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Will Social Network Relationship Significantly Enhance Farmers' Participation in the Supply of Small Water-Saving Irrigation and Water Conservancy Facilities in China?

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Abstract: The supply level of irrigation and water conservancy is related to the utilization efficiency of water resources, the production level of farmers, and the supply quality of agricultural products, especially relating to national food security and stability. Based on 1169 pieces of data collected from field surveys in three provinces of China in 2019, an evaluation system of social network relationships was constructed from five aspects: network scale, network tightness, trust and commitment, social atmosphere and sense of belonging, and social participation. These five aspects are the channels for farmers to obtain information. A binary logistic model was used to analyze the impact of the social network relationships on farmers' participation in small water-saving irrigation and water conservancy facilities supply, and the key factors affecting farmers' behavior were selected. The purpose of this study is to further improve the evaluation system of social network relationships and the study of the effect of social network relationships on farmers' water-saving behaviors, enrich relevant theories and provide a feasible path for the implementation of water-saving irrigation from the macro initiative level. The results show that higher network closeness and policy satisfaction, water management experience, agricultural insurance, strong family decision-making power, etc., will reduce the likelihood of farmers participating in the supply of small water-saving irrigation and water conservancy facilities; increasing network compactness will increase the possibility of farmers' participation in the supply; trust and commitment, social ethos and sense of belonging, social participation, and other factors have no significant influence on farmer participation behavior. It can be seen that network tightness and network scale play an important role in the behavior of farmers' participation in public affairs. In conclusion, social network relationships will affect farmers' participation in the supply of irrigation and water conservancy facilities, but different dimensions have different influences on it.

Keywords: social network relationship; small water-saving irrigation; water conservancy facilities; farmers' participation; binary logistic model

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1. Introduction

China is one of the 13 countries with the poorest per capita water resources in the world. Agriculture is the industry that consumes the most water in China. According to China Water Resources Bulletin 2021, agricultural water consumption accounts for 61.5% of China's total water consumption, while irrigation water accounts for 90% to 95% of agricultural water consumption. Therefore, the mode of agricultural irrigation has a crucial impact on the contradiction between the supply and demand of water resources. However, the utilization rate of farmland irrigation water in China is low, and the effective utilization coefficient is only 0.568, while it is as high as 0.7–0.8 in developed countries [1]. It can be seen that China's agricultural water is still in the stage of inefficient and extensive development. The Ministry of Water Resources, the Chinese Academy of Engineering, and other

departments predict that only if agricultural water use maintains zero or negative growth can China ensure water security and ecological security and then ease the contradiction between the supply and demand of water resources. Developing water-saving irrigation is an important way to improve agricultural water efficiency and reduce agricultural water consumption. At present, small water-saving irrigation facilities are mainly promoted by the government, and how to guide farmers to actively participate in the construction of farmland water conservancy is an urgent problem that needs to be solved in the present and the future. Farmers, as micro-decision-making bodies engaged in agricultural production, have the freedom to choose to participate in the construction of farmland water conservancy or not [2]. Zuo, Z.Y. used a conditional value method to analyze farmers' willingness to pay for water-saving irrigation facilities in North China groundwater over-extraction areas and believed that farmers only had demand for modern water-saving irrigation technology, but the low comparative benefits of agriculture and the low risk tolerance of farmers directly limited farmers' ability to pay for modern water-saving irrigation facilities, and the investment in the adoption of new technology should be jointly committed to by farmers and the government [3].

In addition, according to the FAO report (2019, the State of Food Security and Nutrition in the World), more than 820 million people in the world did not have enough food in 2018, world hunger increased for the third consecutive year, and food security remained uncertain. Mabry (1996) believes that one-third of the world's grain harvest is due to the construction and management of small water-saving irrigation and water conservancy projects, especially in developing countries, which play a very important role [4,5]. At present, nearly half of China's cultivated land is still "fields on hill tops which depend on rains for water", and the main reason is that the shortage of small water-saving irrigation and water conservancy facilities has not been effectively solved [6]. During the period of the people's commune (1958–1978), wherein all of the means of production and the public property of the villages were owned, and unified management was exercised over the farmers and the affairs of the villages, the land was owned by the people's commune, and the irrigation and water conservancy facilities were mainly supplied by the commune with a high degree of organization. Therefore, the shortage of irrigation and water conservancy facilities has greatly improved since the founding of the People's Republic of China (1949). However, after the implementation of the household contract responsibility system (1978-), the land was distributed to farmers, which broke the original situation of the collective supply of irrigation and water conservancy facilities, and the degree of organization decreased [7]. As a result, the construction of irrigation and water conservancy facilities has been slow or even stagnated for a long time [8]. From the 1990s, the construction of irrigation and water conservancy facilities began to recover. However, with the diversification of the crop planting structures, the contradiction between the public supply of small water-saving irrigation and water conservancy facilities, which can only be used to irrigate food crops, and the individual demands of the household management of farmers, which require more timely and convenient irrigation, has become increasingly fierce. Therefore in the current household contract responsibility system based on finely cultivated land, the participation of farmers is an effective way to solve this contradiction [9].

