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The Influence of Farmers' Clan Networks on Their Participation in Living Environment Improvement during the Time of Transition in Traditional Rural China

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Abstract: Farmers' participation in public affairs is the combined effect of informal and formal institutions. In order to improve the current situation of low willingness of Chinese farmers to participate in living environment improvement, and to enhance the motivation of farmers and the effectiveness of living environment improvement, this paper incorporates the clan network in the informal institution and the perceivable authority of village chiefs in the formal institution into a unified analytical framework, divides the clan network into two dimensions (scale and strength) and explores the influence of the clan network and the perceivable authority of village chiefs on farmers' participation in rural living environment improvement. Finally, an empirical test is conducted using survey data from 683 farming households in the provinces of Henan, Shaanxi and Sichuan. The results show that the strength of the clan network and the perceivable authority of the village chiefs have a significant positive effect on the farmers' participation in rural living environment improvement, while the scale of the clan network does not have a significant effect on farmers' behavior. The perceivable authority of the village chief has a positive moderating effect between the clan network and farmers' participation in rural living environment improvement, while the heterogeneity analysis shows that the positive effect of the clan network on farmers' participation in the rural living environment is reduced for those who have worked outside, far away from the village. It is suggested that the protection of traditional clan relations should be emphasized, and the positive role of clan agents and their influence should be effectively utilized in promoting the improvement of the rural living environment at the grassroots level. Moreover, it is necessary to carry out timely training of professional knowledge and skills for grassroots leaders, propagandize and interpret policies, thus increasing the enthusiasm of farmers to participate in the improvement of the rural living environment.

Keywords: informal institution; farmers' participation in public affairs; authority of the village chief; formal institution; China's rural areas

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1. Introduction

In recent years, the problems in the rural living environment of China have caused seriously negative impacts on the life of farmers, and even directly affected the health level of rural residents [1–3]. Therefore, making up for the shortcomings in rural environmental governance has become a crucial challenge in China's rural social governance [4]. The low willingness of farmers to pay for rural living environment improvement has resulted in the ineffectiveness of government-led environmental improvement as a single model, which in turn has led to the low motivation of farmers to participate in village environmental improvement [5]. Therefore, the Chinese government has introduced a series of policy measures to increase the enthusiasm of farmers to participate in living environment improvement.

For example, the Chinese government issued the Three-Year Action Plan for Rural Living Environment Improvement in February 2018, which states that the wishes of the villagers should be respected and that the priorities and standards of remediation should be reasonably determined according to the needs of the villagers. Similarly, the Five-Year Action Plan on Improving Rural Living Environment (2021–2025) and Action Plan on Rural Construction presented that the government should stimulate farmers' willingness to take the initiative and ensure their participation in decision-making on living environment improvement projects. The above government documents all propose to mobilize villagers to join the construction of beautiful villages, strengthen villagers' awareness of environmental protection and enhance their consciousness, enthusiasm and initiative to participate in the improvement of their living environment. Only by giving full play to the main role of farmers can we ensure the effectiveness of rural living environment improvement. In this context, it has become an important issue to explore the intrinsic mechanism affecting farmers' participation in living environment improvement, so as to improve their enthusiasm for participating in living environment improvement.

1.1. Review of the Literature

Many scholars have conducted substantial research on the factors that influence farmers' participation in rural living environment improvement, mainly focusing on the following three aspects: first, as for the factors of government, some scholars have pointed out that insufficient government financial support [6], the promotion of urbanization and community harmony [7], community officials' conflicted roles [3], new social networks of trust at the local level [8], the inadequate institutional mechanism of rural environmental governance [9,10] and innovation and technology adoption effects of past environmental policies [11] are factors that affect farmers' participation in living environment improvement. Second, for the factors of the village, some scholars consider the improvement measures at a village level and community participation [12], the distance between villages and county towns [13,14], village scale and residential density as factors influencing farm households' participation in living environmental improvement. Third, for the factors of farmers, some studies based on the theory of planned behavior have explored that farmers' willingness to pay and the payment level to participate in environmental improvement [15], the level of farmers' per capita income [16] and the level of environmental protection awareness [17] can have a positive impact on farmers' participation in rural living environment improvement.

The need for mobilizing effective participation by farmer beneficiaries in the management of irrigation systems as well as other local commons has increasingly been voiced in recent years [18,19]. However, the initiative of Chinese farmers to participate in village governance is not high. On the one hand, Chinese rural areas coexist as both a traditional agricultural society and a modern industrial society. The typical features of living in groups in rural society are still widespread, and farmers' behavior often revolves around clan-based social networks [20,21]. As a public organization formed by the family, Chinese villages mainly use the internal authority of the family to allocate resources and regulate and guide the behavior of farm households. On the other hand, it is necessary to notice that for the village, as a grassroots public organization with collective autonomy, village authority is also an important mechanism to achieve an effective allocation of resources and ensure an effective supply of rural public goods. In fact, village governance in China has always been characterized by elite governance. Village elites include "institutional elites" who hold authoritative power resources in the village and "non-institutional elites" who do not hold authoritative power resources in the village, but have some political and social influence in the village. Therefore, it is unclear how the two systems affect farmers' participation in the living environment improvement behavior.

On the one hand, in the context of the continuation of traditional village governance and democratic villager autonomy, the clan network and the village chief authority represent the informal and formal authority of village governance, respectively [22] Some scholars argue that with economic development and social transformation, traditional rural

areas will gradually transform into modern rural areas where clan networks no longer influence the level of village public services [23]. However, some have thought that ethnic diversity is related to the lower provision of some public goods and to the higher provision of others. In some cases, there is no clear relationship [24,25]. On the other hand, some think there are four relationships between formal and informal institutions, comprising complementary, accommodating, competing and substitutive relationships [26]. Roy [27] suggested that both can influence other members of the organization and even the community structure, and contribute to the development of the village by virtue of their own superior resources, playing a 'leadership, management, decision-making and integration function' in village community life, while Chen [28] disagreed with this statement. Therefore, it can be seen that existing research on the impact of clan networks on the level of public services in villages is divided. In other words, it is not clear whether the clan network will affect farmers' behavior. It is not clear what relationship exists between formal and informal institution in rural China, and the mechanism of farmers' participation in public affairs is blurry between these two systems. Our paper is a discussion of these controversial issues.

1.2. The Aim of the Research

Compared to the existing studies, the contribution of this paper is mainly in the following three aspects: firstly, it examines whether there is a synergistic effect of both informal and formal institutions on the participation of rural households in living environment improvement in traditional Chinese rural areas with a strong local culture. Secondly, the paper considers whether the experience of rural households working outside the home has a differential impact on their participation in public affairs governance in the context of large-scale urban-rural labor mobility in China. Thirdly, this paper analyses the influencing factors of rural households' participation in living environment improvement from multiple perspectives, in order to provide a more realistic and complex explanation for further understanding the real-life dilemma of rural households' participation in living environment improvement.

Therefore, in the process of promoting farmers' participation in living environment improvement, do clan networks and the perceivable authority of village chiefs influence farmers' adoption of living environment improvement measures? What is their mechanism of action? This is still an important issue worth exploring under the implementation of the rural revitalization strategy. Therefore, based on theoretical analysis and the construction of research hypotheses, using the micro-survey data of 683 households in the Henan, Shaanxi and Sichuan provinces to identify the current situation of farmers' participation in living environment improvement, this paper explores the influence of clan networks and village chiefs' perceptible authority on farmers' participation in living environment improvement, and further tests the mechanism of influence of clan networks and village chiefs' perceptible authority on farmers' adoption of living environment improvement measures on this basis.

