

## Article

# Why “Say One Thing and Do Another” a Study on the Contradiction between Farmers’ Intention and Behavior of Garbage Classification

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**Abstract:** How to protect the ecological environment is an important international issue for achieving the sustainable development goals. Using survey data of 2628 farmers in 52 administrative villages in 13 prefecture-level cities of the China Land Economic Survey in 2020, probit and multinomial logistic regression models were used to explore the influence of social capital on farmers’ willingness, behavior and the transformation between willingness and behavior. The results show that: (1) The consistency between farmers’ willingness and behavior is low; 90.25% of farmers had the willingness to separate waste, but only 48.49% of farmers had actually classified waste, and only 48.22% of farmers had transformed willingness into behavior. (2) Among the three dimensions of social capital, social network, social norm and social trust, all had positive and significant effects on farmers’ willingness and behavior to separate waste. (3) Social network and social norm had a positive and significant impact on the transformation of farmers’ willingness to separate waste into behavior, but social trust was not significant. The research results confirm that the contradiction between farmers’ intention and behavior of waste separation were generally inconsistent in rural areas. At the same time, the results showed that social capital can promote farmers’ willingness and behavior of waste separation and the transformation from a willingness to behavior, which can provide decision-making reference for how to improve farmers’ high willingness and behavior.

**Keywords:** social capital; waste separation; willingness and behavior; influencing factors

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## 1. Introduction

With the development of the world economy, and with living and consumption standards gradually increasing, the total amount of waste is increasing day by day [1,2], which poses a great threat to the ecological environment [3,4]. This phenomenon is particularly evident in China, the world’s largest developing economy with the biggest population [5,6]. The rural living environmental improvement has become an urgent problem for the construction of beautiful villages [7,8]. Since the 1990s, China has been exploring “front-end waste reduction and separation” experimental work. Later, the Chinese government released the “Three-Year Action Plan on Improving Rural Living Environment (2018–2020)”, the “Five-Year Action Plan on Improving Rural Living Environment (2021–2025)”, and a series of policies. These policies have achieved good results in promoting rural waste separation, source reduction and harmless treatment [9]. According to the latest statistics from the Ministry of Agriculture and Rural Affairs and Housing and Urban-rural Development of the People’s Republic of China, China’s rural household waste collection and transportation system had covered more than 90% of administrative villages nationwide by the end of 2020. However, waste separation and treatment are still at a low level in

some rural areas. According to statistics, although the rural waste treatment rate is 84.35%, the harmless treatment rate is only 47.48%. Garbage has attributes to public goods and services. Because of the imperfect management mechanism and asymmetric information rights and responsibilities in rural waste separation and treatment, farmers have insufficient enthusiasm and motivation to participate, and they are unwilling to take action even if they have willingness [10]. This often reflects the gap between the superficial form of theoretical “say one thing” rather than practical “do” [11]. One of the important reasons lies in the lack of farmers’ awareness and behavior, resulting in inconsistencies of cognitive and behavioral decision making [11,12]. How to promote the transformation from willingness to behavior plays an important role in promoting the process of rural waste separation. What factors affect farmers’ willingness and behavior on waste separation? Why did farmers’ willingness not turn into actual behavior in the end, and what caused the contradiction between willingness and behavior? This is the main research problem in our study. Rural governance is a process in which government forces and farmers in public space act together [13]. Therefore, it is necessary to stand in the perspective of farmers to further explore the constraints affecting farmers’ waste separation.

Waste separation is defined as the management method of collecting, storing and transferring waste according to certain standards [14,15]. At present, there have been many studies on waste separation in academia, mainly focusing on the following aspects: In the section of the effect of waste separation, farmers generally have a strong willingness to classify waste, but the initiative to adopt the actual behavior is not strong [6,16]. As for the research content, most of the studies focus on the study of Chinese cities, ignoring the attention to the problem of rural waste separation [3,17,18]. In the limited studies on rural areas, scholars only focus on farmers’ willingness to participate in waste separation [19–21] or behavior [21–23], but few studies focus on the transformation of waste separation willingness to behavior. In terms of factors affecting waste separation, scholars mostly focus on farmers’ individual characteristics [24], environmental attitudes [25] and family characteristics [26]. In terms of emerging influencing factors, some scholars have studied the influence of related factors such as consumption trust in organic food [27], sharing economy [28], COVID-19 pandemic and climate change [29,30]. However, few studies have explored the perspective of social capital and focus on the influence of social capital on farmers’ willingness to classify waste, behavior and the consistency of willingness and behavior.