Farmers' participation in supply is based on a certain region, and many individual farmers participate in the process of collective cooperation. Theoretically speaking, the goals of an individual and the collective are not necessarily identical, but people want prestige, respect, and friendship, as well as other social and psychological goals, and when there is no economic incentive for individuals to contribute to the interests of the group, social incentives may drive people to do so [10]. The essence of farmers' participation in supply is to achieve compatibility between the goals of an individual and the collective among the relevant stakeholders in a certain region. As a special organization group, farmers learn from the social network relationship formed on the basis of geography, blood relationships, and kinship to form similar ideas and to influence the decision-making behavior of farmers [11], which can push the combination of micro individual behavior

with macro collective behavior and promote the realization of collective action. For example, in a clan village, the 'clan leader' of the clan has high prestige and is also the leader of the villagers' group. The members of the clan support the leadership of the 'clan leader', and the social network formed by the 'clan leader' as the center guides the villagers to form norms with certain functions of encouragement and restraint, which can influence the behaviors of the members of the clan [12]. Therefore, it is of great theoretical significance and feasibility to introduce the concept of social network relationships into the study of farmers' participation in the supply of small-scale irrigation and water conservancy facilities. As a result, it is of great significance to study social network relationships and promote rural public governance to introduce education for farmers based on social network relationships into the supply problem of farmers participating in small-scale irrigation and water conservancy facilities.

The concept of the social network was first proposed by R. Brown. Later, many scholars interpreted the connotation of the social network, and the description of the single dimension has changed to multi-dimensional [13]. Economic behavior is restricted by the social network, and the appropriate embedding of social network relationships can improve the quality of organizational resource acquisition [14–19]; effective network relationship embedding enables people to obtain information content through effective information channels [20]. It also provides the basis of social trust for people and provides decision-making-related information for people, which is more accurate and effective in the process of communication [14]. In addition, it improves social learning and the cooperation willingness and efficiency of participants through information sharing [21]. From the perspective of institutional economics, an effective social network makes it easier to realize collective action by reducing the cost of collective action, and the success of cooperation makes social networks expand [22,23]. At the same time, effective social network relationship also plays an important role in risk sharing [24,25]. In the field of the supply of public goods, good social network relations contribute to enhancing trust and expanding social exchange, thus improving the supply of public goods. The larger the stock of social capital between the farmers and villages, the higher the level of trust in the village, and the more actively the farmers participate in the supply of public goods [13,22,26,27]. However, because farmers may have different concerns within social network relationships, different dimensions of social capital have different impacts on Farmers' participation behavior [28]. Although most scholars believe that social networks can promote the realization of collective action and improve management efficiency, some scholars put forward the opposite view. The constraints of network relationships will reduce people's choices and then affect people's behavior, and people have free-riding behavior [29]. It leads to the lack of farmers' ability to participate in governance and the dilemma of cooperation, and the impact on Farmers' willingness to participate is relatively complex [30]. Affected by the social network, some people may have a herd mentality, and a few people's non-participation behaviors will lead to the majority of people not participating in the behavior, which may lead to the failure of cooperation [31,32]. Therefore, the negative influence of social network relationships on the spontaneous supply of rural public goods cannot be ignored, which may make the spontaneous supply of rural public goods face the threat of failure.

In summary, scholars have undertaken relevant research on the index evaluation system where social network relations, relationship networks, and trust and norms are regarded as the three dimensions of social capital [33]. However, it is still relatively one-sided and fails to cover such factors as the strength of the network relationship and the interpersonal environment of the village where the farmers live. Although scholars have recognized the importance of social network relationships to members' participation, technology expansion, and resource acquisition, few scholars take the subdivision dimension of social network relationship as the influencing factors of farmers' participation in the supply of farmland and water conservancy facilities. In addition, most scholars study rural household social network systems from the perspective of social capital. For example, Li, J.P.

analyzed the influence of social capital on farmers' willingness to participate and pay in the cooperative supply of water-saving irrigation facilities by selecting the dimensions of social capital, such as social networks, trust, reputation, participation, norms, and reciprocity. Xu, L. estimated farmers' social capital from three dimensions of network, trust, and norms and analyzed the influence of social capital on farmers' willingness to participate in irrigation management reform. Cai, Q.H and Zhu, Y.C empirically analyzed the mechanisms that influence farmers' participation in village collective action from the dual perspectives of social capital and income gap [2,34,35]. Therefore, starting from the social network relationship, this article attempts to analyze the channels through which these dimensions affect human behavior using the structure of the relationship network. To be brief, the article pays more attention to the channels and paths that social network relationships affect farmers' individual behaviors. This article draws on the previous research results and combines the field research in Shaanxi, Ningxia, and Henan provinces in 2019 to build a social network relationship evaluation system and then combines the Logistic model to focus on whether and how the social network relationship will affect farmers' participation in the supply of irrigation and water conservancy facilities so as to further improve the evaluation system for social network relationships and the study of the effect of social network relationships on farmers' water-saving behaviors, enrich relevant theories, and provide a feasible path for the implementation of water-saving irrigation from the macro initiative level.

