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Research on the Rural Environmental Governance and Interaction Effects of Farmers under the Perspective of Circular Economy—Evidence from Three Provinces of China

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Abstract: As an essential subject of rural environmental governance, farmers' environmental governance behavior directly affects the level and efficiency of rural environmental governance. In traditional rural society, the characteristics of "acquaintance society", "circle doctrine", and "clan society" have led to farmers' behaviors being influenced and constrained by their surrounding social support and social relations. Therefore, the interaction between farmers will affect the effectiveness of rural environmental governance, and the interaction effect will also affect the implementation of policies in rural environmental governance. In the strategic context of the policy of "building a beautiful and harmonious countryside that is desirable to live and work in" and "promoting green development and harmonious coexistence between human beings and nature" put forward by the 20th National Congress, we follow the principles of Reduce, Reuse, and Recycle from the perspective of circular economy, taking farmers as our research subject. We take the behavior of domestic garbage disposal as an example and, relying on the National Social Science Foundation project, use field research data and refer to neighbor groups and neighboring village groups. We use the Manski model to test the interaction effect of the two groups, analyze the interaction between individual farmers and the interaction between neighboring villages, and, finally, prove that there is an endogenous interaction effect and a situational interaction effect between the neighbor group and neighboring villages. Endogenous interaction effects, contextual interaction effects, and association effects exist between neighbor groups, while only contextual interaction effects and association effects exist between neighboring village groups. The above conclusions provide a policy reference for rural household waste and environmental management.

Keywords: circular economy; public participation; interactive behavior; rural environmental governance

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1. Introduction

Since the beginning of reform and opening up, China's rural economic construction has made great achievements while rural ecological pollution has become increasingly severe. Urban pollution has been transferred to the countryside in the process of urbanization. The increase in the consumption level of farmers has led to a rapid increase in the amount of domestic garbage, while its composition has become more complex. However, compared with urban areas, rural environmental management facilities are relatively backward, and farmers' environmental awareness is relatively weak. Consequently rural environmental pollution has become a stumbling block for the construction of a livable and beautiful countryside, and it is urgent to solve the problem of rural environmental pollution. Although the construction of a new and beautiful countryside has promoted the improvement of the rural ecological environment to a certain extent, ecological problems accumulated over a long period are fundamentally challenging to solve through actions

taken over a short period. Rural ecological problems are still the weak point of the policy of comprehensively promoting rural revitalization in the new stage of development [1]. The report of the 20th National Congress of the Communist Party of China puts forward the need to "promote green development and harmonious coexistence between human beings and nature", "accelerate the construction of a waste recycling system", and "promote urban and rural habitat improvement" [2]. Reduction, reuse, and resourcing, as characteristics of a circular economy in line with the requirements of green development and the construction of ecological civilization, are crucial ways to overcome the contradiction between economic development and environmental protection.

Farmers are the main body of rural production and life and the direct bearer of rural environmental damage, but they are also the direct beneficiaries of rural environmental governance. Therefore, the rural environment relies on the majority of farmers living in rural areas to protect it, and the breadth and depth of their participation largely determine the level of rural environmental governance [3], thus affecting the development process of the circular economy. With the current village "hollowing out" phenomenon becoming increasingly severe, most young farmers go out to work; the age of the farmers left behind and their degree of education, environmental awareness, and other personal qualities are generally at a lower level. In the case of limited investment in public services in rural areas by government departments, how to promote the construction of a circular economy through the in-depth participation of villagers in rural environmental management is a question we need to think deeply about. According to the social interaction theory, the public is not an independent agent in society, and its behavior is influenced by that of the members of society, resulting in peer effects. The rural community is a traditional "acquaintance society"; farmers' social interaction is based on their obtained information or the village norms [4]. The social interaction effect of behavioral decision-making has important policy implications, and the social impact of behavioral spillovers has a multiplier effect, which can effectively enhance policy effects. Therefore, an issue that needs to be further considered is how policymakers can strengthen the interaction among farmers from the external rural environment as well as the internal factors of individual farmers and enhance the interaction effect.

Therefore, based on the collection of first-hand information and data, the following study takes the most widely used household waste disposal behavior in rural environmental management as an example and uses neighbors and neighboring villages as reference groups to study the farmers' interaction behavior, as well as the peer effects generated by the interaction, in depth. The study results show that farmers' interaction effects are different in reference groups of different sizes. There are endogenous interaction effects, situational interaction effects, and association effects in neighboring groups. The endogenous interaction effect disappears when the scope of the reference group is expanded to the village. On this basis, effective countermeasures for rural environmental management are proposed from a circular economy perspective.

2. Review of the Literature

The circular economy is a sustainable model of economic development centered on the efficient use and recycling of resources and based on the principles of reduction, reuse, and recycling [5]. Under increasing environmental pollution and resource consumption, solid waste, if not properly managed, can pose multiple threats to the environment and public health, including water pollution, soil degradation, air pollution, and disease transmission [6]. Therefore, there is a need for proper waste management to reduce, reuse, recycle, and properly dispose of solid waste, develop circular agriculture [7], and expand the availability of natural resources to sustain life on earth [8]. At present, the world's significant economies generally take the development of a circular economy as the primary path to overcome resource and environmental constraints, cope with climate change, and cultivate new economic growth points; additionally, the development of a circular economy is necessary to promote ecological priority, conservation and intensification, and

green transformation of the development model [9]. Some scholars have proposed that the circular economy is a complex systematic project that requires the participation and collaboration of the central and local governments, enterprises, the public, and many other subjects. In China, because the promotion of circular economy focuses on top-down approaches, government departments play a leading role, meaning the public, enterprises, and other stakeholders do not participate in the main decision-making body enough [10]. In particular, the participation of farmers is even more insufficient.

Currently, there have been many academic discussions on China's rural environmental governance, mainly focusing on the current situation of rural environmental governance [11,12], the governance model [13–15], problems of rural environmental governance [16,17], and rural environmental governance strategies [18–20]. Many scholars have already explored how the government should play its role in environmental governance [14,21], and some scholars believe that government-led "regulatory governance" is no longer suitable for the current social development and ecological environment. The multi-body "interactive governance" model of the government, enterprises, and the public is a governance model that meets the current situation [15,17,22,23]. Since farmers' awareness of environmental participation is still weak, some scholars have proposed a "beneficiary subject" approach based on government compensation or incentives to achieve "internal incentives-external compatibility" [24,25] in order to mobilize farmers' motivation to participate. Some other scholars advocate the model of autonomous rural governance [13]. Most of the above literature explores the model of rural environmental governance from a "macro" perspective. However, in rural environmental governance, farmers are the direct bearers of rural environmental damage and the main body of rural environmental governance [26]. Therefore, studying the interaction effect of environmental governance from the "micro" perspective of farmers will effectively improve the efficiency of rural environmental governance.