Compared with the existing research, the marginal contributions of this study include: (1) In the research on waste separation, there is no consistent conclusion on the willingness and behavior of separation at present [23,26]. Moreover, we find that the contradiction between will and behavior is widespread, and the academic community lacks a deeper understanding of the conflict between them [8,15]. Therefore, this paper is a supplement to the research in this field. (2) From the existing research, few studies start with the theory of social capital to explore the impact on the willingness and behavior of waste separation. Based on this, this paper innovatively builds a theoretical analysis framework of the impact of social capital on waste separation, which can better explain which factors have an impact on waste separation. Furthermore, the research results of this paper can provide a decision-making reference for the formulation of public governance and waste separation policies in other countries in the world. Especially when in the face of rapid economic development and an environmentally sustainable coordination dilemma, it is suitable for rural decentralized management; per capita public resources are tight, and the level of economic development is low in the vast developing countries and regions.

The structure of this paper is as follows: The second section introduces the gap between the willingness and behavior in theory and practice under the background of waste separation as a public product and analyzes its possible influence on farmers’ participation in waste separation from the perspective of social capital theory. Section 3 details the data and model setup. Section 4 discusses the impact of social capital on farmers’ participation

in waste separation, including factor analysis, model regression and robustness test. Finally, Section 5 provides conclusions and policy implications.

## 2. Theoretical Analysis

Traditional economics holds that public goods are non-exclusive and non-competitive, and the supply of public goods has many disadvantages such as low efficiency, shortage and low quality [31]. Rural domestic garbage has the attribute of public goods, and everyone can enjoy the benefits brought by this service. However, some people do not follow the methods and principles of waste separation, which make the environmental pollution problems and treatment “externalities” [26]. Generally speaking, environmental governance is a problem of public goods decision making, and public participation in rural ecological environment governance in developing countries is in a state of high attention and low participation [5,32]. On the issue of village internal motivation, Yaghoubi Farani et al. [11] found that the attitude of environmental responsibility has a positive impact on farmers’ environmental protection behavior by studying Iranian farmers’ environmental responsibility attitude and behavior, and some scholars found that the organizational function of farmers’ professional cooperatives can also obviously promote farmers’ environmental protection awareness and participation ability [33]. On the issue of village external power, Moyes et al. [34] evaluated rural public goods in mountainous areas of Sichuan Province, China. It was concluded that the village-level democratic system has gradually become the key factor affecting public decision making. Rural environmental governance can be realized by using social capital. Rural organizations and norms are based on appropriate institutional arrangements, mutual agreements, and common understanding, and the identity of rural social collective identity can affect whether individuals will participate in public governance [7,35]. For this dilemma of public collective action, Li Yongmei [32] pointed out that rural areas can strengthen exogenous motivation and increase endogenous motivation by cultivating rural social capital [31,36].

Social capital is the basis for organizations to achieve collective and cooperative behavior, with social network, social norm and social trust as core elements [37,38]. Social capital theory emphasizes the action outcomes obtained by individuals using social structures to obtain scarce resources when trust, norm, and sanctions are in play [39–41]. Social relationships are an important foundation for rural environmental improvement [42,43], and social capital can be used to achieve improvement of the rural environment by playing the role of social trust, social participation, social norm and social network [44–46]. Therefore, this paper constructed the influence of social capital on farmers’ participation in waste separation through three dimensions of social capital: social trust, social network and social norm. Therefore, we propose that social capital has a positive impact on the transformation from a willingness to behavior, which is hypothesis H4.

Social trust is a mutual trust relationship established between individuals through interaction, communication and common awareness, which generally include two aspects: interpersonal trust and institutional trust [47]. Among them, interpersonal trust is mainly manifested as farmers’ trust in their relatives and neighbors, which is formed through interactions in daily production and life with affinity, geopolitical relations and blood ties [48]. It can eliminate the risk of uncertainty in participation and decision [49,50]. Institutional trust is mainly expressed as farmers’ trust in village cadres and legal norms [51]. He [52] and Du et al. [53] found that when farmers have trust in institutions, they will respond positively and participate in village environmental management. Therefore, we propose hypothesis H1.

