agriculture

MDPI

Article

The Impact of Social Capital on Farmers' Willingness to Adopt New Agricultural Technologies: Empirical Evidence from China

Mingyang Han [1], Ruifeng Liu [1,*], Hengyun Ma [1], Kaiyang Zhong [2], Jian Wang [1] and Yifan Xu [3]

[1] College of Economics and Management, Henan Agricultural University, Zhengzhou 450046, China
[2] School of Economic Information Engineering, Southwestern University of Finance and Economics, Chengdu 611130, China
[3] School of Accounting, Anhui University of Finance and Economics, Bengbu 233030, China
* Correspondence: ruifeng076@163.com; Tel.: +86-371-5655-2512

Abstract: Based on the microdata of 11,547 farmers from the China Labor Dynamics Survey (CLDS) database in 2017, an ordered multi-classification logistic model was constructed to empirically test the impact of social capital (i.e., social networks, social participation, and social trust) on farmers' willingness to adopt agricultural technology. The moderating effect of demographic changes (i.e., the number of instances of hukou migration) on social capital and farmers' willingness to adopt new agricultural technology was further investigated. The results show that the following: (1) Social trust has a significant positive impact on farmers' willingness to adopt new agricultural technologies, while social participation has no significant impact on farmers' willingness to adopt new technologies. (2) Social networks influence farmers' technology adoption behavior differently, e.g., the scope of relatives' wedding gifts has a significant and positive influence on farmers' technology adoption behavior, while the scope of non-relatives' wedding gifts has no significant influence on farmers' technology adoption behavior. (3) Demographic change plays a moderating role in the impact of social capital on farmers' willingness to adopt new agricultural technologies. In other words, the greater the number of instances of hukou migration, the less the promoting effect of social capital on farmers' willingness to adopt agricultural technology. (4) In the eastern and central regions of China, social capital has a significant positive impact on farmers' adoption of new agricultural technologies. In the western region of China, social capital has a significant negative impact on farmers' adoption of new agricultural technology. In the northeast region of China, social capital has no significant impact on farmers' adoption of new agricultural technologies. Social capital and population changes are important factors that affect farmers' willingness to adopt new agricultural technologies. Therefore, attention should be paid to cultivating and promoting farmers' social capital to improve farmers' willingness to adopt new agricultural technologies.

Keywords: social capital; new agricultural technologies; willingness to adopt; moderating effect; demographic change

Citation: Han, M.; Liu, R.; Ma, H.; Zhong, K.; Wang, J.; Xu, Y. The Impact of Social Capital on Farmers' Willingness to Adopt New Agricultural Technologies: Empirical Evidence from China. *Agriculture* **2022**, *12*, 1368. https://doi.org/10.3390/agriculture12091368

Academic Editors: Vítor João Pereira Domingues Martinho, Paulo Reis Mourão and Nikolaos Georgantzis

Received: 27 July 2022
Accepted: 29 August 2022
Published: 2 September 2022

1. Introduction

The Chinese government has actively explored the transformation of agricultural production modes [1,2]. However, the resource-consuming mode of extensive agricultural management has not fundamentally changed, and the trend of agricultural non-point source pollution and ecological degradation has not been effectively curbed [3]. Studies have shown that the application and promotion of new agricultural technologies are conducive to optimizing the input structure of agricultural production factors [4,5], improving the efficiency of resource utilization [6], improving the allocation efficiency of agricultural production factors [7], improving the living environment [8], and promoting the transformation of agriculture from "quantity" to "quality" [5]. Therefore, attaching importance to promoting and applying new agricultural technologies and actively advocating and

encouraging farmers to adopt new technologies are essential ways to accelerate the high-quality development of agriculture. Given this, this paper mainly studies farmers' technical decision-making behavior under the social capital background. It empirically tests whether the technical decision-making behavior of farmers will be affected by demographic changes. Finally, we use instrumental variables at the end of this study to explore its endogeneity.