Current research on interaction effects has been explored in the areas of corporate decision-making behavior [27], individual economic decision-making behavior [28,29], consumer spending behavior [30], student health [31], crime [32], and learning [33,34]. However, there are few quantitative studies on the interaction effects of farmers, which are mainly focused on agricultural production technology and economic decision-making. In terms of agricultural production, in the 1990s, Case tested the interaction effect with a study of regions adopting new agricultural technologies [35]. Later, many scholars also tested the interaction effect among farmers. Foster, Munshi, et al. tested the interaction effect of adopting new agricultural technologies by taking villages adopting new technologies as their research subject [36,37]. Matuschke I proposed that social network interaction could spread information effectively among farmers [38]. Luo Qing examined the interaction effects of agricultural technologies among neighborhood, kinship, and plot-adjacent clusters based on field survey data from Mengzhai Village in Henan Province, one of the few studies to analyze the interaction effects [39] quantitatively. Skevas T (2022) investigated the role of peer effects on farmers' decision to adopt drones [40]. Ziheng Niu (2022) analyzed the role of peer effects among different groups of farmers based on survey data of farmers in the North China Plain region [41]. In terms of economic decision-making, Durlauf, in his discussion on the mechanism of social interaction's influence on residents' financial decision-making behaviors, classified the channels of social interaction's influence on residents' insurance purchasing decisions into endogenous and situational interactions. Endogenous interaction emphasizes that residents' decision-making behavior is influenced by others while theirs, in turn, influences others. In situational interaction, residents' decision-making behavior is only influenced by others and does not, in turn, influence others, which is a kind of "demonstration effect" [42]. Moran J R et al., in a study of the impact of social interaction on the choice of medical insurance for the elderly, found that social interaction hurts the purchase of commercial medical insurance behavior of residents. That is, the higher the level of social interaction, the lower the likelihood of purchasing commercial medical insurance; less educated people are more

likely to be affected by social interaction, thus reducing their likelihood of purchasing commercial medical insurance [43]. Regarding environmental governance, He Xingbang studied the effect of social interaction on individual environmental behavior and found that social interaction is heterogeneous for different environmental behaviors. Social interactions significantly impact daily environmental behaviors and minorly impact non-daily environmental behaviors [44]. Social networks as a carrier of residents' interaction can significantly improve the level of residents' domestic waste classification, and the more frequent the network interaction, the higher the level of domestic waste classification. Network interaction as an information carrier can promote information dissemination and cultivate residents' environmental awareness and behavior. Shi Hengtong also believes that all social network variables positively affect farmers' participation in watershed ecological management behavior [45]. Farmers with higher levels of social networks can access more information resources on watershed ecological management, and specific monitoring and constraining mechanisms for watershed ecological management among these farmers will increase the willingness of farmers to participate in collective rural action.

To summarize, there have been many studies on the circular economy and China's rural environmental governance. However, most are from the "macro" perspective, exploring the mode of rural environmental governance and the participating subjects. There needs to be more quantitative literature on the effects of farmers' participation in environmental governance from a "micro" perspective. Research on the interaction effect between farmers primarily focuses on agricultural production and farmers' economic decision-making. The research field is relatively single, the research object is mainly confined to a specific region or village, the reference group is not precise enough, the research subject is rough, and there is a lack of empirical examination of the "micro" subjects. Whether the precision of the research subjects and reference groups will affect the identification of the interaction effect is yet to be proved. Based on the shortcomings of related academic studies, the following is a quantitative empirical test of the interaction effects of domestic waste disposal in rural environmental management from a circular economy perspective, with individual farmers and villages as a whole as the research subjects.

3. Theoretical Analysis and Research Hypothesis

Social interaction theory suggests that individuals' behavioral decisions are not independent; they depend not only on their characteristics and the environment in which they live but are also directly influenced by the behavior and characteristics of other individuals in the reference group. This influence occurs in three main ways. The first form of influence is social norms. Behavioral decisions of the reference group are likely to be regarded as some social norms, especially in relatively closed rural societies, and individuals follow such social norms to form social interaction effects. In the same village, if the surrounding neighbors adopt a more environmentally friendly way of disposing of household waste, then the farmers themselves will adopt a more environmentally friendly way of disposing of household waste for the sake of face or due to the influence of the "circle doctrine." The second form of influence is strategy complementarity. The behavioral decisions of the reference group may affect the marginal benefits of individual behavioral decisions, thus forming a social interaction effect [46]. The rural environment is a public good for villagers in the same village. If neighbors adopt more environmentally friendly ways to dispose of household waste, it will also bring a better living environment for farmers themselves. The third form of influence is information exchange. The daily communication between the reference group and the actors will generate information transfer and learning, and the information output by others and self-learning will also affect the actors' decision-making choices. Neighbors may convey the benefits of environmentally friendly behaviors to farmers in their daily communication, thus improving farmers' waste disposal behaviors.

Manski (2000) classified social interaction theory, categorizing interaction effects into endogenous, situational, and association effects [47]. Endogenous interaction effect refers to an individual's behavior being affected by the behavior of the reference group members

and their own decisions, in turn, affecting the behavioral decisions of the reference group members. In other words, endogenous interaction means that the individual and the reference group members are influenced by each other. Several scholars have used the effect of the average performance of cohort members on individual output to identify endogenous effects [48]. However, because social effects have a lag in the transmission process, some scholars identify endogenous interaction effects by assuming that the behavior of their contemporaries influences individuals; some authors assume that there is a time lag of several years, while others assume that social effects operate across generations. Contextual interaction effects are when an individual's behavior changes in response to the exogenous characteristics of the people around them, and this influence is unidirectional. The correlation effect refers to the fact that the behavior of individuals within the same group is consistent because they share similar individual characteristics, institutional environments, and other objective conditions. While endogenous and situational interactions express how a behavioral agent may be influenced by his or her social environment, correlation effects express a non-social phenomenon. Social influences affect individuals with a lag, while the effects of non-social forces are simultaneous. Taking farmers' domestic waste disposal behavior as an example, there is an endogenous interaction effect if, other things being equal, farmers' domestic waste disposal behavior changes with the domestic waste disposal behavior of their neighbors, other villagers, or other reference groups. A contextual interaction effect exists if farmers' domestic waste disposal behavior varies with the exogenous characteristics of the cluster. A correlation effect exists if farmers in the same village adopt similar domestic waste disposal behaviors because they live within the same social norms or have similar upbringings.

It is essential to distinguish between the role of endogenous interaction effects, situational interaction effects, and correlation effects because these assumptions imply different predictions of the impact of public policy [47]. Social multiplier effects can only occur if endogenous interaction effects are present. As an example of a policy intervention on farmers' environmental behavior, some villagers in a village are educated about the environment and persuaded about environmental behavior, but not other villagers. If the per capita annual centralized collection of domestic waste of the villagers being educated improves as the per capita annual centralized collection of domestic waste of the villagers in the village improves, then the environmental publicity and education of this government department not only restrains the environmental behavior of individual villagers but also indirectly regulates the environmental behavior of all the villagers in the village as their environmental behaviors are regulated and feed back into the environmental behaviors of individual villagers being educated and persuaded to further enhancement. Contextual interaction and association effects imply no such feedback. Figure 1 illustrates the mechanism of action of the interaction effect.