Social network refers to the relational network formed by each member in society due to identity association [54,55]. Social networks can reduce the transaction costs of farmers’ decision making through information sharing and mutual assistance in resources, and it forms a collective environmental awareness [34,56]. Conversely, social networks can promote the dissemination and exchange of members’ information and resources and thus

enhance individual environmental protection awareness and behavior [4,57]. Thus, we establish hypothesis H2.

Social norm means that individuals are bound by their social environment [58]. This restriction can positively influence individual awareness and behavior, playing a facilitating and monitoring role [59,60]. Conversely, this restriction can enhance the predictability of decisions and motivate individuals to implement waste separation behavior through reward and punishment mechanisms [61]. Thus, we propose hypothesis H3.

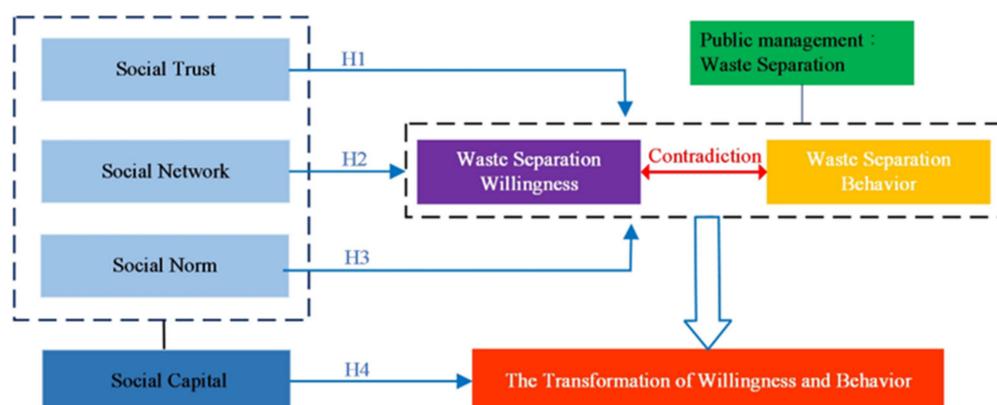
This paper proposes the following research hypotheses (Figure 1):

**H1.** *The higher the degree of social trust, the stronger the willingness and behavior of farmers to participate in waste separation.*

**H2.** *The higher the degree of social network, the stronger the willingness and behavior of farmers to participate in waste separation.*

**H3.** *The higher the degree of social norm, the stronger the willingness and behavior of farmers to participate in waste separation.*

**H4.** *The higher the degree of social capital, the stronger the transformation between willingness and behavior of farmers to participate in waste separation.*



**Figure 1.** Conceptual framework.

### 3. Data and Methods

#### 3.1. Data

The data used in this paper are from the China Land Economy Survey in 2020. The survey was established in 2020. The observation samples are tracked every year in Jiangsu Province covering all 13 prefecture-level cities. Jiangsu Province has a total area of 102,600 km<sup>2</sup>, and the total resident population exceeded 84.773 million by 2020, making it the province with the highest population density in China. Jiangsu is located in the east of China, in the Yangtze River Delta region, with the fastest economic development and the most vitality in China. It is the second highest and highest province in China's gross domestic product (GDP) and per capita GDP, respectively. Specifically, the total GDP in 2020 exceeded 10.28 trillion CNY (1 CNY = 0.15 USD). The survey was conducted at two levels of farmers and villages with questionnaires. It covered agricultural production, factor markets, green development, financial insurance, rural governance and construction. The survey used the PPS sampling method for sampling. The sampling implementation steps are as follows: First, the research districts and counties were selected using unequal probability sampling, based on the proportion of the number of rural population in the 2010 census of each district and county to the rural population of the prefecture-level city to which they belong, and two districts and counties were selected from each prefecture-level city in Jiangsu. Second, based on the proportion of the number of administrative villages and town streets in the sample districts and counties, two townships were selected

from each sample district and county. Then, one administrative village was selected from each sample township, totaling 52 villages; finally, 50 farming households were selected from each sample village by simple random sampling method. In order to study the influence of social capital on the transformation of farmers' willingness and behavior to separate waste, this paper selects farmers' questionnaires for analysis. Through data cleaning, we finally obtained the sample data of 2628 farmers in 52 administrative villages in 13 prefecture-level cities.