2. Background Analysis and Hypothesis Development

2.1. The Impact of Clan Networks on Farm Household Participation in Rural Living Environment Improvement

A social network, commonly known as relationships, is a concept from sociology that is widely used in economics. The ties that form such networks vary from country to country. This includes the existing caste-based networks in India, that are measured as the number of adopters amongst relatives and friends [29,30], club-based networks in the USA, race-based networks in some African countries, which define segregation as a microecological process that 'shapes relations in contexts where members of different groups share proximity and co-presence and where racial boundaries are fleeting and informal' [31] and blood-based networks in Chinese rural society [32].

After China's Reform and Opening-up, the revitalized clan became a joint group which no longer served to rebuild the authority of the patriarch, but instead played a role

in rebuilding the cohesion and sense of identity within the clan, which is conducive to collective action and normative control [33]. Based on the authority and collective action of the patriarch within the clan, the clan organization in rural China has a great impact on the behavior of farmers. In China's rural villages, the village head is elected by all the villagers [34], so most of the village heads are elected from the clan heads, especially in some single-clan villages whose patriarch is highly likely to be elected as the village head. To some extent, the goal of the village head is the goal of the clan. Therefore, the clan will complete the task of the village head to improve the environment while protecting the tradition. In other words, the existence of the clan network will promote farmers' participation.

A clan network is a family organization formed by families related by male lineage and regulated by the concept of patriarchy, a kinship community formed by families with a common ancestor [35]. In fact, clan networks can be divided into two dimensions: clan network scale and strength, with clan network scale measured by the population ratio of family surnames, and strength reflecting intra-clan cohesion and the possibility of collaboration among members [36]. In traditional rural societies of China, people's behavior often revolves around clan relations. Su et al. [33] highlight that a clan can overcome the problem of collective action by giving members a sense of belonging and building trust. Clan networks can rebuild intra-clan cohesion and identity, promote collective family action and normative control and influence farmers' decisions to participate in living environment improvement. On the one hand, village living environment improvement is not only an act of the household, but also a public affair at the village level, with the attributes of a public good. As an informal institution for regulating the behavior of farmers, clan organizations can effectively exercise moral authority and moral restraint to guide farmers to reduce "free-riding" behavior and promote their participation in living environment management. On the other hand, clan networks formed on the basis of blood and kinship can play the role of 'bridge' and 'glue', which can significantly increase the possibility of collective cooperation among individual farmers, thus realizing the unity of individual and collective interests and effectively promoting the collective action of village environmental management. Based on the above analysis, this paper proposes the following hypotheses:

Hypothesis 1 (H1): *The scale of the clan network will have a positive impact on the participation of farm households in living environment improvement.*

Hypothesis 2 (H2): *The strength of the clan network will have a positive impact on the participation of farmers in living environment improvement.*

2.2. The Impact of Village Chiefs' Perceived Authority on Farmers' Participation in Rural Living Environment Improvement

The perceivable authority of village chiefs refers to the extent to which farmers agree with the village chief's social and moral reputation, professional knowledge and ability and management experience [35,37]. Village chiefs have long played an important role in the development and construction of Chinese villages, and as direct managers of village organizations, farmers' perceptions of their authority will directly affect the promotion and development of village public affairs. The influence of the village chief's perception of authority on the participation of farmers in living environment improvement is mainly reflected in two aspects. On the one hand, the village chief's personal social and moral reputation is an important source of his authority. The authority of the village chief helps to create a cohesive group within the organization, which in turn reduces management and agency costs and increases the efficiency of the members' performance [38]. The higher the moral reputation of the village chief, the lower the likelihood of moral hazard in policy implementation, the more likely he or she is to be supported by villagers and the higher the level of trust of households in him or her. The higher the trust in village chiefs, the higher the willingness of farmers to respond to environmental policies at the grassroots level, and the higher the motivation of farmers to participate in living environment improvement. On the

other hand, the professional knowledge and management experience of village chiefs are also an important source of their authority. The higher the perceived authority of the village head, and the more professional knowledge and management experience the village head has, the more rational the village head will be in making decisions. The more thoroughly the village head understands the policies and measures at the grassroots level, the more scientific and appropriate the specific implementation methods and approaches will be, and the higher the response of farmers to the grassroots environmental improvement policies. Based on the above analysis, our study proposes a third hypothesis as:

Hypothesis 3 (H3): *The perceivable authority of village chiefs has a positive impact on farm households' participation in rural living environment improvement.*

2.3. Moderating Effects of Village Chiefs' Perceivable Authority

As mentioned above, clan networks can influence farmers' participation in living environment improvement, but are not sufficient to fully resolve conflicts of interest in the process of living environment improvement and require some degree of formal institutional support and protection. The clan network not only has a direct influence on farmers' living environment improvement behavior through clan agents, but also strengthens cooperation with the local government to 'clan-ize' village governance [39], making clan agents and village agents one and the same, thus influencing farmers' behavior through the authority of village chiefs. There have been studies that show that there is a principal–agent mechanism in Chinese rural governance [40], whereby the agents of the informal institution of clan organizations are internalized as the head of the village collective organization, who is also the agent of the village clan organization. Through the agents of the clan, the clan organization influences the behavior of clan members in improving the human environment, which in turn influences the behavior of farmers outside the clan through the 'herd effect'; at the same time, some of the agents of the clan are internalized as agents of the village and influence the behavior of farmers in improving the environment through the perceived authority of the village head. Under the premise of formal institutional constraints, the clan network has a certain restraining effect on the rural living environment improvement behavior of farmers; that is, once farmers are found to have damaged the living environment, they will face criticism and punishment from clan members or the village community, causing them direct losses in the clan organization. In turn, with the restraint of the village chief's authority, the various forms of punishment will, to a certain extent, also affect the reputation and face of the farmers in the village collective [41], thus further enhancing the binding effect on the farmers' living environment behavior. In this regard, the interaction between the clan network and village chief authority will affect individual living environment improvement behavior, especially in the context of improving the quality of grassroots village cadres and optimizing the level of governance. Farmers with different clan network scales and strengths as the participating subjects of living environment improvement will show different levels of participation in living environment improvement behavior under different perceived conditions of village chief authority. Based on the above discussion, our study puts forward a fourth hypothesis as:

Hypothesis 4 (H4): *The perceivable authority of the village head plays a moderating role in the relationship between the clan network and farmers' participation in rural living environment improvement.*

2.4. Analysis of the Impact of Having or Not Having Experience of Working Outside the Home on Farm Household Participation in Living Environment Improvement

Behavioral decision theory suggests that individuals are susceptible to perceptual biases when identifying problems and making decisions. According to the Chinese Farmers' Development Report 2013, farming households who work outside of China have a low level of interest and participation in village affairs. There are two main ways in which migrant workers have a negative impact on farmers' participation in living environment improvement. Firstly, migrating to work will lead to a shift in the orientation of farming

households from within the village to outside the village, and a corresponding decrease in the frequency of family participation in clan activities, which in turn will affect farming households' enthusiasm for participating in village public affairs. Secondly, migrant workers will lead to a change in the main decision makers in the household, i.e., the proportion of women and older people making decisions will increase. However, compared to young male decision-makers, women and the elderly are less educated and have weaker social capital, have more conservative values and perceptions and will focus more on private and family affairs, thus lacking interest in village affairs such as living environment improvement [42]. Therefore, there is a significant difference in the influence of the clan network on the participation in living environment improvement between two categories of farmers with and without experience of going away. This leads to the following fifth hypothesis; Figure 1 represents the theoretical model of this study.