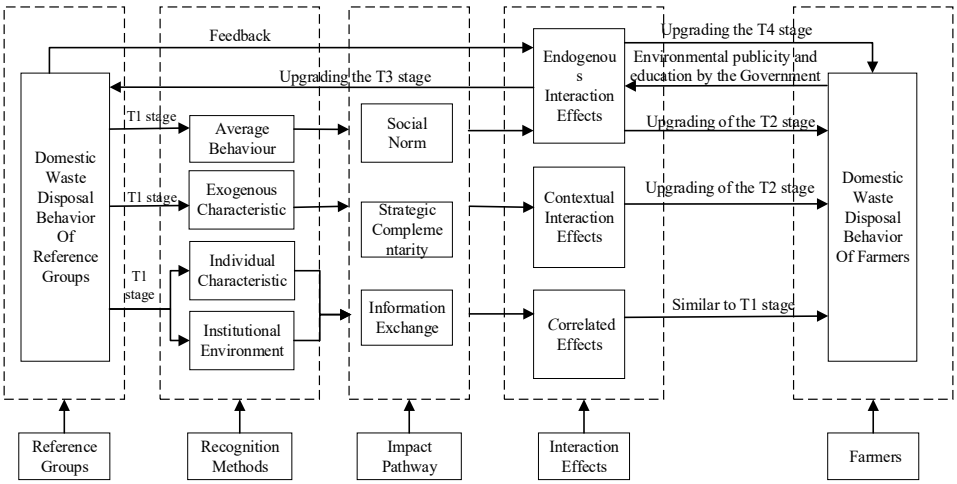

Figure 1. Mechanism of the interaction effects of rural environmental governance.

Based on the above analysis, the following hypotheses are proposed:

Hypothesis 1. *There are endogenous interaction effects on farmers' household waste disposal behavior.*

The endogenous interaction effect is a two-way influence with a time lag. When farmers choose to dispose of their household waste, they are influenced by their neighbors and change their household waste disposal behavior, which affects the average level of the whole reference group and feeds back to the farmers to further regulate their household waste disposal behavior more rationally. Suppose the surrounding neighbors collect and dump their garbage at the centralized location. In that case, the farmers will also tend to collect and dump their garbage at the centralized location, increasing the amount of centralized garbage disposal in the village as a whole. In the next stage, the amount of garbage disposal in the village will continue to increase along with the increase in the average amount of garbage disposal in the village. In daily life, it is challenging to avoid communication and interaction between farmers; the dissemination of information will affect the farmers' decision-making and judgment because the choice of individual action will be affected by the awareness of the effect of their behavior on others and the expectations of others on their behavior [49]. Farmers choose to centralize the dumping of domestic waste because others expect them to do so, and their neighbors also centralize the dumping of domestic waste because they expect them to do so.

Hypothesis 2. *There are contextual interaction effects on farmers' household waste disposal behavior.*

The contextual interaction effect is a unidirectional influence where farmers' habits are created in interaction with the external environment [50]. Farmers will only be influenced by their surrounding neighbors when choosing their domestic waste disposal behavior, but their own behavioral decisions will not affect their surrounding neighbors in reverse. If their neighbors collect and dump their domestic waste, the farmers will be influenced by their neighbors to collect and dump their domestic waste. However, the farmers' behavior will not, in turn, affect their neighbors. This behavior is the result of normative social influence. Normative social influence refers to an individual's behavior remaining consistent with the rest of the group to maintain his or her relationship with the social group, better adapt to the group, and not be rejected by the group. This behavior is sometimes pressured rather than voluntary [49]. Therefore, if farmers are surrounded by neighbors who collect and dump their household waste at a centralized location, they will adjust their behavior and choose to dispose of their waste in the same way as their neighbors to adapt to the group.

Hypothesis 3. *There are correlated effects between farmers' household waste disposal behavior.*

The correlation effect refers to individuals within the same group behaving similarly because they share similar personal characteristics, institutional environments, and other objective conditions. If all farmers in the same village choose to collect and dump household garbage at a centralized location, it may be because the village rules and regulations are stricter or there are stronger rewards and penalties for environmental behavior; on the other hand, if all farmers in the same village dispose of garbage randomly, it may be because the village rules and regulations are very loose. The relevant environmental policy constraints must be implemented because the villagers generally have a low literacy level. The villagers' low level of education reflects the institutional environment's significant influence on individual behavioral choices.

4. Study Area

The areas investigated by the research team include Fujian, Anhui, and Shaanxi provinces, which are representative of the eastern, central, and western regions of China.

Among them, Fujian Province is located in the southeast coastal area of China, belongs to the eastern region, and has a relatively developed economy. The specific research areas in Fujian Province include Minqing County, Gutian County, Sha County, the Yanping District of Nanping City, Wuyishan City, the Xinluo District of Longyan City, and the Yongding District. Minqing County is a county under the jurisdiction of Fuzhou City, Fujian Province. It is located in the east of Fujian Province, northwest of Fuzhou City and the lower reaches of the Minjiang River. Gutian County is a county under the jurisdiction of Ningde City. It is located in the northeast of central Fujian Province, connecting with Ningde and Luoyuan to the east, Nanping and Jianou to the west, Minqing and Minhou to the south, and Pingnan to the north. Shaxian County belongs to Sanming City, Fujian Province. It is located between the Wuyi Mountains and the Daiyun Mountains. The Shaxi River runs through the whole area. The terrain slopes from the two sides to the middle. Yanping District is a district under the jurisdiction of Nanping City, Fujian Province. It is located in the north-central part of Fujian Province, at the confluence of Jianxi and Xixi and at the lowest point of the central Fujian valley. Wuyishan City is affiliated with Nanping City, located in the northwest of Fujian and at the junction of Fujian and Jiangxi. It is the location of a famous scenic spot, Wuyishan. Xinluo District is a district under the jurisdiction of Longyan City, Fujian Province, located in the west of Fujian Province. Yongding District is located in the southwest of Fujian Province, bordering Nanjing County in the east, Pinghe County in the southeast, Dapu County and Mei County in Guangdong Province in the southwest, Shanghang County in the northwest, and Xinluo District in the northeast. It belongs to Longyan City, Fujian Province.

Anhui Province is located in the central and eastern parts of China and is the most dynamic part of the Yangtze River Delta. It belongs to the central region, and its economy is relatively underdeveloped. The research areas in Anhui Province include Changfeng County, Feidong County, Funan County, and Jieshou City. Changfeng County is affiliated with Hefei City. The county is located in the north of Hefei City, the provincial capital, and connects with Hefei, Huainan, and Bengbu. Feidong County is affiliated with Hefei City and is located in the central part of Anhui Province. It is connected to county-level Chaohu City, the Nanqiao District of Chuzhou City, and Quanjiao County in the east, Chaohu Lake in the south, Yaohai District, Baohe District, and Changfeng County in the west, and Dingyuan County in the north. Funan County is a county under the jurisdiction of Fuyang City, Anhui Province. It is located in the northwest of Anhui Province, on the north bank of the junction of the upper and middle reaches of the Huaihe River and across the river from Gushi County and Huaibin County in Xinyang City, Henan Province to the south. Jieshou City is a county-level city under the jurisdiction of Anhui Province. It is managed by Fuyang City. It is located in the northwest of Anhui Province, at the border of the northwest of Anhui Province and the junction of Henan and Anhui provinces.