2. Materials and Methods

2.1. Model Construction

2.1.1. Coefficient of Variation Method

In order to calculate the value of each dimension of social network relationships, it is necessary to select a method to determine the weight of the lowest index in the index system. Since the objective weighting method is not based on the subjective judgment of human beings, it reduces the biased performance of expert weighting and objectively reflects the relative importance of indicators. This paper selects the objective weighting method—the coefficient of variation method to determine the weight of each index [36]. The basic idea of the variation coefficient method is: in the multi-index comprehensive evaluation, if a certain index has a large degree of variation in the observed values of all of the evaluated objects, it can clearly distinguish the level of each evaluated object in this aspect, then the index should be given a larger weight; conversely, it should be given a smaller weight. The coefficient of variation and the weight of each index were calculated as in Formulas (1)~(3).

$$V_i = \frac{\sigma_i}{\overline{x_i}} \tag{1}$$

$$W_i = \frac{V_i}{\sum_{i=1}^{n} V_i} \tag{2}$$

$$F = \sum_{i=1}^{n} (W_i \times I_i) \tag{3}$$

In Formula (1), σ_i is the standard deviation of index i and $\overline{x_i}$ is the average value of index i. In Formula (2), V_i is the coefficient of variation of the index i, and W_i is the weight of each index obtained after normalizing V_i. In Formula (3), F is the comprehensive evaluation index, and Ii is the single evaluation score of the index i after standardization.

2.1.2. Logistic Regression Model

The linear regression model is suitable for regression analysis with continuous dependent variables but not for regression analysis with discrete dependent variables. In general, discrete data are used to measure peoples' behavior selection, so when discrete data are used as a dependent variable, the linear regression model is no longer applicable. The discrete selection model originated from Fechner's conditional binary reflex research,

and then Warner applied it to the field of economic research. The binary logistic regression model is a kind of discrete choice model that refers to a multivariate analysis method of the relationship between the binary observation results and some influential factors, which can make up for the deficiency of the simple regression model when dealing with discontinuous variables [37,38]. The model can clearly explain the correlation between the dependent variables and independent variables and reveal the quantitative change law between the dependent variables and the independent variables. However, this model also has some limitations. The model theoretically requires the sample size to be greater than 50 for parameter estimation and cannot solve the problem of "multicollinearity" [39,40]. Therefore, it is necessary to adopt a large sample when applying this model and try to choose independent variables.

The model is shown in Equation (4). In Formula (4), Y is the dependent variable, which obeys a binomial distribution, and the values are 0 and 1, respectively, the independent variable is X_1,X_2 ... X_n. It is the same as the linear regression model. β_0 is a constant term and β_i is the partial regression coefficient corresponding to X_i ($i = 1, 2 \ldots, m$).

$$LogP_{it}(Y = 1) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_n X_n \quad (4)$$

2.2. Farmers' Social Network Relationship System

2.2.1. The Data Source

Shaanxi, Ningxia, and Henan provinces have large agricultural output and good agricultural development. In terms of geographical location and ecological environment, Henan Province is mainly plains, Shaanxi Province is mainly hilly, and Ningxia is short of water. In terms of planting structure, Shaanxi Province mainly produces grain crops; Henan Province mainly produces food crops and cash crops; and Ningxia mainly produces cash crops. These three provinces are representative in terms of geographical location, ecological environment, and planting structure.

Therefore, the study conducted in 2019 took Shaanxi, Ningxia, and Henan provinces as the research objects and selected representative provinces and cities for the questionnaire distribution and statistical analysis. The questionnaire can be divided into four aspects: the basic information of the farmers (collecting the basic information of the farmers, such as the head of household, age, gender, etc.), the supply of small water-saving irrigation and water conservancy facilities, and the overall supply of small water-saving irrigation and water conservancy facilities, and the basic situation of the social capital of the farmers.

The basic information of the farmers was collected to explore whether their own characteristics will affect their participation behavior. The status of farmers' participation in the supply of small water-saving irrigation and water conservancy facilities is to understand the participation behavior of the farmers and obtain the dependent variable data of the binary logistic regression model; the purpose of studying the overall supply of small water-saving irrigation and water conservancy facilities is to explore the supporting effect of the government on farmers' behavior from the other hand by understanding the current construction and management of small water-saving irrigation and water conservancy facilities. The basic situation of farmers' social capital involves each dimension of farmers' social network relationships, and the social network relationship of each dimension is taken as the independent variable of the binary Logistic regression model to explore the influence of the social network relationships of different dimensions on farmers' participation behavior. In the process of issuing the questionnaires, 3 cities were selected from each province, 1–2 counties were selected from each city, 4 townships were selected from each county, and 5 villages were selected from each township. Overall, 80 samples were randomly selected from each village for questionnaire distribution and statistical analysis. The random sampling method was adopted to sample the counties, townships, villages, and farmers. A total of 1440 samples were collected, of which 1169 were valid samples, and the effective rate of samples was 81.12%. See Appendix Table A1 for details. The research areas are shown in Figure 1.