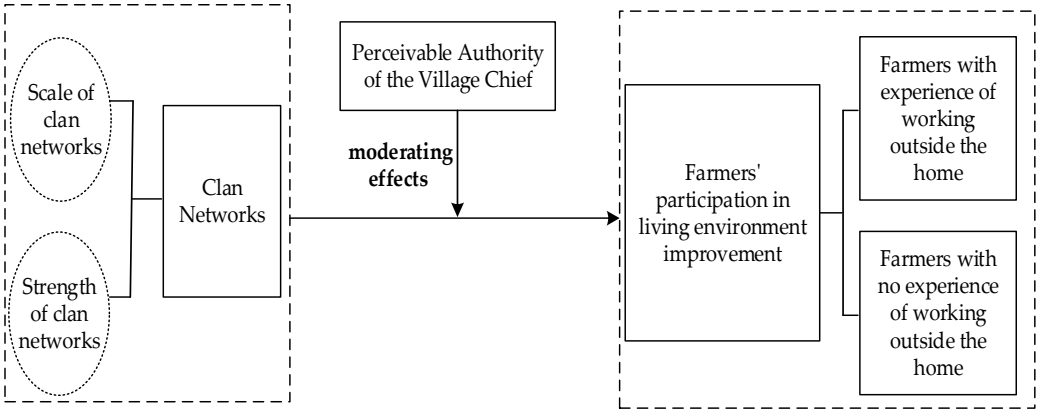

Figure 1. Theoretical model of the impact of clan networks and perceivable authority of the village chief on farmers' participation in living environment improvement.

Hypothesis 5 (H5): *Working outside the home can discourage farming households from engaging in living environment improvement behaviors compared to groups that do not work outside the home.*

3. Materials and Methods

3.1. Data Source

A stratified sampling method was adopted to collect the empirical data. The data used for this study came from a survey of farm households in the Henan, Shaanxi and Sichuan provinces in July and August 2018 by the Rural Revitalization and Talents in the Countryside project team. A total of nine prefecture-level cities were selected for the comprehensive study: Anyang, Nanyang and Puyang in Henan Province, Yulin, Xianyang and Ankang in Shaanxi Province and Nanchong, Suining and Chengdu in Sichuan Province, the survey regions are shown in Figure 2. The selection of these nine cities was based on three main considerations: the level of economic development, the state of environmental quality and the implementation of rural living environment improvement work. The specific sampling process was as follows: firstly, 1 to 2 counties (county-level cities and districts) were randomly selected in each city; secondly, 2 to 3 townships (towns) were selected in each county (county-level cities and districts) according to the purpose of the survey and the briefing by the head of the Agriculture and Rural Bureau; then, 2 to 3 administrative villages with a large village population were selected in each township (town); finally, 10 to 15 farming households were randomly selected in each sample village. The farm household questionnaire included basic information on farm households, the situation of farm clan networks and the situation of farm household domestic waste disposal and toilet renovation. The village questionnaire mainly covered the village population structure, village living environment improvement measures and whether the village was a scenic spot.

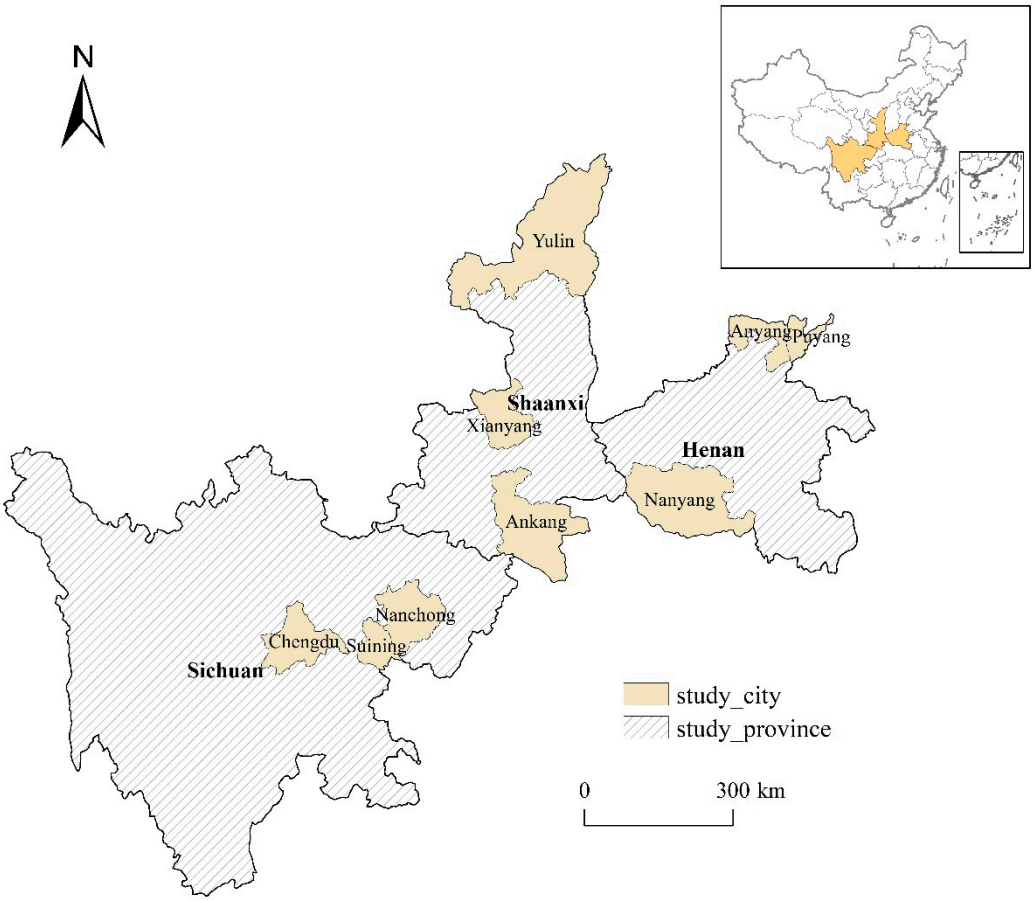

Figure 2. Map of survey regions.

A total of 718 farmers' questionnaires and 86 village-level questionnaires were collected in this survey, of which the response rate for the farmers' questionnaire was 84.47%. Excluding invalid questionnaires such as those with too much missing information and outliers, 683 valid questionnaires for farmers and 83 valid questionnaires for villages were finally obtained and the effective rates of the questionnaires were 95.13% and 96.51, respectively. There were 238 valid questionnaires in Henan Province, 240 in Shaanxi Province and 205 in Sichuan Province. The questionnaire included six parts: household population, household income and expenditure and assets, household land management, returning home to start businesses and industrial management, household cognition of living environment policy and village chiefs and social network and social capital. Most of the questionnaire questions were objective questions. For some subjective questions that were difficult to measure, a 5-point Likert scale was used to investigate. About half of the questionnaires were single choice and the other half were multiple choice.