Shaanxi Province is located in the hinterland of China, along the middle reaches of the Yellow River. It belongs to the Western region, and its economy is relatively underdeveloped. The research areas include Lintong District, Xi'an City, Baota District, Yan'an City, Jingbian County, and Yulin City. Lintong District is under the jurisdiction of Xi'an City, Shaanxi Province. It is located in the middle of the Central Plains, the east gate of the ancient capital of Xi'an. It is adjacent to Lishan Mountain in the south, Weinan High-tech Industrial Development Zone in the east, Chanba Ecological Zone and Xinzhu International Port Area in the west, and Yanliang National Aviation Industry Base in the north. Baota District belongs to Yan'an City, Shaanxi Province, and is located in the northern part of Shaanxi Province. It is adjacent to Yanchang in the east, Ansai in the west, Ganquan, Yichuan, Fuxian in the south, and Yanchuan and Zichang in the north. Jingbian County belongs to Yulin City, Shaanxi Province. It is located in the northwest of Shaanxi Province, on the southern edge of the Mu Us Desert. According to the topography, it is divided into three areas: a windy beach area in the north, the Liangmaojian area in the middle, and a hilly and gully area in the south. The temperature is high, the precipitation is basically the same, and the sunshine is less.

Table 1 shows the basic situation of the surveyed rural areas, including population and land area. It can be seen that there are three towns with a population of less than 10,000, nine towns with a population of 10,000–20,000, seven towns with a population of 20,000–30,000, five towns with a population of 30,000–40,000, three towns with a population of 40,000–50,000, two towns with a population of 50,000–60,000, and two townships with a population of more than 60,000. There are six townships with a land area of less than 10,000 hectares, twelve with a land area of 10,000–20,000 hectares, and eleven with a land area of 20,000–30,000 hectares. There are two townships with a land area of more than 40,000 hectares.

Table 1. Basic information on the study area.

Region	Population (Person)	Region	Land Area (Hectare)
Hongdunjie Town, Jingbian County	5916	Wangjiaba Town, Funan County	3299
Longzhou Town, Jingbian County	7360	Xinfeng Street, Lintong District, Xi'an	4400
Shuikou Town, Gutian County	8760	Guangwu Town, Jieshou City	4640
Fukou Town, Sha County	11,076	Towns in Funan County	4991
Yangzhuang Township, Wuyishan City	11,213	Daiwang Street, Lintong District, Xi'an	5693
Qingzhou Town, Sha County	11,603	Bandong Town, Minqing County	6100
Shanglian Township, Minqing County	11,820	Hukeng Town, Yongding District, Longyan City	10,138
Hukeng Town, Yongding District, Longyan City	11,859	Chiyuan Town, Minqing County	10,200
Ganguyi Town, Baota District	12,195	Shanglian Township, Minqing County	11,666
Taqian Town, Yanping District	17,235	Qiaotou Market Town, Feidong County	11,731
Gaosha Town, Sha County	18,052	Shuikou Town, Gutian County	12,188
Wangjiaba Town, Funan County	19,731	Meixi Town, Minqing County	13,482
Xingcun Town, Wuyishan City	23,799	Qingzhou Town, Sha County	13,959
Chiyuan Town, Minqing County	24,693	Taqian Town, Yanping District	14,679
Huangtian Town, Gutian County	25,863	Gangji Town, Changfeng County	15,668
Xiayang Town, Yongding District, Longyan City	27,391	Changlinhe Town, Feidong County	15,668
Xiamao Town, Sha County	27,649	Gaosha Town, Sha County	16,090
Meixi Town, Minqing County	28,421	Ganguyi Town, Baota District	17,244
Daqiao Town, Gutian County	29,302	Daqiao Town, Gutian County	20,200
Xinfeng Street, Lintong District, Xi'an	31,000	Xiayang Town, Yongding District, Longyan City	20,781
Xiqin Town, Yanping District	32,381	Huangtian Town, Gutian County	21,200
Liulin Town, Baota District	32,771	Longzhou Town, Jingbian County	22,000
Hetang Town, Gutian County	33,293	Fukou Town, Sha County	22,609
Changlinhe Town, Feidong County	33,436	Fenggang Street, Sha County	23,240
Towns in Funan County	40,713	Xiqin Town, Yanping District	25,030
Daiwang Street, Lintong District, Xi'an	42,000	Liulin Town, Baota District	25,100
Bandong Town, Minqing County	42,300	Xiamao Town, Sha County	25,136
Qiaotou Market Town, Feidong County	53,511	Hetang Town, Gutian County	26,068
Gangji Town, Changfeng County	54,476	Hongdunjie Town, Jingbian County	28,800
Guangwu Town, Jieshou City	60,377	Yangzhuang Township, Wuyishan City	48,115
Fenggang Street, Sha County	62,000	Xingcun Town, Wuyishan City	67,977

Data source: "China County Statistical Yearbook (Township Volume)-2018", Shaxian District People's Government Portal. Note: Population and land area are listed in ascending order.

5. Data Source, Variable Selection, and Model Setting

5.1. Data Source

The article relies on the National Social Science Fund Project, obtains first-hand information through the field research of the research team members, and uses quantitative statistical methods for statistical analysis. The research time was from July 2017 to August 2018, lasting one year. The research locations were Fujian, Anhui, and Shaanxi provinces, representing the east, middle, and west of China.

The survey methods are: 1. Province selection: first, select Fujian, Anhui, and Shaanxi provinces to represent the eastern, central, and western parts of China; 2. City Selection: According to the list of areas provided by the government departments with rural environmental contiguous improvement or rural environmental comprehensive improvement projects, randomly select 2–5 cities in each province; 3. Counties (districts) selection: randomly select 1–2 counties or districts with this project in the selected cities; 4. Township (street) selection: select 1–7 townships in the selected counties or districts; 5. Village selection: Randomly select 1–6 administrative villages in the selected townships or streets; 6: Research object selection: Randomly select 1–6 farmers in the selected administrative villages to conduct face-to-face questionnaire surveys.

The survey content is as follows: Field surveys are used, and oral questionnaires are used to obtain the basic situation of rural households, the situation of domestic waste disposal of rural households, the subjective cognition of rural households, the willingness of rural households to protect the environment, and the situation of rural social capital. Among them, the household waste treatment part includes two stages: taking 2013 as the node, including the situation before 2013 and the current stage, and assessing the domestic waste disposal of farmers before 2013 (denoted as T1) and at the current stage (denoted as T2). The final research area includes three provinces, ten prefecture-level cities, and one hundred and three administrative villages. Nearly 530 households were surveyed, and 529 questionnaires were obtained. According to the research purpose of this paper, after excluding invalid questionnaires, a total of 525 valid questionnaires were obtained. The sample distribution is shown in Table 2.