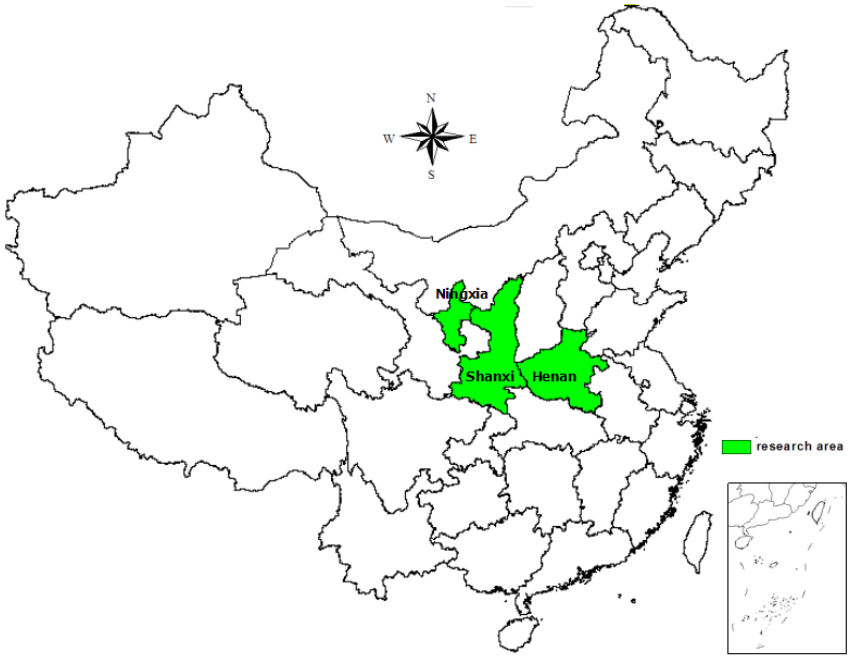

Figure 1. The main survey areas (Shanxi, Henan, Ningxia) in China.

2.2.2. Index System Construction

A social network is an overall network of formal and informal relationships among specific groups of people, including the direct relationships between people and the indirect relationships formed through the nodes of material, environmental, and cultural sharing, which can also be called relationships [41,42]. Social capital refers to the social resources people use through social networks, which are different social networks [43]. However, most scholars do not distinguish between the two when constructing the index system, and the social capital they mentioned is actually the social network. Referring to the achievements of predecessors on the construction of social network relationship index systems, this study constructs an index system of social network relationships using five dimensions: network scale, network compactness, trust and commitment, social atmosphere and sense of belonging, and social participation.

Network scale refers to the scope and breadth of social network coverage; it reflects the range of resources that people can obtain information from social networks [44]. Network compactness refers to the frequency and quality of the mutual connection between individuals, and it reflects the dynamic degree of sharing material resources and knowledge resources [45]. Trust and commitment can be expressed as the degree of trust and trust in neighbors, relatives, the residents of the whole village, government departments, and civil servants, and it reflects the informal values and norms shared among the members [46]. It is worth noting that farmers only make general judgments about different relationships. Social ethos and a sense of belonging are the background of the village on which social network relations depend. Social participation refers to the members' investment in public affairs, reflecting the degree of members' participation in farmland affairs [47,48]. Social learning is influenced by these four aspects and could change an individual's behavior [49].

Previous studies generally divided the social network relationship variables into two target levels and added one of the indicators of social ethos and sense of belonging on the basis of which, in order to reflect people's emotional strength to the collective and confidence in the development of the village [39–41], as shown in Table 1.

Table 1. Evaluation System of farmers' social network relationship.

Level 1 Sub Target Layer	Level 2 Sub Target Layer
Network size	Number of general friends (A1); number of close friends (A2); number of relatives and friends with their own business (A3); number of relatives and friends working in government agencies (A4); number of relatives and friends working in public institutions (A5); and the number of relatives and friends living in cities (A6)
Network compactness	The number of recent visits with neighbors (B1); recent return visits with neighbors (B2); recent contact with relatives and friends (B3); number of relatives and friends visited on New Year's Day (B4); the number of red packets sent out and recovered on the annual festival (B5;, and the voluntary help between relatives and friends (B6)
Trust and commitment	Trust in neighbors (C1); trust in relatives (C2); trust in the whole village residents (C3); trust in government departments and civil servants (C4); trust in neighbors to keep keys (C5); and trust neighbors to take care of children (C6)
Social ethos and sense of belonging	The sense of security for village life (D1); the sense of honor for village life (D2); the identity of doing well without leaving a name (D3); the sense of responsibility to support natural disasters and man-made disasters (D4); whether the village has a common vision for a better life (D5); and whether the neighbors have mutual help (D6)
Social participation	Whether or not to participate in arts and entertainment organizations (E1); whether to join the party and League organizations (E2); whether to participate in the village committee (E3); whether to participate in rural credit cooperatives or various cooperatives and trade associations (E4); whether the villagers will collectively help the villagers in sudden difficulties (E5); and whether the village plans collective public affairs according to their actual needs (E6)

3. Results

3.1. Weight Determination and Evaluation

In this study, the coefficient of variation method is used to calculate the weight of the variable (index). According to each group of data obtained from the questionnaire survey, the evaluation value of the five variables in the first-level target layer is calculated from the weight of each variable in the secondary target layer and the actual survey data. The calculated weights are shown in Figure 2. According to the survey data and the calculated weight, the index value of each sample is calculated. There are 1169 samples, each sample has four calculated values, and there will be 4676 pieces of data to be presented. Because the output data will take up a lot of space, it will not be displayed here.