Farmers are an essential micro-subject in adopting new agricultural technologies. Exploration of the influencing factors of this subject is conducive to conducting in-depth discussions on farmers' decision-making and broadening the channels for farmers' adoption of technology [9]. In recent years, the government and academia have paid close attention to this problem and carried out active exploration. Some scholars believe that based on the "economic man" hypothesis, farmers will prioritize their self-interest due to the impacts of agricultural vulnerability and seasonality in technology selection. Some studies empirically analyze farmers' attitudes towards risks and benefits, and the effects of costs and benefits express different willingness to adopt technology [10–12]. Some scholars believe that farmers' technology adoption is affected by farmers' educational level, social concepts, and economic status [13–22]. Some studies suggest that the risks and benefits of the technology itself, along with risk attitudes and information acquisition, may also have an impact on the adoption of technology by farmers [21–24]. In addition, the natural environment—such as climate differences and land types, as external factors—also represents key factors affecting the adoption of technology by farmers [14–16]. Previous studies have found that social capital is an important determinant of individual behavior decisions [17,18]. However, the existing research on the relationship between social capital (i.e., social networks, social trust, and social participation (in this study)) and the adoption of new agricultural technologies by farmers is insufficient. If the direction and degree of influence of social capital on farmers' adoption of new agricultural technology can be discovered, policymakers can use its influence mechanisms to more effectively guide the formulation of public policies and the effects of their implementation.

"Social capital" originated from the "Social Capital Essay" discussed by French sociologist Bourdiera [25] in the journal "Social Sciences Research". Portes [26] believes that the main core content in the development of social capital theory is "the ability of individuals to acquire resources based on social relations or broader social structures". Lin [27] holds that social capital is "embedded in a specific social structure and helps individuals obtain the resources they want through targeted activities and exchanges". Quisumbing [28] argues that social capital refers to the relationship networks gradually established by farmers, families, and stakeholders in the process of communication, and the ability to use these relationship networks to obtain the resources they need. Sunday [29] believes that social capital is mainly a society of acquaintances linked by geography, blood, and kinship. Regarding the measurement of social capital, Uphoff [30] and Lee [31] define social capital as structural social capital and cognitive social capital. Structural social capital is dominated by some objectively existing micro-subjects in society, mainly including organizations, networks, and regulations that have an impact on farmers' behavior. Cognitive social capital refers to people's sensory perceptions, including trust, values, social status, etc. However, at present, the academic circles have not yet formed a unified concept and classification of social capital, and different scholars have given different definitions of social capital based on their research categories.

With the deepening of the theoretical exploration of social capital in academia, scholars have begun to pay attention to the impact of social capital on farmers' adoption of new agricultural technologies. For example, Tong [32] referred to Putnam's social capital theory and believed that, in terms of structural social capital, farmers' surnames are significant, and the scale of gift money expenditure can significantly promote the adoption of water-saving irrigation technology. In terms of cognitive social capital, the frequent cooperation and trust between farmers in the process of rice production will have an impact on their willingness to adopt water-saving irrigation technology [33].

The objective of this study was to examine the impact of social capital on farmers' willingness to adopt new agricultural technologies. Existing research provides a rich theoretical basis and experience for understanding the relationship between farmers' social capital and their adoption of new agricultural technologies. However, there is still room for improvement in three respects: First, the interpretation of social capital by the results of existing research is mainly based on social networks, social participation, and social trust. Most of the conclusions are simply expressed with reference to Putnam's theoretical results. However, relevant empirical studies are still insufficient. Based on the China Labor Dynamics Survey (CLDS) database, we mined specific variables that could represent social networks, social participation, and social trust, and further empirically studied the impact of social capital on farmers' willingness to adopt new agricultural technologies. Second, research shows that demographic changes directly affect technological innovation and diffusion. However, under the development of the domestic urbanization trend, whether or not the resource endowment of farmers is adjusted by demographic changes (quality, quantity, and structure) leads to differences in farmers' willingness to adopt technology, which calls for further examination. Third, the existing literature has focused on the adoption of agricultural technologies by farmers in economically developed or specific regions of China. However, this paper studies the regional differences (i.e., eastern, central, western, and northeastern China) in the impacts of social capital on the adoption of new agricultural technologies by farmers, expanding the boundaries of the existing research regions [34–36].

The remainder of this study is organized as follows: Section 2 develops the theoretical analysis and research hypotheses. Section 3 introduces the data and methodology. Section 4 presents the empirical results and discussion. Section 5 comprises conclusions and policy implications.