Table 1 shows the basic characteristics of the sample farm households and individual household heads. The results show that the household heads were mainly men (70.57%) over 40 years old (86.24%), while 19.43% of household heads were female. Second, the educational level of household heads was primarily concentrated in junior secondary, with junior secondary and below accounting together for more than half of respondents (70.72%); this reveals that the educational level of household heads is generally low. Third, from the perspective of farm size, farmers with a planting scale of 4–6 mu (1 mu = 1/15 ha) accounted for 71.89% of the total sample. Fourth, from the perspective of household income level, farmers with household incomes of less than RMB 100,000 (during the study period, USD 1 = RMB 6.78) accounted for 63.10% of the total sample, and those with incomes of over RMB 100,000 accounted for 36.90% of the total sample. Fifth, the distance between

household and county mainly under 19 km^2 (73.34%). Overall, the characteristics of sample farmers were essentially consistent with the actual situation in rural areas of China.

Table 1. Descriptive statistics.

Variables	*N*	%	Variables	*N*	%
Gender			Education level		
Male	482	70.57	Illiterate and Primary	156	22.84
Female	201	29.43	Junior secondary	327	47.88
Age			Junior college and above	200	28.68
Under 40	94	13.76	Household income level		
40–59	439	64.28	Under RMB 50,000	173	25.33
60 and above	150	21.96	RMB 50,000–100,000	258	37.77
Farm size			Above RMB 100,000	252	36.90
Under 3 mu	136	19.91	Distance to the county		
4–6 mu	491	71.89	Under 10 km^2	331	48.46
Above 6 mu	56	8.20	11–19 km^2	170	24.89
			Above 20 km^2	182	26.65

Note: Data source was accessed from July and August of 2018.

3.2. Variable Measurements

3.2.1. Dependent Variables

Referring to the "Three-Year Action Plan for Rural Living environment Improvement" issued by the General Office of the CPC Central Committee and General Office of the State Council of the People's Republic of China, and drawing on the studies of Luo et al. [1], the two indicators of "whether to participate in domestic solid waste disposal and whether to use flushing sanitary toilets" were used to measure farmers' participation in rural living environment improvement behavior. If a farmer threw household waste into a garbage pool or garbage can, the household was assigned a value of 1 for participation in solid waste disposal, and otherwise, a value of 0. If a farmer used a flushing toilet that met the harmless treatment standard, the variable was assigned a value of 1 for flushing toilets, and otherwise, a value of 0.

3.2.2. Core Independent Variables

Families in Chinese villages share a blood-based clan organization, and the existence of this organization increases the likelihood of collaboration to some extent. The population scale of the clan is a natural measure of the clan network [43]. However, clan population scale is only a measure of clan network scale, not strength, and some studies [44] have argued that network strength (or cohesion) is often more important in the context of mutual benefit or risk sharing within the clan. Therefore, in this paper, we set the questions "Is your family a big surname in the village?" and "Does your family belong to a clan with a genealogy or ancestral hall?" to measure the scale and strength of clan networks, respectively.

3.2.3. Moderating Variables

Village head authority is a psychological perception, and many scholars at home and abroad have set scales to measure it according to the changes in the scenario. Drawing on Moore, Firstenberg et al. and Greve et al. [45–47], the author measured the perception of village chief authority by setting five question items. Based on this, the author used SPSS 23.0 statistical software to perform dimensionality reduction through exploratory factor analysis, and tested the reliability and validity of the scale data before factor analysis. The results of the factor analysis showed a KMO statistic of 0.867 and a *p*-value of 0.000 for the Bartlett's spherical test, indicating that the sample data were suitable for factor analysis. One common factor was obtained from the five indicators by dimensionality reduction, factor extraction and factor rotation techniques on the data, and then this common factor was

standardized and incorporated into the model. The Cronbach's value for the indicator was 0.671, indicating that the extracted common factor was well represented. The descriptions of the settings and assignments of the indicators for measuring the perceived authority of village leaders are shown in Table 2.

Table 2. Definition and summary statistics of the selected variables.

Variables	Definition (Unit)	Mean	Std. Dev
The use of flush toilets by farmers	Does your household toilet use flush toilets? Yes = 1; No = 0	0.77	0.42
Domestic solid waste disposal behavior	Is your household solid waste disposed of in an environmentally friendly manner? Yes = 1; No = 0	0.73	0.45
Clan network scale	Is your family a big surname in the village? Yes = 1; No = 0	0.34	0.47
Clan network strength	Does your family clan have a family tree or ancestral hall? Yes = 1; No = 0	0.21	0.40
Perceivable authority of the village chief	Calculated from factor analysis	0.62	0.16
Age	Age of head of household (years)	51.43	11.01
Gender	Gender of head of household: male = 1; female =0	0.92	0.27
Years of education	Number of years of education for the head of household: illiterate and primary = 1; junior secondary = 2; junior college and above = 3	2.06	0.72
Total household income is taken as logarithm	Total annual household income taken as logarithm	1.47	19.62
Total number of families	Total number of family members (persons)	4.65	1.41
Living environment improvement measures at village	Does your village help with living environmental improvement in the village? Hardly = 1; Relatively little = 2; Average = 3; More = 4; Very much = 5	3.58	1.00
Centralized water supply	Is the village collective centrally supplied with running water? Yes = 1; No = 0	0.96	0.12
Availability of public litter bins in villages	Whether public litter bins have been installed by the village community? Yes = 1; No = 0	0.45	0.55
Whether the village is a tourist attraction	Whether the village is a tourist attraction: Yes = 1; No = 0	0.33	0.47
Distance of village from county town taken as logarithm	Distance of village from county town taken as logarithm	1.07	0.42
Whether it is Shaanxi province	Whether the sample is located in Shaanxi province: Yes = 1; No = 0	0.41	0.50
Whether it is Henan province	Whether the sample is located in Henan province: Yes = 1; No = 0	0.30	0.50

Notes: Data source was accessed from July and August of 2018.

3.2.4. Control Variables

Many studies have confirmed that individual characteristics, family characteristics and village characteristics of farm households have important effects on farm households' willingness to participate in living environment improvement and behavior [48,49]. Drawing on existing research results, this paper divides the control variables that may affect farm households' participation in living environment management into three categories. First, variables reflecting the characteristics and perceptions of household heads, such as

their gender, age, health status, years of education and whether they are party members. Second, variables reflecting farm households' characteristics, such as total household income and total household population. Third, variables reflecting village characteristics, such as rural-level living environment improvement measures, centralized supply of tap water, setting of public garbage cans by village collectives, whether the village is a tourist attraction, distance between the village and the county and regional dummy variables. The settings, meanings and descriptive statistics of the relevant variables are shown in Table 2.

3.2.5. Instrumental Variables

Additionally, instrumental variables were introduced because clan networks may pose problems for farmers' confidence in participation in living environment improvement. We focused on the impact of farmers' clan networks on participation in living environment improvement within the context of rural modernization of China. The "clan network" in a village where farmers live was selected as the instrumental variable of farmers' clan networks. If the clan network in the village where the farmer lives is relatively higher, the farmers' clan network will be more significant [50]. At the same time, the clan network in the village where the farmers live is not directly related to the farmers' participation in living environment improvement, so it is strictly exogenous. The data for the instrumental variables were derived from the survey data for the village level.

3.3. Common Method Bias Test

The scale questionnaire method was used to collect data for this study. Due to the particular measurement method (such as measurement context, item context or item-specific characteristics), potential systematic measurement error will inevitably occur, often referred to as common method bias. Such systematic errors can lead to incorrect causal inferences and seriously affect the accuracy of results. To avoid the effects of such systematic errors, the following measures were taken in this study: pre-control and post-testing addressed the potential common method bias. Initially, both objective and open-ended questions were inserted into the questionnaire. At the same time, the data were tested using Harman's one-way test [51]. As per previous practice, exploratory factor analyses were conducted on all latent variables under a non-rotated extraction method with eigenroots greater than 1. The results indicated that the first principal component explained 23.75% of the total variance, less than half of the total variance accumulated; this indicated that the established generic approach to the data was not subject to significant generic method bias.