Table 2. Sample distribution by region.

Province	City	Counties, Districts (County-Level Cities)	Streets, Towns, Townships	Sample Size
Fujian	Fuzhou	Minqing County	Bandong Township, Shanglian Township, Chiyuan Township, Meixi Township	44
	Ningde	Gutian County	Daqiao Township, Shuikou Township, Hetang Township, Huangtian Township	42
	Sanming	Sha County	Fenggang Street, Fukou Town, Gosha Town, Qingzhou Town, Xiamao Town	93
	Nanping	Yanping District	Taqian Town, Xichen Town	20
		Wuyishan City	Yangzhuang Township, Xingcun Township	39
	Longyan	Xinluo District	Xiaochi Town, Longmen Town	30
		Yongding District	Hukeng Town, Xiayang Town	30
Anhui	Hefei	Changfeng County	Gangji Town	25
		Feidong County	Changlinhe Township, Qiaotou Settlement	24
	Fuyang	Funan County	Di Town, Wangjiaba Town	24
		Jieshou City	Guangwu Town	26
Shaaxi	Xian	Lintong District	Xinfeng Street, Daiwang Street	36
	Yanan	Baota District	Willow Grove Town, Ganguye Town	48
	Yulin	Jingbian County	Hongdunjie Town, Longzhou Town	48

The results of the statistical analysis of the samples are shown in Table 3. Regarding gender, males accounted for 52.20 percent of the survey sample and females for 47.80 percent, with the proportion of males slightly higher than that of females, which aligns with the current situation in rural areas. Regarding marital status, 95.22% of the

survey respondents were married. In terms of age level, the older the age, the higher the proportion of survey respondents, with the highest proportion (42.45%) being over 60 years old. In rural areas, most young and middle-aged people go out to work, leaving only the elderly and children in the villages, so more than 40% of the survey respondents are elderly. 92.93% of the respondents are not village cadres, and the proportion of village cadres is only 7.07%. The proportion of party members is only 9.64%, indicating that the number of party members in rural areas is still relatively small. In terms of education level, most of the respondent's education level is concentrated in elementary school and junior high schools, with the highest proportion of elementary school education (35.76%), followed by junior high schools (34.80%) and illiteracy (18.93%), while the proportion of senior high school education and above is only 10.51%. Combined with the survey respondents' age distribution, most were older and generally had a lower level of education, so the education level was mainly concentrated in junior high school and below.

Table 3. Basic information about the sample.

Projects		Frequency	Percentage (%)	Projects		Frequency	Percentage (%)
Gender	Male	273	52.20	Village officials	Yes	37	7.07
	Female	250	47.80		No	486	92.93
Marriage	Married	498	95.22	Political Appearance	Yes	51	9.75
	Unmarried	25	4.78		No	472	90.25
Age	20 and below	4	0.96	Education level	Illiterate	99	18.93
	$20 \leq$ age <30	25	4.78		Primary School	187	35.76
	$30 \leq$ age <40	40	7.65		Junior High School	182	34.80
	$40 \leq$ age <50	79	15.11		High School	35	6.69
	$50 \leq$ Age <60	153	29.25		University and above	20	3.82
	60 and above	222	42.45				

5.2. Variable Selection and Reference Groups Classification

Combined with the existing literature and actual research, in the data processing, only villages with dedicated personnel responsible for managing household waste disposal were selected as the sample data; food waste, pesticide bottles, plastic bottles, used cartons, and used plastic bags were selected as the range of household waste, and direct throwing into garbage collection points, sorting into garbage collection points, and selling were selected as the centralized household waste disposal behavior. The explanatory variables were selected as the annual centralized disposal amount of household waste per capita and the sum of the annual centralized disposal weight per capita for food waste, pesticide bottles, plastic bottles, used cartons, and used plastic bags. Among them, the weights of food waste and used cartons can be directly derived from the questionnaire. Pesticide bottles and plastic bottles are reflected as quantities in the questionnaire, so it is necessary to convert pesticide bottles and plastic bottles into weights, and the weights of used plastic bags need to be light and are therefore neglected. Feng Chengyu (2011) calculated the weight of waste pesticide packaging plastic bags and plastic bottles in his paper. It concluded that the average weight of waste pesticide packaging plastic bags and plastic bottles was 7.5 g, while the average weight of plastic bottles was 18 g [51,52].

In order to test the endogenous interaction effects, contextual interaction effects, and correlated effects of farmers' behavior regarding household waste disposal, the following aspects were selected as explanatory variables based on the availability of survey data and concerning the existing literature for the neighborhood reference groups. The first is the average annual centralized household waste disposal per capita in the reference groups in 2013. This indicator is further explained here by assuming that five farmers A, B, C, D, and E, were surveyed in a village. If A is the leading group, the reference groups of A are B, C, D, and E. If B is the leading group, the reference groups of B are A, C, D, E,

and so on. The year 2013 was chosen because it takes time for the interaction effect to occur, especially for a habitual behavior such as household waste disposal, which needs time to change gradually, and the year 2013 was the completion date of the first batch of rural environmental improvement projects. The second explanatory variable is the average characteristics of individual farmers' groups. The average age, number of members of the reference groups, average years of education, average health status, and the average length of time living at the home of the group they belong to are calculated in the same way as the annual centralized household waste disposal amount per capita of the reference groups. The third explanatory variable is the individual characteristics of farmers. These include their age, number of household members, years of education, health status, and length of time living at home. The explanatory variables for the annual centralized household waste disposal per capita of individual farmers in 2017 are shown in Table 4.

Table 4. Explanation and description of variables.

Variable Name	Variable Definition	Effectiveness Test
Explained variables		
Annual centralized treatment volume of own household waste in the T2 period	Annual centralized household waste disposal per capita in 2017 itself, continuous variable	
Explanatory variables		
Annual centralized treatment volume of household waste in the reference groups in the T1 period	The mean of annual centralized household household waste disposal per capita in the reference cohort in 2013; continuous variable	Testing the endogenous interaction effects
Average age of the reference cohort	The mean of age of reference cohort; continuous variable	Testing the contextual interaction effects
Number of reference groups	Number of members of the reference groups; continuous variable	
Average years of schooling in the reference cohort	The mean of years of education for the reference cohort; continuous variable	
Average health status of the reference cohort	The mean of the health status of the reference cohort; continuous variable	
Average length of stay at home for the reference groups	The mean of length of residence at home for the reference cohort; continuous variable	
Age	Age of self; continuous variable	Testing the correlated effects
Number of family members	Number of own family members; continuous variable	
Years of education	Own years of schooling; continuous variable	
Health Status	Self-health status; 1 = very poor, 2 = poor, 3 = fair, 4 = good, 5-very good	
Length of stay at home	Length of self-residence at home; continuous variable	

According to the above theoretical analysis, we selected neighbors and neighboring villages as reference groups to distinguish the size of the reference groups, as shown in Table 5. The neighboring group in this study refers to other surveyed subjects within the same village, except for the farmers, which are within 1000 m of each other. Neighboring villages in this study refer to other surveyed villages in the same township or district, except for the surveyed villages. Due to the actual situation of the research, the number of

neighbors of each farmer and the number of neighboring villages are sometimes different. Therefore, we selected a number of neighbors ranging from one to twelve. In other words, the number of reference groups for each farmer is at least one and at most twelve, and the neighboring villages are all neighboring villages in the same township or district. The number of reference groups is at least one and at most five.