The samples have the following characteristics: the male is the main factor, accounting for 70.13%; mainly middle-aged and elderly people, with an average age of 61.05 years; most of them have received primary education, with an average length of education of 6.90 years; most of them are small- and medium-sized families with 2–5 people, accounting for 80.65% of the total, and each family has an average of three members; most families are low- and middle-income families, and 55.94% of them have an annual income between CNY 15,000 and 150,000; farmers generally have a high degree of awareness of waste separation and function, with an average of 3 and above.

### 3.2. Variable Description

Willingness, behavior and the transformation of willingness and behavior of farmers to participate in waste separation are the explained variables in this paper, which describe the process of transforming farmers' willingness into behavior. Willingness and behavior refer to the answer of "Are you willing to separate household waste?" and "Do you separate your household waste?", with 1 for "Yes" and 0 for "No". Furthermore, "the transformation between willingness and behavior" is based on the answers to the above two questions. If the answer is "with willingness and behavior", the value is 2, "no willingness, no behavior" is 1, and "with willingness, no behavior" is 0.

Social capital is the core independent variable of this paper. Referring to the analytical frameworks of Ostrom [31] and Zhao [62], this study divided social capital into three dimensions: social trust, social network and social norm, which are measured as follows: (1) Social trust: based on Wang et al. [36] and Huhe et al. [63], social trust was measured by the degree of trust in relatives, neighbors and village cadres in the daily production and life of farmers. (2) Social network: referring to Shi et al. [64], social network of farmers is reflected by their ability to obtain resources, which includes the following two indicators: "the number of cell phone contacts" and "the number of people who can borrow CNY 50,000 in case of difficulties". (3) Social norm. Referring to Du et al. [65], "Does the government publicize the separation of rural household waste?" and "Does the government reward and penalize rural household waste separation?" were used to measure the social norm.

To minimize the influence of omitted variables on farmers' willingness and behavior to separate waste, control variables were selected in this paper to further examine the influence between variables. They are divided into the following three categories: (1) individual characteristics, including interviewees' age, gender and education level [8,24]; (2) household characteristics, including population [26] and annual cash income [65–67]; (3) environmental awareness, including interviewees' awareness level of rural waste separation and environmental improvement by rural waste separation [68,69]. Finally, farmers in different regional conditions may influence farmers' willingness and behavior to participate in waste separation [70,71]. This paper included regional dummy variables to control for regional differences. The definition of each variable is shown in Table 1.

**Table 1.** Variable definition and descriptive statistics.

Variables	Observed Variables	Definition
Farmers' willingness and behavior to separate waste	Waste separation willingness	Are you willing to separate household waste? (0 = No; 1 = Yes)
	Waste separation behavior	Do you separate your household waste? (0 = No; 1 = Yes)
	The transformation of willingness and behavior	Willingness and behavior transformation of waste separation (0 = willingness not transformed into behavior; 1 = willingness unconverted into behavior; 2 = willingness converted into behavior)
Social trust	Relatives trust	Level of trust in relatives (1 = very distrustful; 2 = relatively distrustful; 3 = average; 4 = relatively trusting; 5 = very trusting)
	Neighborhoods trust	Level of trust in neighborhoods (1 = very distrustful; 2 = relatively distrustful; 3 = average; 4 = relatively trusting; 5 = very trusting)
	Village cadres trust	Level of trust in village cadres (1 = very distrustful; 2 = relatively distrustful; 3 = average; 4 = relatively trusting; 5 = very trusting)
Social network	Number of cell phone contacts	The number of cell phone contacts (Person)
	Number of people who can borrow 50,000 Yuan in trouble	The number of people who can borrow 50,000 Yuan when you in case of difficulties (Person)
Social norm	Rural waste separation publicity	Does the government publicize the separation of rural household waste? (0 = No; 1 = Yes)
	Rural waste separation rewards and punishments	Does the government reward and penalize rural household waste separation? (1 = Yes; 0 = No)
Individual characteristics	Gender	Gender of interviewee (0 = Female; 1 = Male)
	Age	Age of interviewee (Year)
	Education	Years of education of interviewee (Year)
Household characteristics	Population	Total family population living at home for 6 months or more of year-round (Person)
	Income	The annual income of the family (CNY)
Environmental awareness	Awareness level of rural waste separation	Do you know how to sort rural waste? (1 = have not heard of it; 2 = just heard of it, not really; 3 = know a little; 4 = know better; 5 = know very well)
	Awareness level of perception of environmental improvement by rural waste separation	Do you agree that the separation of waste has a positive effect on the improvement of the rural environment? (1 = completely disagree; 2 = not quite agree; 3 = fairly agree; 4 = more agree; 5 = completely agree)