3.2. Logistic Regression Model

3.2.1. Variable Selection

Only the model was introduced in 2.2, and the dependent and independent variables should be identified now. In this paper, whether the farmers participate in the supply of irrigation and water conservancy facilities is selected as the dependent variable. The independent variables include the social network relationship variables and the control variables. Among them, the social network relationship variables include network scale, network compactness, trust and commitment, social ethos and sense of belonging, and social participation; the control variables are agricultural insurance (whether to obtain agricultural insurance), policy effect satisfaction (the government's support for farmers' participation), the number of sons, participation in farmers' cooperatives, water conservancy management experience, family decision-making power, and technology. Skills, health status, the number of the labor force, and cultivated land area. See Table 2 for details.

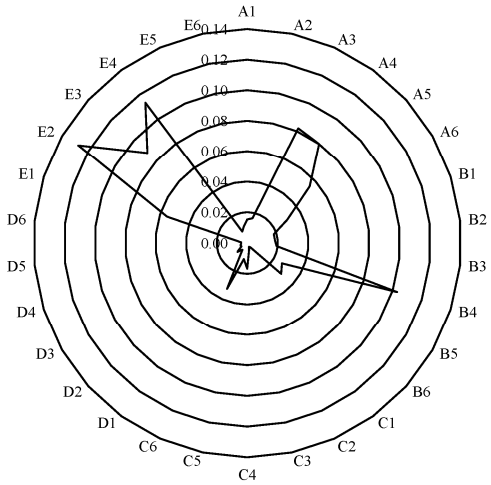

Figure 2. Index weight distribution of level 2 sub target layer.

Table 2. The related variables of driving factors of social network relationship.

			Variable Name	Variable Definition	Mean Value	Standard Deviation
Dependent Variable			**Participation or Not**	**Yes = 0, No = 1**	**0.27**	**0.45**
Independent variables	Social network		network size	The score is calculated by the secondary target level index	0.04	0.04
			network compactness	The score is calculated by the secondary target level index	0.07	0.04
			trust and commitment	The score is calculated by the secondary target level index	0.30	0.10
			social ethos and sense of belonging	The score is calculated by the secondary target level index	0.72	0.12
			social participation	The score is calculated by the secondary target level index	0.05	0.09
	control variable	Influence of insurance and policy	agricultural insurance	Purchase or not, yes = 0, no = 1	0.88	0.30
			satisfaction of policy effect	Is the policy of "one case, one discussion" effective yes = 1, general = 2, no = 3	2.90	0.36
		Influence of production conditions	farmers' cooperative	participation or not, yes = 0, no = 1	0.95	0.23
			water management experience	have water management experience or not, yes = 0, no = 1	0.99	0.12
			technical skills	use technical skills or, yes = 0, no = 1	0.83	0.38
			number of labor	population with working capacity (person)	1.98	0.78
			cultivated land area	total family cultivated land area (MU)	8.13	4.99
		other impacts	number of sons	number of sons owned (person)	1.34	0.72
			family decision making power	head of household, yes = 0, no = 1	0.45	0.50
			health condition	very poor = 1, poor = 2, general = 3, relatively healthy = 4, very healthy = 5	4.24	0.84

Note: household head, skills, health status, water conservancy manager, farmer cooperatives, and agricultural insurance all indicate the individual characteristics of the interviewees, the same below.

3.2.2. Regression Results

In this paper, the binary logistic model was analyzed using SPSS26.0 software(IBM, New York, USA). The regression results are shown in Table 3.

Table 3. The regression results of driving factors of social network relationship.

		Variable Name	B	SE	Wals	Sig	Exp(B)
Social network		network size X1	2.569 *	1.508	2.901	0.089	13.055
		network compactness X2	−15.954 ***	2.521	40.053	0.000	0.000
		trust and commitment X3	0.938	0.807	1.351	0.245	2.555
		social ethos and sense of belonging X4	−0.456	0.596	0.585	0.444	0.634
		social participation X5	−0.258	0.708	0.133	0.715	0.772
Control variable	Influence of insurance and policy	satisfaction of policy effect X6	−0.678 ***	0.154	19.453	0.000	0.508
		agricultural insurance X7	−0.510 **	0.199	6.540	0.011	0.601
	Influence of production conditions	farmers' cooperative X8	0.290	0.388	0.557	0.455	1.336
		water management experience X9	−1.147 **	0.499	5.283	0.022	0.318
		technical skills X10	−0.655 ***	0.172	14.529	0.000	0.519
		number of labor X11	0.339 ***	0.092	13.590	0.000	1.404
		cultivated land area X12	0.000	0.003	0.000	1.000	1.000
	Other impacts	number of sons X13	0.180 *	0.109	2.719	0.099	1.197
		health condition X14	−0.068	0.083	0.665	0.415	0.934
		family decision-making power X15	−0.303 *	0.158	3.649	0.056	0.739
		constant β_0	5.116 ***	1.494	11.730	0.001	166.680

Note: *, **, ***, respectively, represent the significance level of 10%, 5% and 1%.