2. Theoretical Analysis and Hypotheses

As an important social resource attached to farmers themselves, social capital can help farmers to obtain technical information through technical learning, communication, and other channels, effectively improving farmers' knowledge awareness, and promoting their enthusiasm for adopting new agricultural technologies. Based on this, the impact of social capital on farmers' adoption of new agricultural technologies is a question worthy of further study. Peng [37] believes that social capital is affected by changes in the relationship networks of individuals, showing a dynamic development trend. During this process, due to population changes (i.e., population quantity, quality, and structure), the relationship networks of farmers lead to changes in individual behavioral decision-making. Zhang et al. [38] confirmed through research that labor mobility effectively drives the adjustment of rural resource endowments, which can have a complex and far-reaching impact on the development of agricultural technology. However, whether population changes (e.g., the number of household registration changes)—as an important situational factor in the decision-making behavior of farmers—can have a moderating effect in this study remains to be further verified. Therefore, this paper presents the theoretical analysis frame diagram (Figure 1) and corresponding hypothesis: H1, H1a, H1b, H1c, H1d and H1e.

H1. *Social capital has a significant positive impact on farmers' willingness to adopt new agricultural technologies.*

2.1. The Impact of Social Networks on Farmers' Willingness to Adopt New Agricultural Technologies

A social network is a close social relationship gradually formed by the purposeful interactions among individuals and between individuals and organizations. Farmers access information through social networks to reduce the cost of learning and using new agricultural technologies and make decisions to adopt them. Social networks play an essential role in this process. Zhang [39] believes that the preliminary social network analysis can be divided into homogeneous and heterogeneous networks. Homogeneous

networks are mainly influenced by the relatively close social relations in the village—such as blood and kinship—to form the relationship network. Heterogeneous networks are mainly based on the relationships of geography and industry to form information dissemination chains. These networks can enable farmers to promptly obtain relevant information from outside their areas of life, which not only makes up for the insufficiency of the homogeneous networks, but also expands the scope of farmers' communication, enriches their theoretical knowledge and, ultimately, affects their decision-making behavior.

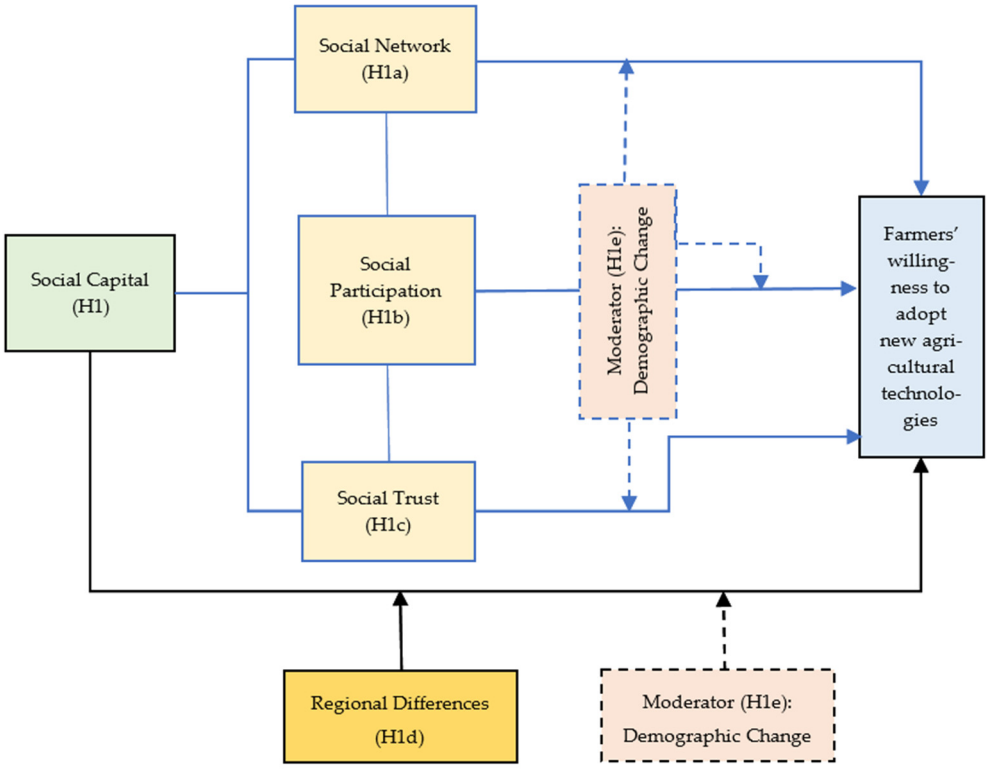

Figure 1. Theoretical analysis framework.