Table 5. Classification of reference groups.

Reference Groups Division	Number of References
Neighborhood Groups	1–12
Neighboring Village Cluster	1–5

In processing the data of the reference groups of neighboring villages, the individual data of survey respondents in the same village are averaged and the final result is used as the data of that village. Suppose a total of four villages, A, B, C, and D, are surveyed in a town; then the reference groups for village A are B, C, and D. Suppose a total of five farmers, A, B, C, D, and E, were surveyed in village A. The data of each group of these five farmers were summed and averaged as the data of village A. From this, the age, number of household members, years of education, health status, and length of residence at a home in village A could be obtained. By analogy, the data of B, C, and D can be obtained.

5.3. Model Setting

According to the requirements of the Manski interaction effect identification strategy in the above theoretical analysis, the different variables of endogenous interaction effects, contextual interaction effects, and correlated effects are included in the model, which is able to overcome the measurement problems of simultaneity, endogeneity, and omitted variable bias in the following manner:

$$ln(Y_{i,t}) = a_0 + a_1 ln(Z_i) + a_{2,k} ln\left(P - i_{,t-1}\right) + a_{3,k} ln(Z - i) + u_{i,t} \quad (1)$$

In the above equation, $Y_{i,t}$ is the annual centralized household waste disposal per capita of individual farmers at t; Z_i refers to the information of individual farmers at i; $Z - i$ refers to the exogenous characteristics of the reference groups of farmers at i, such as the average age and education level of the reference groups' members; $\bar{P} - i_{,t-1}$ is the average annual centralized household waste disposal per capita of the reference groups' members who constitute the individual farmers at i at $t - 1$, which is also a proxy variable for the treatment effect of the reference groups in the rural household waste treatment. Where $Z - i$ is the exogenous eigenvector of the reference groups of farmers, i, excluding i itself, and $u_i \sim N(0, \sigma^2{}_u)$, k denotes the reference groups of i. Correlated effects exist if $a_1 \neq 0$, endogenous interaction effects exist in the group if $a_{2,k} \neq 0$, and contextual interaction effects exist in the group if $a_{3,k} \neq 0$.

6. Empirical Test

Farmers are the mainstay of rural production and life. In addition to relying on the government, it is also necessary to rely on the farmers to get twice the result with half the effort. This study focuses on the role of farmers in rural waste management. The traditional rural society is characterized by "acquaintance society", "circle doctrine", "clan society", etc., which leads to the fact that the people around farmers influence them in their words and actions. Their domestic waste disposal behavior is also influenced by their interaction with the people around them. Their interaction with the surrounding people will also influence their behavior. Therefore, in this section, we will analyze the influence of interaction behaviors on the centralized treatment of rural household waste according to the social interaction theory.

6.1. Model Estimation Results

The paper uses Stata 13.0 software to estimate the data of 523 samples and tests the interaction effect in the output according to the above formula. The continuous variables, such as annual centralized household waste disposal per capita and annual income per capita, are taken in logarithmic form. The variables with "0" observations can be kept in the equation as discrete variables to prevent the exclusion of many observations when using the logarithmic form. Table 6 shows the model estimation results.

Table 6. Test results of interaction effects of farmers' centralized household waste disposal behavior.

Variables	Neighborhood Reference Groups		Neighboring Villages Reference Groups		Effectiveness Test
	Model 1	Model 2	Model 3	Model 4	
Annual centralized collection of household waste per capita in the reference groups in period T1	0.1024 * (0.0544)	0.0978 * (0.0592)	−0.0225 (0.1130)	−0.0588 (0.1134)	Testing the endogenous interaction effects
Average age of the reference cohort	0.1028 (0.1468)	0.0903 (0.1468)	0.0729 (0.0680)	0.0483 (0.0671)	Testing the contextual interaction effects
Mean age squared for the reference cohort	−0.0010 (0.0013)	−0.0009 (0.0013)	−0.0007 (0.0006)	−0.0005 (0.0006)	
Number of reference groups	0.0431 (0.1859)	−0.0652 (0.1950)	0.7733 * (0.4610)	0.7866 (0.4921)	
Number of reference groups squared	−0.0003 (0.0133)	0.0062 (0.0137)	−0.1518 * (0.0769)	−0.1428 * (0.0820)	
Average years of schooling in the reference cohort	−0.0992 ** (0.0485)	−0.0829 * (0.0492)	0.1353 (0.0871)	0.1495 * (0.0854)	
Average health status of the reference cohort	0.3571 * (0.1972)	0.3496 * (0.2034)	−0.0291 (0.3970)	0.0970 (0.4148)	
Length of stay at home for the reference groups	−0.0297 (0.0846)	−0.0640 (0.0870)	−0.0022 (0.1495)	−0.0994 (0.1522)	
Age	−0.0102 (0.0075)	−0.0096 (0.0075)	−0.0117 (0.0211)	−0.0076 (0.0208)	Testing the correlated effects
Number of family members	−0.0700 * (0.0424)	−0.0676 (0.0424)	−0.2481 * (0.1365)	−0.2711 ** (0.1346)	
Years of education	0.0545 ** (0.0255)	0.0576 ** (0.0255)	−0.0320 (0.0682)	−0.0178 (0.0670)	
Health Status	0.1258 (0.0931)	0.1241 (0.0939)	0.9490 *** (0.2896)	1.0191 *** (0.2956)	
Length of stay at home	0.1388 *** (0.0427)	0.1307 *** (0.0429)	0.1240 (0.1135)	0.0654 (0.1136)	
Constant term	−1.7066 (4.3935)	−0.4600 (4.4520)	−1.8001 (3.1776)	0.0221 (3.3835)	\
Regional Variables	Uncontrolled	Control	Uncontrolled	Control	\
Sample size	523	523	95	95	

Standard errors in parentheses. The superscripts *, **, and *** represent the passing of the significance test at 10%, 5%, and 1% levels, respectively.

In Table 6, Model 1 and Model 2 are the test results of the neighboring reference group without and with area variables, respectively, and Model 3 and Model 4 are the test results

of the neighboring village reference group without and with area variables, respectively. It can be found that the model remains stable after adding regional variables, and the factors that significantly affect the annual centralized treatment of farmers' domestic waste and the annual centralized treatment of villages' domestic waste remain basically unchanged.

There are endogenous interaction effects, contextual interaction effects, and correlated effects in the neighboring reference groups. Among them, the annual concentrated disposal of household waste in the reference groups, the average years of education in the reference groups, and the average health condition in the reference groups in the T1 period have significant effects on the annual concentrated disposal of household waste in the T2 period at a statistical level of 10%; the years of education of farmers have significant effects on the annual concentrated disposal of household waste in the T2 period at a statistical level of 5%; the length of time farmers live at home has significant effects on the annual concentrated disposal of household waste in the T2 period at a statistical level of 1%.