3.4. Econometric Model

Based on the previous theoretical analysis, this paper constructs a model of the clan network and village head's perception of authority on farmers' participation in living environment improvement. The core explanatory variables are the clan network and the perceivable authority of the village head, and the control variables include the individual characteristics, family characteristics and village characteristics of the respondent. Considering that the explanatory variable is a dichotomous variable, this paper intends to use a binary logistic regression model to analyze the influence of clan network and village head authority perception on farmers' participation in living environment improvement, and its potential model can be set as follows.

$$FB_i = \beta_0 + \beta_1 CN_i + \beta_2 LN_i + \sum_{k=1} \beta_3 C_i + \varepsilon_i \quad (1)$$

where i represents the ith farmer; FB_i is the dependent variable representing the participation behavior of the ith household; CN_i is the key independent variable representing the clan network; LN_i is the perceived authority of the ith household; C_i represents the control variables, which include household head characteristics, family characteristics and village

characteristics; β_i is the estimated parameter; ε_i is the error term that obeys a standard normal distribution and $F(\cdot)$ is a function.

For farmers with different perceptions of village head authority, there may be differences in the influence of clan networks on their participation in rural living environment improvement behavior. In order to explore the influence of village head authority perceptions, this paper further examines the interaction effect between clan networks and village head authority perceptions. At this point, the binary choice model of farmers' participation in living environment improvement can be defined as.

$$FB_i = \beta_4 + \beta_5 CU_i + \beta_6 LN_i + \beta_7 CU_i * LN_i + \beta_8 C_i + \varepsilon_i \quad (2)$$

where i represents the ith farmer; CU_i is the perceived authority of the village head; $CN_i * LN_i$ reflects the interaction term of the perceived authority of the village head and the farmer's clan network and the other variables are set in the same way as in Equation (1).

3.5. Basic Steps

To explore the relationships between the clan network, perceivable authority of the village chief and farmers' participation behavior in living environment improvement, as well as their interaction mechanism, the empirical analysis steps of this paper were as follows: firstly, the benchmark was returned to explore the influence of clan networks and the perceivable authority of village chiefs on farm household participation in living environment improvement. Second, the moderating effect of the village head's perceivable authority on each dimension of the clan network was explored. Finally, the samples were classified according to whether they had experience of working outside the village, and whether the direct and moderating effects differed across the samples.

4. Results

4.1. Basic Regression

Before regression, the variables were first diagnosed for covariance, considering the possible problem of covariance between the variables. The estimation results showed that the variance inflation factor was 1.15 (VIF less than 2) for all variables, indicating that the possibility of multicollinearity among the variables was very small. Table 3 reports the results of the regressions performed by stepwise introduction of explanatory variables to the model. The dependent variable in regressions 1 and 2 was solid waste disposal behavior, and the dependent variable in regressions 3 and 4 was the behavior of using flushing sanitary toilets. The pseudo-R^2 values in the first four regressions were significant at different levels, indicating a good model fit, while the regression estimates showed that the significance of the core variables and the positive and negative signs of the coefficients did not change, indicating that the estimates were robust.

Table 3 estimates the results of the impact of clan networks on farmers' participation behavior in living environment improvement. The dependent variable in Models 1 and 2 was the farmer's participation in solid waste disposal behavior, and the dependent variable in Models 3 and 4 was the behavior of using flushing sanitary toilets. Models 1 and 3 examined the effect of clan network size on the dependent variable, and Models 2 and 4 examined the effect of clan network strength on the dependent variable, respectively.

For the impact of the clan network scale and clan network strength on farmers' participation behavior in living environment improvement, the regression results show that the clan network scale variable is insignificant, while the clan network strength is significant at the 1% statistical level, indicating that clan network strength positively affects farm households' living environment improvement behavior. Hypothesis 1 can be rejected and Hypothesis 2 can be verified. With the disintegration of traditional villages, some villages still have large surnames, but their cohesion is not as strong as before; the influence and authority of clan agents are seriously weakened, and the impact of clan network size on farmers' participation in living environment improvement is low. The possible reason for the significant clan network strength variable is that the greater the strength

of the clan network, the higher the degree of clan members' recognition of the clan; the stronger the influence of the clan organization and the stronger the appeal of the clan agents to the members, the higher the likelihood that farmers will carry out solid waste disposal and use flushing toilets, resulting in a higher enthusiasm to participate in living environment improvement.

Table 3. Regression results of the models of whether farmers participate in solid waste disposal and whether they use flushing toilet.

Variables	Model 1	Model 2	Model 3	Model 4
Clan network scale	0.011 (0.035)	-	0.026 (0.034)	-
Clan network strength	-	0.170 *** (0.038)	-	0.139 *** (0.038)
Perceived authority of the village chief	1.101 *** (0.935)	1.126 *** (0.093)	0.814 *** (0.096)	0.829 *** (0.095)
Age	0.003 (0.002)	0.003 (0.002)	0.000 (0.002)	0.000 (0.002)
Gender	0.032 (0.062)	0.027 (0. 060)	0.055 (0.060)	0.049 (0.060)
Years of education	0.007 ** (0.024)	0. 006 ** (0.024)	0.071 ** (0.024)	0.067 ** (0.023)
Health Level	−0.007 (0.019)	−0.005 (0.019)	−0.036 (0.017)	−0.035 (0.017)
Total number of families	0.012 (0.012)	0.008 (0.012)	0.026 * (0.011)	0.022 * (0.011)
Total household income is taken as logarithm	0.006 (0.043)	0.006 (0.042)	0.053 (0.042)	0.061 (0.041)
Living environment improvement measures at village-level	0.019 (0.017)	−0.023 (0.017)	0.015 (0.016)	0.013 (0.016)
Centralized water supply	0.032 (0.017)	0.022 (0.020)	0.007 * (0.025)	0.012 * (0.022)
Availability of public litter bins in villages	0.100 ** (0.156)	0.108 ** (0.158)	0.095 (0.160)	0.098 (0.159)
Whether the village is a tourist attraction	0.104 *** (0.037)	0.100 ** (0.036)	0.124 *** (0.037)	0.114 *** (0.037)
Distance of the village from the county town is taken as logarithm	−0.040 ** (0.043)	−0.101 ** (0.041)	−0.048 (0.040)	−0.069 (0.039)
Province dummy variables	Yes	Yes	Yes	Yes
Constants	−2.353 *** (0.912)	−2.833 *** (0.932)	−2.703 *** (0.920)	1.316 *** (0.897)
Pseudo-R^2	0.173 ***	0.194 ***	0.169 ***	0.183 ***
LR cardinality	99.31 ***	106.78 ***	97.00 ***	103.87 ***
Number of observations	683	683	683	683

Note: ***, ** and * represent significance levels of 1, 5 and 10%, respectively. Robust standard errors are in parentheses.

For the impact of the perceivable authority of the village chief on farmers' participation behavior in living environment improvement, a higher perceivable authority of the village head has a positive effect on farmers' participation in solid waste disposal and use of flushing toilets at the 1% statistical level, and the farmers are more likely to participate in rural living environment improvement, meaning that Hypothesis 3 can be verified. On the one hand, the higher the farmers' perception of their authority, the higher the farmers' recognition of the village chief's social moral level and strong management ability; the higher the farmers' tendency to believe that the village chief has a good knowledge base and can lead the village collectively to achieve certain achievements, the higher the likelihood that the village chief is respected and recognized by the farmers. On the other hand, the higher the farmers' perception of the village head's authority, the fewer obstacles the village head faces—as the main body responsible for the implementation of grassroots policies—in carrying out living environment improvement measures, and the more motivated the farmers are to participate.

