductions, and strive to solve the problems of "expensive internet access", "unstable signal", and "difficult internet access" for rural residents, better meet the new requirements for network quality such as online classes and home office, and release the promotion effect of informatization on rural social and

economic development. Software construction refers to the proper guidance and publicity of using the internet and the cultivation of farmers 'awareness. Especially for farmers with lower education and of an older age, internet information technology should be improved to have the essential information acquisition and application ability. In addition, it should play the main role of rural revitalization. For example, the leading role of college students, village officials, volunteers, and village leaders can be used to teach rural "internet beginners" on a one-to-one basis, help farmers solve the problems existing in the use of smart phones at any time, understand and use the relevant APP software or information platform about environmental protection, and truly utilize the role of the internet. Second, the "online + offline" method is adopted to promote rural garbage classification in a diversified way. For example, in addition to offline knowledge training, information related to garbage classification can also be released through the mass media, and public welfare application software related to garbage classification can be developed. By improving farmers' awareness of environmental protection and environmental responsibility, the consistency of farmers' willingness and behavior can be improved, and the integration of knowledge and the practice of garbage classification can be realized. At the same time, it is worth mentioning that there are often members of different age groups within the family, so different publicity methods can be used for different groups. For example, for students, we can carry out garbage classification competitions with schools. For middle-aged groups, we can implement a "garbage classification point system" in the community, and the points obtained by actively participating in garbage classification can be used for free in exchange for physical goods and direct reward money.

The shortcomings of this paper are as follows: firstly, it only considers whether to use the internet. In contrast, different ways of using the internet and different levels of internet may use have different effects on farmers' garbage classification willingness and behaviors. Secondly, this paper focuses on the influence of internet use on farmers 'garbage classification willingness and behavior, and how the influence and mechanism between farmers 'garbage classification willingness and behavior need further in-depth research in the future.

Author Contributions: Conceptualization, F.Z., J.H., Y.C. and D.X.; methodology, F.Z., D.X. and C.Q.; formal analysis, F.Z. and Y.C; investigation, J.H. and D.X.; writing—original draft preparation, F.Z. and D.X.; writing—review and editing, F.Z. and D.X.; supervision, D.X.; funding acquisition, D.X. All authors have read and agreed to the published version of the manuscript.

Funding: We gratefully acknowledge financial support from Special Program for Cultivating Excellent Young Talents under the Dual Support Plan of Sichuan Agricultural University, Key research base project of Sichuan Province Philosophy and Social Science (SC22EZD038) and Research interest Training program for College students (2121993005).

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

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