There are contextual interaction effects, correlated effects, and no endogenous interaction effects in the reference clusters of neighboring villages. Among them, the number of reference groups and the average years of education of the reference groups have significant effects on the annual centralized treatment of village household waste in the T2 period at a statistical level of 10%; the average number of family members in villages has significant effects on the annual centralized treatment of village household waste in the T2 period at a statistical level of 5%; the average health condition of villages has significant effects on the annual centralized treatment of village household waste in the T2 period at a statistical level of 1%. The average health condition of villages significantly influences the annual centralized treatment amount of village household waste in the T2 period at a statistical level of 1%.

6.2. Analysis of Model Estimation Results

6.2.1. Analysis of Endogenous Interaction Effects

As shown in Table 6, the average annual centralized household waste disposal per capita of the neighbor reference groups in period T1 passes the significance test at a 10% confidence level, which proves that there are endogenous interaction effects between neighbors and that the annual centralized household waste disposal per capita of neighbors in the previous period has a significant positive effect on the annual centralized household waste disposal per capita of farmers in the current period. It indicates that the higher the per capita annual centralized household waste disposal of neighbors, the higher the per capita annual centralized household waste disposal of farmers is; similarly, the higher the per capita annual centralized household waste disposal of farmers, the higher the per capita annual centralized household waste disposal of their neighbors will also be, and the two affect each other. In terms of environmental management, if the governmental part first educates some farmers about environmental protection and persuades them to adopt environmentally friendly waste disposal behaviors, then their neighbors will be influenced to adopt environmentally friendly waste disposal behaviors, and the results will be fed back to the farmers to regulate their waste disposal behaviors further afterward. Farmers share a rural community with their neighbors, and the increased frequency of farmer–neighbor interactions can enhance their expectations for future cooperation and even form a mechanism of risk sharing and mutual benefit, where farmer-neighbor interactions promote the realization of their common interests—a better rural environment.

In contrast, the average annual centralized domestic waste disposal per capita in the neighboring villages reference group does not pass the significance test, and the endogenous interaction effect does not exist in the neighboring villages reference group. The endogenous interaction effect disappears the more significant the geographic scope of the reference group.

6.2.2. Analysis of Contextual Interaction Effects

Contextual effects in the neighborhood reference groups were manifested in average years of education and health status. Contextual effects in neighboring village reference groups were expressed regarding the number of reference groups and average years of schooling.

The average years of education in the neighbor reference groups have a significant adverse effect on the annual centralized household waste disposal per farmer at a statistical level of 10%, which indicates that the higher the education level of the reference groups, the less centralized household waste disposal by farmers. This result is consistent with Luo Qing's conclusion in his test on the interaction effect of new agricultural technology land–neighborhood reference groups that farmers are reluctant to engage with people who are more educated than themselves in their daily communication interactions, and the higher the level of education than themselves, the more noticeable this rejection is [39]. The average health status of the neighboring reference groups has a significant positive effect on farmers' per capita annual centralized household waste disposal at a statistical level of 10%. This means that the better the health condition of the reference groups is, the higher the per capita annual centralized household waste disposal capacity of the farmers themselves will be. The better the health condition, the more time and energy they have, the more they have the primary objective conditions to dispose of household waste, and the more neighbors can help each other and care for each other. In addition, it can be observed that the relationship between the average age of the reference groups of neighbors and the annual amount of centralized household waste disposal per farmer is an inverted "U." Let the annual amount of centralized household waste disposal per farmer be *Y*. The average age of the reference groups is *A*. The relationship between the average age of the reference groups and the annual amount of centralized household waste disposal per farmer is as follows:

$$\frac{\partial ln(Y)}{\partial (A)} = 0.0903 - (0.0009 \times 2)A \quad (2)$$

That is, the farmers' per capita annual centralized domestic waste disposal reaches its highest value when the average age of the reference group is 50.17 years. Before the average age of the reference group is 50.17 years, the amount of per capita annual centralized domestic waste disposal of the farmers themselves increases with the increase in the average age of the reference group, and after the average age of the reference group is 50.17 years, the amount of per capita annual centralized domestic waste disposal of the farmers themselves decreases with the increase in the average age of the reference group. As a result of traditional living habits, the older the person is, the more frugal he or she is, so he or she tends to save some of the household waste that can be sold, meaning the older the person is, the more waste he or she recycles; after reaching a certain age, due to physical and energy limitations, the elderly can no longer continue to collect and sell household waste, so the amount of household waste centralized disposal decreases with age. The average age of the reference groups will affect the annual amount of household waste collected and disposed of by farmers.

In the reference groups of neighboring villages, the number of reference groups significantly influences the annual per capita household waste disposal quantity at a statistical level of 10%. The relationship between the two is an inverted "U". Let farmers' annual per capita household waste disposal quantity be *Y* and the number of reference groups' members be *N*. Then the relationship between farmers' per capita annual household waste disposal and the number of reference groups members is as follows:

$$\frac{\partial ln(Y)}{\partial (N)} = 0.7866 - (0.1428 \times 2)N \quad (3)$$

That is to say, if other conditions remain unchanged, the relationship between the per capita annual centralized domestic waste disposal quantity and the number of reference

group members shows an inverted U-shaped trend, and the per capita annual centralized domestic waste disposal quantity of villages reaches the highest value when the number of reference group members is 2.75. This shows that three reference group members are optimal for the demonstration effect, and three neighboring villages can reach the optimal state of mutual learning and reference. At the same time, once there are more than three villages, and the number of reference group members grows more and more, this situational effect will go "downhill" and the interaction effect will be worse. The annual per capita amount of centralized domestic waste disposal in a village decreases as the number of reference group members increases.

In the neighboring village reference groups, the average number of years of education of the reference groups has a significant positive effect on the village's annual centralized household waste disposal per capita at a statistical level of 10%. This result is opposite to the validation result of the neighboring reference groups, which indicates that the influence of the education level of the reference groups on the annual centralized household waste disposal quantity is related to the geographical range of the reference in the neighboring reference range, the years of education of the reference groups have a significant negative influence on the annual centralized household waste disposal quantity of farmers, and the years of education of the reference groups has a significant positive effect on the annual concentration of village household waste. As mentioned in the radiation theory, regions with a higher level of modernization and economic development will send talent, capital, labor, technology, and other factors to regions with a lower level of modernization and economic development and also promote the spread of ideas and living habits between the two regions to improve the allocation of resources. Villages with higher years of education generally have relatively higher levels of economic development. According to the radiation theory, they will transfer elements and spread ideas to the surrounding villages with relatively lower levels of economic development, thus driving the economic development of villages with lower levels of economic development, improving the ideological quality of their villagers, strengthening their environmental awareness, and thus promoting the villagers' centralized disposal behavior of household waste.