4. Discussion

The scores of the five indicators of the social network relationships from high to low are social atmosphere and sense of belonging, trust and commitment, network compactness, social participation, and network scale. The average score for the social ethos and sense of belonging is the highest, which indicates that farmers have a relatively high sense of identity with the local culture due to the relatively fixed and consistent public moral concepts generated by Chinese civilization within the organization. Farmers are constrained by the basic rules of "acquaintance society" and follow the behavioral logic of "one's own people" [50], so they have high trust in themselves. Rural areas are relatively closed, and the communication between farmers and the outside world is relatively less. Due to the influence of the market economy concept on farmers, farmers regard the development of the family economy as the top priority, which may reduce the frequency of communication with others and the social participation activities that will not bring direct benefits to farmers.

It can be seen from Table 2 that most of the farmers are non-households because the farmers were selected randomly during the fieldwork; there is only one head for each family in China. Most of them have no water conservancy management experience and lack technical skills. The grass-roots water conservancy managers are mainly responsible for the management and maintenance of basic water conservancy facilities as well as the scheduling of water resources. In China, each village generally has 2–4 grass-roots water conservancy managers, and the farmers who are engaged in agricultural production are older, and most of them have no technical skills nowadays. The survey found that the health of farmers is generally good, each household has about two workers, and each

family has about one son. The average total arable land of the family is 8.13 mu, which means that each labor force is responsible for farming and irrigating an area of about 4 mu. However, 97% of the farmers are not water managers, their active concern and participation in irrigation and water conservancy facilities supply will be relatively low, and according to the feedback of the peasant household questionnaire, the farmers are not satisfied with the effect of the "one case, one discussion" policy. In this way farmers cannot be encouraged to participate in the supply of irrigation and water conservancy facilities from the policy level. The policy of "one case, one discussion" means that the village must hold a villagers' assembly for a public matter of production, with the participation of more than two-thirds of the village's farmer representatives and the approval of more than half of the farmers, and all of the participants have the right to supervise. It is to further standardize the rural collective production public welfare enterprise financing management system. However, due to poor operability, financial opacity, and other reasons, the mean of Table 2 shows that the system did not give full play to its institutional advantages, resulting in villager dissatisfaction. Farmer cooperatives are conducive to establishing cooperative relations among farmers and coordinating their limited supply capacity of labor, irrigation and water conservancy facilities so as to achieve better supply effects. However, 94.4% of the farmers stated that they did not participate in farmers' cooperatives, which shows that the degree of agricultural production organization in China is still low. Agricultural cooperatives are a kind of spontaneous organization, lacking standardized organization and supervision systems. The investigation found that farmers did not receive the expected income when they participated in agricultural cooperatives. At the same time, 79.9% of the farmers did not participate in the agricultural insurance, which would increase the risk faced by farmers relating to agricultural production.

4.1. The Impact of Social Network on Farmers' Participation in Small Water-Saving Irrigation and Water Conservancy Supply

From the regression results in Table 3, it can be seen that the variable coefficient of the network scale is positive and passes the test at a significance level of 10%. Therefore, the larger the network scale, the weaker the willingness of farmers to participate in the supply of small water-saving irrigation and water conservancy facilities. Coleman also believed that network size would affect members' participation behavior, but he believed that the impact was positive [51]. With the expansion of the network scale, the scope and breadth of the social network coverage will also increase. The expansion of the social network has realized valuable communication and cooperation, which has great social value. In addition, people will receive more experience and knowledge from social learning, which affects their decision-making behavior [52]. For example, with the continuous development of communication equipment, farmers have access to more and more information sources. Their decision-making is not only based on their own experience but is also affected by other people's opinions, government policies, and other factors. Information communication enables farmers to obtain more alternative strategies. As rational-economic individuals, farmers are bound to make decisions that can maximize their own interests. Compared with the other incomes of farmers, agricultural investment returns are lower than other industries, and it may not be an optimal choice to participate in the construction of farmland facilities for farmers.

The influence of network compactness on the dependent variable is significant, and the coefficient was negative, indicating that the higher the network compactness, the more willing farmers are to participate in the construction of irrigation and water conservancy facilities. This is consistent with the conclusion of Hu Jinyan and Zhang Bo, who also believe that network compactness can influence people's behavior more than network size [53]. The network compactness is mainly reflected in the frequency of the connection between the farmers. Network compactness has an important impact on the diffusion of information, which in turn affects the decision-making behavior of the farmers [54]. When the network density is high, the interaction between the farmers and the surrounding

villagers is more frequent. The effective transmission of information between the farmers is to enhance the social learning of farmers, which promotes the resonance of the same demand for rural public facilities and strengthens the demand. In this way, farmers are more likely to take cooperative actions and reach a consensus.