### 3.3. Econometric Mode

In this paper, factor analysis and regression analysis are used. First, because there are many indicators involved in each variable, factor analysis is usually used to describe most of the information of the original indicators with a few factors [72]. Principal component analysis was used to reduce the dimensions of seven indicators of social capital, and then, the scores of each factor were included in probit and multinomial logistic regression models of willingness and behavior as core explanatory variables, and control variables and regional dummy variables were added to further investigate the factors affecting farmers' willingness and behavior of waste separation. This is consistent with the analytical method of Alzamora-Ruiz, et al. [73].

### 3.3.1. Principal Component Analysis

Suppose primitive variables are represented by  $u_1, u_2, \dots, u_m$  (mean value is 0, standard deviation is 1), factors  $x_1, x_2, \dots, x_n$  are represented by linear combination. Simplify and reduce the dimension of original variables [74]. The model is as follows:

$$\begin{aligned} u_1 &= \alpha_{11}x_1 + \alpha_{12}x_2 + \dots + \alpha_{1n}x_n + \varepsilon_1 \\ u_2 &= \alpha_{21}x_1 + \alpha_{22}x_2 + \dots + \alpha_{2n}x_n + \varepsilon_2 \\ &\dots \\ u_m &= \alpha_{m1}x_1 + \alpha_{m2}x_2 + \dots + \alpha_{mn}x_k + \varepsilon_m \end{aligned}$$

The matrix form is:

$$U_{mn} = AX + \varepsilon = V_{mn} + \varepsilon \tag{1}$$

The individual farmer is assumed to have a utility function of the form:

$$U_{mn} = V(x_n) + \varepsilon(x_n, Z_m) \tag{2}$$

where  $V$  is the utility function,  $x$  is the social capital attributes, matrix  $A$  is the factor loading matrix, while  $Z$  represents the farmer’s attributes. Farmers will be influenced by various other socio-economic factors in the decision making of waste separation. Thus, a random factor  $\varepsilon$  is included as a component to explain such variances in decisions [75].

In this paper, the factor extraction method is based on the principle components that the eigenvalue is greater than 1. This method can reduce the dimension of input variables and identify important factors when the data set contains a large number of necessary factors [74]. The contribution rate of variance of each factor is:  $\frac{\lambda_i}{\sum_{i=1}^p \lambda_i}$ . The weight calculation is:  $V_i = \lambda_i \left( \sum_{i=1}^p \lambda_i \right)^{-1}$ . Finally, according to the scores and weights of each public factor, the comprehensive evaluation value of the social capital of the  $i$ -th farmer can be calculated:  $\theta = \sum v_i x_i$ , which is the quantitative value of the social capital of the first farmer and its three-dimensional indexes.

### 3.3.2. Probit and Multinomial Logistic Regression Models

For the dependent variables, “waste separation willingness” and “waste separation behavior” are dichotomous variables. Based on Han, Z. et al. [19], a binary probit model was used to investigate the influence of social capital on farmers’ willingness and behavior to separate waste. The model is as follows:

$$Y = \ln\left(\frac{P_i}{1 - P_i}\right) = \alpha_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n + \varepsilon \tag{3}$$

where  $P_i$  is the probability of farmers’ waste separation willingness or behavior;  $\alpha_0$  is a constant term;  $X_1 \dots X_i$  are independent variables, including core independent variables, control variables and regional dummy variables;  $\beta_1 \dots \beta_i$  are regression coefficients;  $\varepsilon$  is a random disturbance term.