6.2.3. Analysis of Correlated Effects

The correlated effects in the neighborhood reference groups were the number of years of schooling and the length of time farmers lived at home. The correlated effects in the neighboring village reference groups were the number of household members and health status.

The years of education of farmers in the neighborhood reference groups have significantly affected the annual concentration of household waste per farmer at a statistical level of 5%. This is consistent with the results of most studies. The higher the literacy level, the better the receptiveness, the stronger the environmental awareness, the better the mastery of environmental knowledge, and the better the ability to regulate the appropriate disposal of household waste. Therefore, the higher the literacy level, the higher the annual centralized household waste disposal per capita. The length of time farmers live at home positively and significantly affects their per capita annual centralized household waste disposal volume at a statistical level of 1%. In rural areas, many farmers choose to go out to work and do not live in the countryside for a long time, so they pay less attention to the living environment in the village, are less influenced by it, have little affection for the countryside, and are likely to discard their household waste at will. Villagers who have lived at home for a long time are more influenced by the surrounding living environment, have deeper feelings and closer ties with the countryside, and care more about their surroundings, meaning that these people will have more centralized disposal of household waste.

In the reference groups of neighboring villages, the number of village household members significantly adversely affects the annual centralized household waste disposal per capita in villages at a statistical level of 5%. The number of household members reflects the population of a village, which indicates that the larger the village population is, the

lower the per capita annual centralized household waste disposal capacity is. The larger the village population is, the worse the household waste disposal status is. The larger the village population, the larger the household waste generated. Without complete disposal facilities and institutional regulations, farmers will choose the most convenient way to dispose of household waste at will. Therefore, the more family members, the less the annual centralized disposal amount of household waste per capita in the village. The health status of the village population in the reference groups of neighboring villages significantly positively affects the annual centralized household waste disposal per capita at a statistical level of 1%. The healthier the farmers are, the more their per capita annual household waste disposal volume is. The body's health condition directly affects household waste disposal behavior. The collection, sorting, and disposal of household waste require physical strength, energy, and time, which all require the essential condition of good health. The healthier the body is, the more time and energy it devotes to the disposal of household waste, and the higher the annual per capita household waste disposal volume will be, meaning health condition has a significant positive effect on the annual per capita household waste disposal volume.

7. Conclusions and Discussion

7.1. Conclusions

In order to promote the development of a circular economy and solve the contradiction between environmental protection and economic development, based on the theory of social interaction, this article examines the interaction effect of rural environmental governance behaviors by using Manski's model on the neighboring groups and adjacent village groups, respectively, targeting the farmers, who are the essential subjects of rural environmental governance. There are endogenous interaction effects, contextual interaction effects, and correlated effects in the neighbor reference group. Among them, the annual centralized treatment volume of domestic waste, the average years of education of the reference group, and the average health status of the reference group in the T1 period passed the significance test at a 10% confidence level; the years of education of farmers passed the significance test at a 5% confidence level; and the length of time farmers lived at home passed the significance test at a 1% confidence level. There are contextual interaction effects, correlated effects, and no endogenous interaction effects in the neighboring villages' reference group. Among them, the number of parties in the reference group and the average years of education in the reference group passed the significance test at the 10% confidence level; the average number of family members in the village passed the significance test at the 5% confidence level; and the average health status in the village passed the significance test at the 1% confidence level.

The results indicate that the endogenous interaction effects disappear when the scope of the reference groups is extended to the village. The interaction effect changes with the change in the scope of the reference groups. In the contextual effect, the average years of education of the reference groups in both the neighboring reference groups and the neighboring village reference groups had a significant effect on the annual per capita household waste concentration, but in the opposite direction, indicating that the contextual interaction effects also changed with the change in the reference groups scope. However, an inverted "U" shape relationship exists between age and annual per capita household waste disposal, indicating that age's effect on annual household waste disposal is relatively constant. In the correlated effects, the years of education and the length of living at home significantly positively affect the annual per capita household waste disposal rate in the neighboring reference groups. In the neighboring villages' reference groups, the number of household members and health status significantly positively affected the annual per capita centralized household waste disposal. This indicates that the correlated effects vary with the reference range. In the smaller reference range, the correlated effects are mainly manifested in the same individual characteristics, such as education level and length of

time living at home; in the more extensive reference range, the correlated effects are mainly manifested in the same regional characteristics, such as population size and health status.

7.2. Discussion

Given the above conclusions, the article, from the perspective of promoting the development of the circular economy, puts forward some suggestions on the treatment of rural domestic waste and the improvement of the efficiency of rural environmental governance in the field of centralized treatment of rural domestic waste, which can effectively alleviate environmental pollution and promote the recycling and reuse of waste. Firstly, encourage rural elites to improve their environmental behavior. For the needs of the current development of rural society, the "capable rural governance elite" plays an essential role in improving the economic status and physical form of rural society, promoting the construction of beautiful and livable villages, and realizing the implementation of the rural revitalization strategy [53]. Rural elites can connect the state and villagers, act as a bridge between the two, assist local officials, co-manage village affairs, integrate villagers' opinions, advocate for the interests of the villagers, upload public opinion, and issue policies [54]. Village elites can lead and mobilize in small groups [55], which can lead the surrounding neighbors to regulate the behavior of domestic waste disposal and thus enhance the environmental behavior of the whole village. This will provide further feedback to the village elite, which will enhance the domestic waste disposal behavior of the village elite in the next stage, exerting the social multiplier effect of the endogenous interaction effect. Therefore, government departments can focus on strengthening education in environmental knowledge for village elites such as party members and village cadres, encouraging village elites to regulate their environmental behaviors, and exerting the leading role of village elites to mobilize other villagers to regulate their environmental behaviors. Secondly, strengthen education in rural areas. Policymakers should pay attention to compulsory education in rural areas, popularize high school education, expand investment in rural areas, improve education facilities, and ensure that rural children can attend school. Strengthen environmental knowledge education, starting with children, popularize the standard of living garbage classification in the primary education stage, popularize basic environmental knowledge, and let environmental awareness deepen into daily life. Thirdly, strengthen the function of rural collective organizations. Policymakers should pay attention to the function of rural collective organizations. They should call on village committees, senior citizen activity centers, and other organizations to serve as information exchange centers to popularize basic environmental knowledge in a way that is pleasing to the people. Fourthly, raise rural people's hygiene awareness and improve rural medical security services. Publicity and popularization of hygiene and preventive health care should be strengthened, and the "toilet revolution" in rural areas should be vigorously promoted. Increase funding to improve medical conditions in rural areas, enhance the quality of medical services, and improve the medical environment in rural areas. Reform of the rural medical system has been stepped up, and equalization of medical services between urban and rural areas has been promoted. Fifthly, set up appropriate-scale rural environmental management mutual aid groups. Drawing on the successful experience of industrial poverty alleviation mutual aid groups in poverty alleviation work in Linyou County, Shaanxi Province, four villages in the same township or district can cooperate in the governance of the rural environment and set up specialized rural environmental governance mutual aid groups of about 100 households in size within the villages, forming an atmosphere of mutual learning and supervision within the groups to give full play to the effects of situational interaction effects.

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