The number of years of education is significant at the 5% statistical level with a positive coefficient, indicating that the higher the number of years of education of the household head, the more likely the farm household is to participate in rural living environment improvement. The possible explanation for this is that higher years of education can improve the household head's awareness of environmental protection and understanding of national policies, while higher years of education may lead to higher personal cultivation

and more attention to their own words and behaviors, so they are more likely to participate in living environment improvement. For regressions 1 and 2, the installation of public garbage bins by village collectives is significant at the 5% statistical level with a positive coefficient, indicating that the installation of public garbage bins by village collectives promotes farmers' solid waste disposal behavior. The village distance from the county variable is significant at the 5% statistical level with a negative coefficient, indicating that the farther a farmer's village is from the county, the less likely he or she Is to participate in solid waste disposal. This may be due to the fact that the farther the distance from the village to the county town, the higher the cost of solid waste disposal due to transportation costs, and the less willing the farmers are to participate in living environment improvement. For regressions 3 and 4, the total household scale variable is statistically significant at the 10% level with a positive coefficient, indicating that the larger the household size, the higher the likelihood of using flushing sanitary toilets. A possible explanation for this is that the larger the household scale, the higher the demand for sanitary latrines and the higher the motivation to use flush latrines. The centralized supply of tap water variable was statistically significant at the 10% level with a positive coefficient, indicating that the centralized supply of tap water by the village community would promote the use of flush toilets by farm households. The variable of whether the village is a tourist attraction has a significant positive effect on farm households' participation in rural living environment improvement at the 10% statistical level. The possible explanation is that for tourist attractions, the tourism sector and local grassroots government are stricter and more meticulous in implementing environmental remediation measures, based on considerations of local tourism attractiveness and economic growth.

4.2. The Moderating Effects of the Perception of the Authority of the Village Chief on Farmers' Participation Behavior in Living Environment Improvement

As described in the previous robustness test, both explanatory and moderating variables are categorical variables, and analysis of variance with full sample interaction effects are moderating effects [52]. The results of regressions 5-8 in Table 4 show that clan network scale is statistically significant at the 10% level and clan network strength is statistically significant at the 1% level. Therefore, the clan network has a significant positive effect on farmers' participation in living environment improvement behavior. The interaction terms of clan network scale, strength and village head authority perception are all significant at the 5% statistical level with positive coefficients, indicating that village head authority perception plays a significant positive moderating role in the influence of clan network strength on farmers' participation in living environment improvement behavior. Therefore, the stronger the farmers' perception of village head authority, the stronger the promotion effect of clan network on farmers' participation in living environment improvement, meaning that Hypothesis 4 can be verified. The possible reason is that the clan network formed based on geography, blood and kinship can contribute to the promotion of farmers' participation in living environment improvement, and at the same time, in the context of the current gradual regulation of village governance, the authority of the village head can give full play to the normative role of formal regulation, increase farmers' enthusiasm to participate in rural public affairs and significantly increase the possibility of farmers' participation in collective village living environment.

4.3. Analysis of Farm Household Participation in Living Environment Improvement by Different Groups of Migrant Workers

The previous paper analyzed the influence of clan networks on farm households' participation in living environment improvement, but the literature has found that rural population mobility affects their social identity and changes the sense of clan affiliation [53]. Therefore, this paper further explores the heterogeneity of clan networks influencing farm households' participation behavior in living environment improvement by dividing the sample farm households into two categories according to whether or not the head of the household has experience in working outside the home. The regression results are

shown in Table 5. Both the clan network and the perceivable authority of the village chief are significant, the signs of the regression coefficients remain consistent with whether farmers participate in solid waste disposal or whether they use flushing toilets in the overall sample and the results are more robust. Meanwhile, compared with the sample without outworking experience, the coefficients of clan network scale in the sample with outworking experience decreased from 0.249 and 0.350 to 0.201 and 0.329, respectively, and the coefficients of clan network strength decreased from 0.257 and 0.268 to 0.192 and 0.225, respectively, indicating that with outworking experience, the positive influence of clan network on farmers' living environment treatment behavior is significantly reduced.

Table 4. Moderating effect of village head authority perception on whether farmers participate in solid waste disposal and use flush toilets or not.

Variables	Model 5	Model 6	Model 7	Model 8
Clan network scale	0.061 * (0.168)	-	0.087 * (0.135)	-
Clan network strength	-	0.154 *** (0.175)	-	0.133 *** (0.145)
Village Chief's Authority Perception	0.862 *** (0.080)	0.740 *** (0.236)	0.771 *** (0.143)	0.788 *** (0.187)
Clan network scale × perceivable authority of village chief	0.622 ** (0.267)	-	0.301 ** (0.220)	-
Clan network strength × perceived authority of village chief	-	0.518 ** (0.270)	-	0.436 ** (0.228)
Control variables	Controlled	Controlled	Controlled	Controlled
Province dummy variables	Controlled	Controlled	Controlled	Controlled
Constants	1.779 ** (0.917)	2.010 *** (1.008)	2.596 *** (0.936)	2.369 *** (0.993)
Pseudo-R^2	0.181 ***	0.199 ***	0.169 ***	0.187 ***
LR cardinality	76.97 ***	147.02 ***	118.01 ***	120.42 ***
Number of observations	683	683	683	683

Note: ***, ** and * represent significance levels of 1, 5 and 10%, respectively. Robust standard errors are in parentheses.

Table 5. Analysis of farm household participation in living environment improvement by different groups of migrant workers.

Variables	No Experience of Working Outside the Home				Experience of Working Outside the Home			
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Clan network scale	0.249 * (0.167)	-	0.350 * (0.206)	-	0.201 * (0.229)	-	0.329 * (0.260)	-
Clan network strength	-	0.257 *** (0.184)	-	0.268 *** (0.214)	-	0.192 *** (0.236)	-	0.225 *** (0.275)
Perceivable authority of village chief	0.630 *** (1.754)	0.724 *** (0.246)	0.952 *** (0.173)	0.615 *** (0.293)	1.058 *** (0.240)	0.805 ** (0.300)	0.775 *** (0.225)	0.940 ** (0.361)
Clan network scale × perceivable authority of village chief	0.407 ** (0.273)	-	0.419 ** (0.331)	-	0.510 ** (0.364)	-	1.011 ** (0.419)	-
Clan network strength × perceivable authority of village chief	-	0.625 ** (0293)	-	0.720 ** (0.332)	-	0.580 ** (0.366)	-	0.642 ** (0.422)
Control variables	YES	YES	YES	YES	YES	YES	YES	YES
Province dummy variables	YES	YES	YES	YES	YES	YES	YES	YES
Constants	2.513 *** (1.165)	3.277 *** (1.218)	2.934 *** (1.138)	2.714 *** (1.222)	3.759 *** (2.040)	1.130 *** (1.773)	2.396 *** (1.829)	3.759 *** (2.040)
Pseudo-R2	0.211 ***	0.207 ***	0.201 ***	0.229 ***	0.148 ***	0.164 ***	0.234 ***	0.236 ***
LR cardinality	87.82 ***	105.56 ***	95.84 ***	100.42 ***	49.09 ***	51.64 ***	39.63 ***	38.71 ***
Number of observations	401	401	401	401	282	282	282	282

Note: ***, ** and * represent 1, 5 and 10% significance levels, respectively. Robust standard errors are in parentheses.