Considering the transformation between farmers’ willingness and behavior to separate waste as a probability event, there are three states in the formation process of this event. They include “with willingness and behavior ( $Y = 2$ )” “with willingness, no behavior ( $Y = 1$ )” and “no willingness, no behavior ( $Y = 0$ )”. Based on Luo, H. et al. [61] and Andati, P. et al. [74], multinomial logistic regression models were used to explore the influence of social capital on the consistency of household waste separation willingness and behavior. The model is constructed as follows:

$$P_i(Y = i|X) = \frac{\exp\left(-\alpha_i + \sum_{j=1}^n \beta_j X_j\right)}{1 + \exp\left(-\alpha_i + \sum_{j=1}^n \beta_j X_j\right)} \tag{4}$$

Among them,  $i = 1, 2, 3$ ;  $P_1 + P_2 + P_3 = 1$ ;  $j = 1, 2, \dots, n$ ;  $\alpha$  is a constant term;  $\beta_j$  is the regression coefficient of the independent variable;  $X = (X_1, X_2, \dots, X_n)$  is the set of variables affecting farmers' willingness and behavior.

#### 4. Results

##### 4.1. Analysis of Waste Separation Willingness and Behavior

Table 2 shows the results of descriptive statistics of farmers' willingness and behavior to separate waste. We found that 90.25% of farmers had the willingness to separate waste, but only 48.49% of farmers had actually classified waste, and only 48.22% of farmers had transformed willingness into behavior. While the proportion of willingness not transformed into behavior was 42.29%. It shows that the transformation rate of farmers is not high. There is a distinct mismatch between high willingness and low behavior. Furthermore, we named the three indicators of social capital obtained by factor analysis, which are higher than the average value, as high social trust, high social network and high social norm. As shown in Table 2, farmers with high social capital have stronger willingness, behavior and transformation between willingness and behavior to participate in waste separation. In particular, social norms are the most likely to translate willingness into behavior, with a total of 826.

**Table 2.** Descriptive statistics of willingness and behavior.

Variables	Waste Separation Willingness	Waste Separation Behavior	The Transformation of Willingness and Behavior	Total
High social trust	1036	673	666	1479
High social network	1465	669	666	1669
High social norm	1647	830	826	1865
Samples	2360	1268	1261	2628
Proportion	90.25%	48.49%	48.22%	100%

##### 4.2. Factor Analysis of Social Capital Affecting Rural Waste Separation

The results of component matrixes for the respective components of sense of place after rotation are shown in Table 3. First, the Kaiser–Mayer–Olkin (KMO) and Bartlett's test of sphericity were used to evaluate the validity of data. The KMO value is 0.679, and the  $p$  value of Bartlett's test of sphericity is 0.000, which indicates that it is suitable for factor analysis [65,72]. Based on the principal component analysis method to extract factors, we selected the eigenvalues greater than 1. Then, the orthogonal rotation method was used to solve the factor loading matrix to reduce the dimensionality of the seven indicators of social capital and to extract the factors (to simplify it, they were numbered as indicators Q1–Q7). The results show that the seven indicators extracted three factors named social trust, social norm and social network. The value of each factor is used as the core explanatory variable in the probit and multinomial logistic regression models.

**Table 3.** Component matrixes for respective components of sense of place after rotation.

Items	Components		
	Social Trust	Social Norm	Social Network
Q1	0.879	0.028	0.019
Q2	0.841	0.014	−0.004
Q3	0.790	0.105	0.047
Q4	0.012	0.793	0.001
Q5	0.092	0.762	0.067
Q6	0.016	−0.002	0.756
Q7	0.024	0.065	0.728
Eigenvalue	2.168	1.234	1.047
Explained variance (%)	30.196	17.530	15.825
Cumulative variance (%)	30.196	47.726	63.551

#### 4.3. The Influence of Social Capital on Farmers' Willingness and Behavior of Waste Separation

Table 4 shows the effect of social capital on the willingness and behavior of farm households to separate waste. As shown by the results of the significance test, the models are all significant at the 0.01 level. This indicates that at least one of the independent variables is significantly correlated with the dependent variables. For purposes of interpreting these coefficients, the results in Table 3 show the marginal effects of the model.