The factors of trust and commitment have no significant impact on farmers' participation in small water-saving irrigation and water conservancy supply, which is inconsistent with Ostrom's view [55]. It is also inconsistent with Dong Li's research. He believes that the higher the level of interpersonal trust of farmers, the more likely they are to form emotional and value identities with other farmers, and they are more willing to credit or act on the advice of other farmers and the possibility of reaching a cooperation contract between farmers is higher [56]. From the perspective of "the Pattern of Difference Sequence" in China, the trust between farmers is mainly based on blood kinship, and the scope of trust follows the "principle of proximity" in the process of expansion [57]. This pattern of differential order forms a differential contract relationship; that is, the closer the relationship, the stronger the contract. According to this theory, the stronger the contractual relationship is, the easier it is to reduce the transaction cost, which is conducive to the realization of collective action. However, irrigation and water conservancy facilities belong to quasi-public goods [58,59], which are non-exclusive and have a long payback period. From the perspective of input–output analysis, it is difficult for farmers to accurately evaluate their input and income because agricultural income has both market and natural risks. Therefore, even if the level of trust and commitment is high, farmers may not be able to determine exactly whether they are involved in the supply of water conservancy facilities.

Social ethos and sense of belonging had no significant impact on farmers' participation in small water-saving irrigation and water conservancy supply. Social ethos and sense of belonging belong to the category of social identity, which can affect the emotion and cohesion between the individuals in a group. However, the study finds that social identity does not have a significant impact on individual behavior, which may be due to group norms [60–62]. In the villages with good social ethos, the degree of organization is higher, and the degree of homogenization of the farmers is also higher. Most of these villages are located in the main grain-producing areas, and over long-term agricultural production, they have formed a system of irrigation and water conservancy facilities suitable for local irrigation. Perhaps farmers are reluctant to break away from this situation. In addition, due to the relatively closed rural environment, resulting in the farmers' cognitive limitations, the enthusiasm for the reform of the construction and management of irrigation and water conservancy facilities is insufficient.

Social participation has no significant impact on farmers' willingness to participate in small water-saving irrigation and water conservancy construction. This conclusion is inconsistent with the conclusion of Yan Tingwu. Yan Tingwu believes that farmers who have participated in the public affairs of the government or other organizations have a broader vision, thus showing a higher willingness to participate [63]. Social participation is the concern, understanding, and behavioral input of farmers to the current situation and activities of all aspects of social life [28]. According to the theory of social identity, social participation can make farmers obtain the identity of being a member of a group [64], and identity will increase the supply of more social resources [65]. Social participation in rural areas mainly includes election, training, entertainment activities, village affairs, etc.; these activities mainly reflect the political rights of farmers, the improvement of skills, or the inheritance of culture. In other words, the use of social rights by farmers does not affect their participation in the supply of irrigation and water conservancy facilities, which may be because most of the participation behaviors of farmers are formed by the spontaneous organization of farmers and have nothing to do with social rights. Although China implements the system of "one case, one discussion", the construction of irrigation and water conservancy facilities involves many subjects, and the interests of each subject are difficult to balance, the effect of the system is not obvious. This can be reflected in the mean value of the satisfaction with the policy effect (Table 2).

4.2. The Impact of Other Factors on Farmers' Participation in Small Water-Saving Irrigation and Water Conservancy Supply Behavior

The variable coefficient of agricultural insurance is negative, and a 5% significance level shows that the farmers without agricultural insurance are more willing to participate in the supply of farmland and water conservancy facilities. Farmers' cooperatives fail to pass the significance test, which has little impact on farmers' participation behavior, probably because local cooperatives fail to provide technical guidance to farmers, resulting in their low degree of participation and the low degree of farmer organization. The coefficient of the water management experience variable is negative, passing a significance test of 10%, which means that the farmers without water management experience are more willing to participate in the supply. This is consistent with the conclusion of Wang, B. and Wang, H., who concluded that water conservancy management experience would affect farmers' participation behaviors [66]. The variable coefficient of technical skills is also negative and passes the significance test; that is, when farmers have relevant skills, their willingness to supply water conservancy facilities will decrease. The number of the labor force passed the significance test at the level of 10%, which means that with an increased labor force, farmers' willingness to participate tends towards "non-participate". The cultivated land area has no significant impact on farmers' participation in the supply of irrigation and water conservancy facilities, while Wang, B. and Zhu, Y.C. believe that the participation behavior of farmers is affected by the area of irrigated farmland [67]. The cultivated land area includes irrigated areas and non-irrigated areas. If there is a large difference in the composition of the cultivated land area, it may be the reason for this phenomenon. The variable coefficient of the independent variable number of sons is positive, which means that with an increased number of sons, the willingness of farmers to participate is weakened. In China, the more sons there are in a family, the heavier the burden on the family will be. Farmers often take the income of migrant workers as the main income of the family, and they will not pay more attention to agricultural production, which weakens the enthusiasm for the supply of agricultural production facilities. The head of the household (through a 10% significance test) has a significant negative effect on the dependent variables. The head of the household plays an important role in household decision-making and has a broader perspective than the other family members, and the more likely they are to believe that non-agricultural production is likely to produce more benefits, the easier it is for them to "not participate". The possible reason is that with the popularization of machine technology, the manual labor of farmers is greatly reduced, and the health status of farmers is no longer the main obstacle for them to engage in agricultural activities, so it has a weak impact on farmer participation in the supply of water conservancy facilities. This is not consistent with the research of Yang, X.Y and Zhu, Y.C. [68]. The survey areas they chose were underdeveloped, with a low degree of mechanization, and agricultural production was strongly dependent on the health status of the farmers.