4.4. Endogeneity Test

Although Equation (1) attempts to include all the variables that may influence farmers' participation in living environment improvement behavior, there may be some factors that may affect farmers' behavior but were not included in the equation as they were overlooked, and would lead to the problem of omitted variables in the equation. Therefore, in order to correct the bias caused by the potential endogeneity between clan network and farmers' participation in living environment improvement behavior, this paper refers to the studies by Ran at el. and Wang et al. [33,54] and selects "village clan network" as an instrumental variable to re-estimate the relationship between the two. The reason for selecting this variable as the instrumental variable is that, for the same village, the village clan network consists of each farmer's clan network, and the clan network of a village does not have a direct influence on the living environment improvement behavior of a single farmer, which satisfies the requirement of exogeneity of the instrumental variable. The results of the weak instrumental variable test showed that the robust F-statistic was 23.301 (exceeding the threshold of 10), which rejected the original hypothesis that "instrumental variables are not correlated with endogenous variables" (p-value of 0.000); meanwhile, the Wald test confirmed that the original hypothesis of "weak instrumental variables" could be rejected at the 5% confidence level (p-value of 0.000). The Wald test also confirmed that the original hypothesis that the "weak instrumental variables" could be rejected at a 5% confidence level (the minimum eigenvalue statistic was 10.59, which was greater than the threshold value of 8.69). Therefore, this paper concluded that there was no problem of weak instrumental variables.

The village clan network can be calculated by the following equation.

$$K = S \times D \tag{3}$$

where S denotes network scale, D denotes network strength and K is the village clan network index that considers both clan network scale and strength dimensions. The proportion of the top three surnames in the village questionnaire was used to measure the scale of the village clan network. In this paper, the clan organizations of farmers were divided into three categories: "1. no family network or organization; 2. a clan network linked by surnames but no formal organization and 3. a clan organization centered on genealogy/shrine", and these three types of organizations were assigned the values of "1, 2, 3" in order. The strength of the village clan network was obtained by summing up the average farm clan assignment; then, the developed degree of the village clan network could be obtained by Equation (3).

Table 6 presents the estimation results using the IV-Probit model, with regressions 9 and 10 being the dependent variables of whether or not to participate in solid waste disposal and whether or not to use flush toilets, respectively. It can be seen that even after correcting for the estimation bias caused by endogeneity, the family clan network still has a positive effect on farm household participation in living environment improvement at the 5 percent level.

4.5. Robustness Check

To test the robustness of the baseline regression results, the strength of village head authority perceptions was used as the grouping criterion to group the entire sample and the effects of the clan network and village head's authority perceptions on farmers' participation in rural living environment improvement were estimated again. The regression results of the subsamples are shown in Table 7. The regression results show that the clan network strength and village head authority perception variables have significant effects on the participation of farm households in living environment improvement, and compared with the baseline, the estimated results of the clan network and village head's authority perception variables are basically consistent with the results of regressions 1 to 4, indicating that the results of the benchmark regressions are more robust.

Table 6. Estimation results of the instrumental variables used in the model of whether farmers participate in solid waste disposal and whether they use flushing toilets.

Variables	(17)		(18)	
	Phase I	Phase II	Phase I	Phase II
Clan Network	-	1.163 ** (1.285)	-	1.474 ** (0.318)
Village Clan Network	0.164 *** (0.064)	-	0.182 *** (0.099)	
Perception of the authority of the village chief	0.340 *** (0.116)	1.038 *** (0.160)	0.627 *** (0.100)	0.845 *** (0.105)
Control variables	YES	YES	YES	YES
Province dummy variables	YES	YES	YES	YES
F-value	23.301	-	23.301	-
R2	0.137 ***	-	0.167 ***	-
Number of observations	683	683	683	683

Note: *** and ** represent significance levels of 1 and 5, respectively. Robust standard errors are in parentheses.

Table 7. Robustness check.

Variables	Weak Perception of Authority				Strong Perception of Authority			
	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
Clan network scale	0.045 (0.278)	-	0.027 (0.567)	-	0.158 (1.100)	-	0.134 (0.239)	-
Clan network strength	-	0.117 *** (0.318)	-	0.125 *** (0.299)	-	0.437 *** (0.280)	-	0.327 *** (0.256)
Perception of the authority of the village chief	0.986 ** (0.388)	0.868 ** (0.679)	0.836 ** (0.479)	0.886 ** (0.606)	0.946 *** (0.233)	0.666 *** (0.315)	0.633 *** (0.215)	0.634 *** (0.306)
Control variables	YES	YES	YES	YES	YES	YES	YES	YES
Province dummy variables	YES	YES	YES	YES	YES	YES	YES	YES
Constants	0.221 *** (1.939)	0.455 *** (2.019)	1.719 *** (1.890)	1.695 *** (1.922)	1.989 *** (1.255)	1.842 *** (1.418)	2.910 *** (1.226)	2.565 *** (1.425)
Pseudo-R2	0.272 ***	0.271 ***	0.215 ***	0.217 ***	0.217 ***	0.257 ***	0.175 ***	0.195 ***
LR cardinality	49.64 ***	54.50 ***	47.00 ***	49.31 ***	87.03 ***	123.43 ***	70.00 ***	81.75 ***
Number of observations	322	322	322	322	361	361	361	361

Note: ***, and ** represent significance levels of 1, and 5%, respectively. Robust standard errors are in parentheses.

5. Discussion

Although existing research has confirmed that both informal and formal institutions have an impact on farmers' participation in public affairs [55–58], in the reality of Chinese rural acquaintance society, it remains to be seen if there is any synergy or conflict relationship between informal and formal institutions and whether this relationship will hinder or facilitate farmers' participation in public affairs. Based on the real-life context of the continuous promotion of living environment improvement in Chinese rural society, this paper uses survey data from 683 rural households to explore the influence of the clan network in the informal institution on rural households' participation in living environment improvement from both theoretical and empirical perspectives, and further analyses the influence of the formal institution-based authority of village chiefs on rural households' participation behavior and the moderating effect of the perceivable authority of village chief. The impact of outworking experience on farm households' participation behavior was also considered. After robustness and endogeneity tests, the empirical results still hold, bridging the gaps of previous studies.

First, clan networks have a significant positive impact on the farmers' participation in living environment improvement, and this finding is consistent with previous research on clan networks and farmers' participation in living environment improvement [59]. Some scholars found that village leaders from the two largest family clans in a village

increased local public investment considerably. This association is stronger when the clans appeared to be more cohesive [59,60]. Tsai [61] stressed that villages where these types of informal groups exist are more likely to have better local governmental public goods provision than villages without these solidary groups, all other things being equal. In the local streets of India, the absence of a formal institution is largely compensated for by the existence of clan networks, which facilitate collective village action and the participation of farming households in the governance of village public affairs [62]. By discussing the case of environmental governance in the Netherlands, some scholars found that farmers would achieve intra-farmer cooperation in the form of environmental cooperatives, so as to conduct environmental governance through self-supervision [63].