**Table 4.** Effect of social capital on the willingness and behavior of farm households to separate waste.

Variables	Waste Separation Willingness	Waste Separation Behavior	The Transformation of Willingness and Behavior	
			Willingness Unconverted Behavior	Willingness Converted Behavior
Social trust	0.016 ** (0.006)	0.015 (0.012)	−0.004 (0.010)	0.019 (0.012)
Social network	0.039 *** (0.008)	0.105 *** (0.010)	−0.063 *** (0.011)	0.106 *** (0.009)
Social norm	0.075 *** (0.023)	0.013 * (0.007)	0.051 ** (0.024)	0.041 *** (0.011)
Gender	−0.006 (0.014)	−0.038 (0.033)	0.026 (0.028)	−0.035 (0.033)
Age	0.000 (0.001)	−0.002 * (0.001)	0.002 (0.001)	−0.002 (0.001)
Education	0.001 (0.001)	0.001 (0.003)	0.001 (0.003)	0.000 (0.002)
Population	−0.002 (0.004)	−0.009 (0.008)	0.005 (0.006)	−0.008 (0.008)
Income	0.005 (0.005)	0.016** (0.006)	−0.013 * (0.007)	0.016 ** (0.006)
Awareness level of rural waste separation	0.031 *** (0.007)	0.104 *** (0.009)	−0.078 *** (0.012)	0.106 *** (0.009)
Awareness level of perception of environmental improvement by rural waste separation	0.044 *** (0.006)	0.012 (0.014)	0.036 *** (0.013)	0.006 (0.014)
Regional dummies	Yes	Yes	Yes	Yes
Pseudo R2	0.2966	0.2282	0.2354	0.2354
N	2503	2503	2503	2503

Note: \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

In terms of willingness to separate waste, among the three dimensions of social capital, social network, social norm and social trust, they all had positive and significant effects on farmers' willingness and behavior to separate waste. Specifically, for each unit increase in social trust, social network and social norm, farmers' willingness to separate waste increased by 1.6%, 3.9% and 7.5% on average. In terms of waste separation behavior, social network and social norm have a positive and significant effect on it, while social trust has a positive but insignificant correlation. In particular, for each unit increase in social network and social norm, the probability of participating in waste separation behavior increased by 10.5% and 1.3%, all other things being equal. This result is similar to Nguyen and Watanabe's [69] research on rural waste separation in Vietnam. Networks and norms in social capital have a positive role in promoting separation behavior. The possible reason is that the closer the social connection, the more information, technology and economic resources the farmers can obtain. At the same time, the better the implementation of policies and systems, the more action farmers will take. This confirms our previous hypotheses H2 and H3.

In terms of the transformation between willingness and behavior, compared to the no-willingness-no-behavior group, the increase in social network suppresses the probability of transformation from "willingness unconverted behavior" to "willingness converted behavior", and social norm increases this probability, while social trust does not have a significant effect on it. At the same time, compared to the no-willingness-no-behavior group, the enhancement of social network and social norm facilitated the transformation from willingness to behavior, while social trust does not have a significant effect. This confirms the previous hypothesis H1. It is consistent with the research results of Luo, H. et al. [61], who found that the influence of social trust on actual behavior is not obvious. The possible reason is that social norm plays an intermediary role. The positive impact of network and trust on individual participation in waste separation mainly plays a role through environmental norms. Whether there is a positive impact depends on the strength of the pre-existing norms at different levels. Social capital will not automatically lead to participation in waste separation. Under different environmental norms, it may reduce the positive impact of the network and trust in practice [47].

The individual characteristics of farmers (gender, age, years of education) are not statistically significant to the willingness and behavior of farmers to participate in waste separation. This is consistent with the research conclusion of Hua, Y. et al. [58] on the separation of social capital waste and pro-environmental behavior, which is mainly influenced by social capital factors. On the contrary, the relationship with individually different variables is not obvious.