5. Conclusions and Suggestions

5.1. Conclusions

In this paper, 1169 pieces of data from a field survey are used to analyze the influence of social network relationships on farmer participation in the supply of water conservancy facilities. The results show that:

Firstly, social network relationships will affect the farmers' behavior. This is consistent with the research conclusions of Cui, B.Y., Zhang, Z.G., and other scholars [56,69]. However, different scholars have different conclusions about the impact of each dimension variable on farmer behavior under the social network. The possible reason is that different scholars choose farmers who provide different public goods or participate in different public affairs, such as environmental protection investment behavior, irrigation system management, and rural public goods [50,67,69]. In the social network relationship, network size and network compactness have a significant impact on farmer participation in farmland and water conservancy facilities, while trust and commitment, social ethos and sense of belonging,

and social participation have no significant impact on farmer participation in irrigation and water conservancy facilities.

Secondly, the expansion of the network scale will decrease the possibility of farmer participation in the supply of irrigation and water conservancy facilities.

Thirdly, the higher the network density of the farmers is, the more likely they are to participate in the supply of water conservancy facilities.

Fourthly, good policy effects, having agricultural insurance, water conservancy management experience, strong family decision-making power, technical skills, increase in the labor force, and the number of sons will inhibit the positive participation of farmers in the supply of water conservancy facilities. However, farmer cooperatives, health status, and cultivated land area have no significant influence on the dependent variables.

In general, social network variables affect farmer participation in the supply of irrigation and water conservancy facilities, but different dimensions have different impacts on the individual behaviors of the farmers.

5.2. Suggestions

According to the above conclusions, this paper puts forward the following suggestions:

Firstly, government departments should strengthen publicity and carry out more collective activities and, at the same time, build a good platform to strengthen the communication among farmers and the contact between villagers and village cadres. In this way, farmers' demand for rural public goods can be further manifested and provide guarantees for realizing the collective supply of the public goods needed by farmers.

Secondly, the government should encourage the dissemination of positive information to farmers and avoid the distortion caused by negative information or false information relating to farmers' behavior, and provide a good humanistic foundation for rural governance.

Thirdly, in public governance, it is necessary to conduct regional governance. The relevant incentive policies of the state should be more in line with the needs of farmers to improve their living standards and pay attention to the timely feedback of policy effects..

Fourthly, building industrial chains for processing and selling agricultural products can provide channels for the sale of agricultural products, improve the efficiency of agricultural production, increase farmers' agricultural income, enhance farmers' confidence in agricultural production, and finally, provide good conditions for agricultural development. In addition, due to the fragility of agricultural production, the government should support agricultural insurance to provide farmers with security in relation to agricultural production.

6. Research Prospect

Due to objective reasons such as length and subjective factors such as the author's research ability, there are still some valuable research issues that have not been discussed in depth in this article, including the following:

First, the data used in this study are only limited to northwest China, mainly studying arid and semi-arid areas with water shortage, which has certain limitations in terms of regional characteristics. However, it is necessary to study the behaviors of farmers' participation in the supply of farmland water conservancy facilities in regions with different regional characteristics and agricultural development conditions. Therefore, surveys in other parts of China can be conducted in the future to obtain national data for further analysis.

Second, the marginal effect of regression analysis is not taken into account in the empirical link, so the explanation is not straightforward enough. The marginal effect can further analyze the influence of the independent variables on the dependent variables. It can show how much more likely farmers are to implement water-saving behavior when the variable changes by one unit.

Third, this paper does not discuss the mediating effect of "social learning" on social network relationships and the individual behaviors of farmers. In the future, we can

further measure the social relationships with individual farmers as the core and measure the quality of the social network relationships.

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Appendix A

Table A1. Statistical range and sample size of the questionnaire.

Statistical Area		Number of Counties, Towns and Villages in The Statistical Area			Number of Statistical Samples/Household	
		County	Township	Village	By Prefecture Level City	By Region
Hetao Area(Ningxia)	Yinchuan City	1	4	20	160	480
	Shizuishan City	1	4	20	160	
	Wuzhong City	1	4	20	160	
Guanzhong Area (Shaanxi Province)	Baoji City	1	4	20	160	480
	Xianyang City	1	4	20	160	
	Weinan City	1	4	20	160	
the Central Plains (Henan Province)	Kaifeng City	2	8	40	320	480
	Xinxiang City	1	4	20	160	
total		9	36	180	1440	

Note: Kaifeng city is mainly divided into grain-crop region and cash-crop region, with obvious regional distribution. In order to understand the situation of different regions, two different types of counties were selected as samples.

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