Secondly, the perceivable authority of village chiefs based on the formal institution at the grassroots level has a significant positive impact on farmers' participation behavior. As a typical formal institution, the authority of village chiefs has a definite influence on the participation behavior of farmers in public affairs. However, scholars' conclusions on the influence of formal institution on farmers' participation in public affairs have diverged. On the one hand, some scholars have found that formal institutions are by and large working effectively in local governance in Ghana [64]. Formal institutions represent a technology that facilitates control over people and promotes farmers to submit to the government's public administration [65,66]. Cao et al. [67] believe that formal institutions, as representatives of public authority, inevitably promote the active participation of farm households in rural public affairs, such as the act of waste disposal and sewage treatment. On the other hand, Peng [68] argues that in Chinese rural areas, which have a traditional society with a strong vernacular feel, formal institutions play a minimal role in the behavior of farming households; it is mainly the informal institutions represented by clans that play a decisive role. Through theoretical and empirical analysis of the authority of village chiefs, this paper verifies that the formal institution represented by the authority of village chiefs has a positive effect on farmers' participation in village public affairs. To a certain extent, this confirms that the formal institution represented by the authority of village chiefs plays an increasingly important role in the process of farmers' participation in village public affairs in the context of the rapid development and improvement of Chinese grassroots democratic self-governance institutions.

Thirdly, the perceivable authority of the village head has a significant moderating role in the process of clan networks influencing the participation behavior of farm households. Moreover, the perceivable authority of the village head plays a moderating role in the relationship between both the scale of the clan network and the strength of the clan network on farm household participation in living environment improvement, which is not the same as the findings of previous studies. For example, clan networks and clan deals penetrate and transform the formal regime in several ways—by clan-based appointments and patronage, by stripping state assets to feed one's clan network and by crowding out other mechanisms of representation [69]. Cheng [28] focused on competing informal institution in a developing context, exploring the mechanisms through which informal rules cumulate their credibility while challenging the formal ones. Our article identifies two fundamental mechanisms that contribute to the increasing credibility of informal rules. Chinese rural practice shows that the villagers' self-governance institution, as a formal institution of rural governance, has not functioned very smoothly, and the grassroots mass self-governance, with "democratic elections, democratic decision-making, democratic management and democratic supervision" as its main elements, has deviated from the "natural" model of the institutional text and has moved towards the informal institution. Objectively speaking, the formal institution cannot eliminate the space for the informal institution to operate in rural societies, and it is necessary to take the informal institution as a prerequisite, to embed the formal institution in the cultural soil of the informal institution and to integrate the two deeply. This view is supported by studies in other countries. Ethnographic research indicates that community participation was introduced as a set of institutions that would govern how villagers interacted with the state and its water

supply, but villagers altered community participation by introducing reforms in water governance [70]. The social structures and traditional norms of rural communities, along which IAs are organized, are critically important in determining the success of collective action [18,71]. In some cases, underlying informal norms do much of the enabling and constraining that we attribute to the formal rules [26,69,72] and formal institutions are only successful when embedded in informal constraints [73].

Finally, for farmers with experience of working outside the home, the experience of working outside the home can, to some extent, discourage farmers from participating in rural living environment improvement. Possible explanations are that during the period of low rural mobility, the clan network was the only social organization that villagers could seek help from. At this time, the social security and public organization functions of the clan network were more prominent, and it also had a strong appeal and cohesive power to villagers; therefore, when it called for participation in rural public affairs, it was easy to get the response and support of villagers. As social mobility increases, a large number of farmers go out to work, spend years away or even settle in cities, leaving the rural areas and their original living environment, resulting in the weakening of the social security and public organization functions of the clan network. On the one hand, the loss of clan members means that some of them no longer rely on the security function of the clan network. On the other hand, the change in the living space of clan members and the fragmentation of their lifestyles have both increased the organizational costs of the clan in coordinating collective action, and weakened the public organizational capacity of the clan network. This has led to a decline in the incentive for migrant farming households to participate in rural living environment improvement.

The research conducted in this paper has a certain reference value for Chinese rural grass-roots governments, which can better use the clan network to guide farmers to participate in rural public affairs more actively. Moreover, it can also improve the enthusiasm of farmers to participate in the improvement of their living environment through the improvement of the village head's own governance ability.

6. Conclusions

This paper provides a theoretical analysis of farmers' participation in living environment improvement behavior from two dimensions: informal institutions and formal institutions, explores the influence of clan network and village head authority perception on farmers' participation in living environment improvement behavior and conducts an empirical test using survey data from 683 farmers in the Henan, Shaanxi and Sichuan provinces of China.

This study found that: first, the strength of the clan network and the perception of village head authority had a significant positive effect on farmers' participation in living environment improvement behavior. Second, the clan network further influences farmers' participation in rural living environment improvement behavior by affecting their perception of village head authority, i.e., the perception of village head authority plays a positive moderating role in the clan network's influence on farmers' participation in rural living environment improvement behavior. Third, for farmers with different perceptions of village head authority, the strength of the clan network differed in its contribution to their participation in rural living environment improvement behavior. The higher the farmers' perception of village head authority, the stronger the positive contribution of clan network strength to their participation in rural living environment improvement behavior; conversely, the lower the farmers' perception of village head authority, the weaker the positive contribution. Fourth, for farmers with different experiences of working outside the village, there are differences in the promotion effect of the clan network on their participation in rural living environment improvement behavior. Compared with farmers without working experience, the positive promotion effect of clan network on rural living environment improvement behavior of farmers with working experience is weaker.

Related to this study, there are some issues worthy of further study. The heterogeneity of the influence of the clan network on farmers' enthusiasm to participate in the living environment can also be considered from the perspective of farmers' own ecological environment cognition, since Chinese human living environment remediation began in 2018, during which the government has invested a large amount of funds and resources. The evaluation of the effect of the implementation of human living environment policies is a possible research direction in the future. In addition, as the Chinese rural residential environment improvement market participation is low, the causes of this realistic dilemma are also worth studying.

7. Policy Suggestion

Based on the above results, our analysis puts forward the following policy recommendations. Firstly, for the central and western provinces of China, the government should focus on the protection of traditional villages in the process of promoting the modernization of grassroots governance, ensure that the informal institution represented by traditional clans can be effectively protected and inherited, give full play to the synergistic role of village clan culture in the governance of the village environment and combine the inheritance and promotion of traditional clan culture with the construction of the rural society. Secondly, timely training of grassroots cadres in professional knowledge and skills, policy propaganda and interpretation should be carried out to improve the professional ability and governance capacity of grassroots village cadres represented by village chiefs, to form positive perceptions of village cadres among farmers, and to promote better functioning of grassroots cadres in grassroots environmental governance. Finally, the influence of traditional clan organizations should be paid attention to in the process of promoting the modernization of grassroots governance. This is in order to avoid conflicts of interest between clan organizations and grassroots village collective organizations, and effectively utilize the positive role of clan agents and their influence in promoting grassroots living environment improvement.

8. Limitations of the Article

There are several limitations to this study. First, among the control variables, the cost of farmers' participation in living environment improvement should be included. However, due to data availability issues, the sample in this paper could not be stripped of the cost of farmers' participation in environmental improvement alone. It is recommended that the variable of cost should be further controlled for in future studies. Secondly, in the Chinese government document, living environment improvement includes three categories: solid waste treatment for farm households, sanitary toilet renovation and rural domestic sewage treatment, but the significant difference between domestic sewage treatment and the other two is that treatment facilities require a huge cost investment and are mainly constructed by the government or social capital in the early stage. In the absence of pre-construction pipeline network, the villagers do not have the realistic possibility to participate in the domestic sewage treatment. Therefore, this paper does not include it in the scope of the discussion of the improvement of the human environment, and future research can include it in the scope of discussion or discuss it separately.

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