#### *4.4. Robustness Tests on the Willingness and Behavior of Influencing Farmers to Separate Waste*

In this paper, a series of robustness tests was conducted on the basis of the original model. The results are shown in Table 5. One is to change the regression model, changing the probit model used previously to a logit model. Another is to change the independent variable measure by constructing three dummy variables in the model and selecting "willingness unconverted behavior" and "willingness converted behavior" for logit regression. From the comparison of the regression results, it can be seen that the results of the alternative model are consistent with the results of the original model in terms of trend. There are only minor differences in the coefficients. This indicates that the results of this study are robust and shows that the three aspects of social capital, namely, social norms, social networks and social norms, all have a positive impact on the willingness and behavior of waste separation. The previous hypothesis H4 has been verified. The result is similar to the research of Rivera, M. et al. [41], who confirmed the significant effects of social capital in rural management through comprehensive research in seven countries. Different dimensions of social capital will lead to different behavioral results in waste separation [47].

**Table 5.** Average treatment effects of different matching algorithms.

Variables	Waste Separation Willingness	Waste Separation Behavior	The Transformation of Willingness and Behavior	
			Willingness Unconverted Behavior	Willingness Converted Behavior
Social trust	0.018 *** (0.006)	0.016 (0.012)	−0.007 (0.010)	0.018 (0.012)
Social network	0.041 *** (0.006)	0.107 *** (0.009)	−0.051 *** (0.015)	0.107 *** (0.009)
Social norm	0.080 *** (0.028)	0.013 ** (0.006)	0.008 * (0.016)	0.013 *** (0.006)
Control variables	Yes	Yes	Yes	Yes
Regional dummies	Yes	Yes	Yes	Yes
Pseudo R2	0.2966	0.2282	0.2354	0.2354
N	2503	2503	2503	2503

Note: \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

## 5. Conclusions and Policy Implications

Based on the data of the China Land Economy Survey in 2020, this study analyzed the effects of social capital on farmers' willingness, behavior and the transformation between willingness and behavior to separate waste. The results show that: (1) The consistency between farmers' willingness and behavior is low; 90.25% of farmers had the willingness to classify garbage, but only 48.49% of farmers had actually classified garbage, and only 48.22% of farmers had transformed willingness into behavior. (2) Among the three dimensions of social capital, social network, social norms and social trust, all had positive and significant effects on farmers' willingness and behavior to classify garbage. (3) Social network and social norms had a positive and significant impact on the transformation of farmers' willingness to classify garbage into behavior, but social trust was not significant.

This study found that farmers generally had inconsistencies between willingness and behavior to sort waste, while social capital had a significant effect on farmers' willingness, behavior, and the transformation between willingness and behavior to sort waste. This paper innovatively builds a theoretical analysis framework of the impact of social capital on waste separation, which can better explain which factors have an impact on waste separation. Furthermore, the research results of this paper can provide a decision-making reference for the formulation of public governance and waste separation policies in other countries in the world. As such, the paper proposed the following two policy recommendations: village environmental conventions should be established in villages to strengthen publicity work and rewards and punishments of waste separation to enhance village cohesion. The government should introduce market-based and waste-recycling systems. Furthermore, preferential and subsidized policies should be reasonably set up to motivate farmers to participate in waste separation. In addition, farmers are encouraged to make full use of the functions of social capital, such as information acquisition, resource sharing and funding source, so as to form the awareness of waste separation. At the same time, the effect of the regulation, supervision and incentive of the external environment plays an obvious role in promoting the transformation between willingness and behavior to waste separation to truly achieve "internalization in the heart and externalization in action".

Although this paper has obtained some practical conclusions, there are also some limitations, which need to be further explored and improved in future research: (1) The level of social capital is relatively simple. In the analysis of social capital, we focused on three aspects: social trust, social network and social norms. We selected seven indicators to measure the impact of farmers' willingness and behaviors. Besides social capital, there may

be other indicators that are not included in the analysis. Future research can try to analyze from a more comprehensive level. (2) The dynamic nature of environmental sustainability is not considered. Sustainable development is not static but is in a state of constant dynamic change, which needs long-term observation [76]. However, due to the limitation of time, funds and data collection, this study is only based on the survey data in 2020 and lacks long-term research and comparison of willingness and behavior. In future research, we can try to use the survey tracking data to make further comparative analyses from a dynamic perspective.

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