Referring to Husen et al. [18], we found that when exploring the influence mechanisms of social networks on farmers' technology adoption, the role of social networks is divided into four aspects: (i) The information acquisition mechanism: Due to the limited education levels of some farmers, they do not know much about how to invest reasonably in technology. Most farmers will listen to technical information from individuals with whom they have close relationships [40]. (ii) The learning mechanism: At the beginning of the introduction of agricultural technologies, since their advantages and characteristics are not well known to the public, if there are large technology adopters around them, farmers tend to learn from the existing adapters. (iii) The risk-sharing mechanism: In rural areas of China, farmers have limited communication channels and access to information, making it difficult and expensive to obtain technical information, and inhibiting farmers' technology adoption behavior. At this stage, as farmers' willingness to adopt technology increases, individuals communicate with one another and obtain experience in using the technology, improving the technical information at their disposal, and providing a specific risk guarantee for farmers' technology adoption [23,24]. (iv) The service complementation mechanism: In agricultural technology extension, the main channels for farmers to obtain technical information are social networks and government promotion. First, social networks mainly emphasize that individuals use their relationship networks for technical communication and exchange. Using these informal organizations can enable farmers to identify technical information and obtain reasonable technical input effectively. Second, government promotion generally takes the form of individual "agricultural demonstration

households" drawn up by the government, and relies on a particular technology adopter to disseminate technical information, effectively reducing the occurrence of information asymmetry. In addition, Genius et al. [41] took agricultural irrigation technology as their research object, and found that government extension services and social network learning are complementary, and the existence of one party enhances the effectiveness of the other in the process of technology adoption.

From this point of view, the social relationship networks in rural areas are mainly affected by geography, kinship, and industry ties, forming an information technology communication chain. The formation of this information chain, as an important platform for farmers to communicate and learn, not only improves the efficiency of information technology dissemination in rural areas, but also reduces the cost for farmers to obtain information, effectively increasing farmers' willingness to adopt new agricultural technologies. Based on this, Hypothesis H1a is proposed:

H1a. *Social networks have a significant positive impact on farmers' willingness to adopt new agricultural technologies.*

2.2. The Impact of Social Participation on Farmers' Willingness to Adopt New Agricultural Technologies

Social participation refers to individuals' concern, understanding, and behavioral investment in the political, economic, cultural, and other factors in social capital. Some studies have carried out preliminary research on the internal correlation of farmers' participation in public affairs and decision-making. Ayodeji et al. [42] took Nigeria as their research object, exploring whether farmers' participation in collective action would lead to differences in the choice of climate change adaptation strategies by farmers in the region. Miao [43] selected the data of six representative villages in Shanxi Province as the research object, and found that raising the awareness of individual participation helps improve farmers' willingness to adopt technology.

It is generally believed that the impact mechanism of social participation on farmers' willingness to adopt new technologies is mainly divided into two aspects: One aspect is the mechanism of public participation. The participation of farmers in the public activities formally organized in the village not only increases the opportunities for cooperation, communication, and learning with other farmers, but also, because some farmers may have successfully adopted the technology, they can more quickly understand the essentials of technical operations at different stages and reduce the difficulty of learning the technology, improve the enthusiasm of farmers to adopt it [44]. In addition, due to the limited knowledge levels and judgment ability of farmers themselves, farmers embedded in a rural "relationship network" are easily influenced in their decision-making behavior by other surrounding farmers. When farmers participate in public activities, due to the complexity of their relationship networks, they may show obvious "herd behavior", leading to the convergence of willingness to adopt the technology. The other aspect is the social interaction mechanism. When farmers participate in special activities voluntarily organized within the village, they can not only realize their value through social labor or social activities, etc., but also improve their sense of happiness. At the same time, Cai [45] believes that with the improvement of farmers' happiness, farmers' willingness to adopt new agricultural technologies will also increase, while meeting their growing economic, cultural, and social needs. It can be seen that the original intention of farmers to participate in this activity is based on the promotion of most personal needs, which can effectively help farmers to accurately locate the required relationship networks in the process of participating in the activity to efficiently disseminate agricultural technology information and improve farmers' willingness to adopt new agricultural technologies.

Social participation is an information network platform formed under the influence of "public participation" and "social interaction". This platform can effectively help farmers to communicate and learn, make decisions, and make choices while meeting the needs of

emotion and belonging, thereby improving farmers' willingness to adopt the technology. Thus, Hypothesis H1b is proposed:

H1b. *Social participation has a significant positive impact on farmers' willingness to adopt new agricultural technologies.*

2.3. The Influence of Social Trust on Farmers' Willingness to Adopt New Agricultural Technologies

Social trust is a behavioral code of mutual recognition and interdependence among people and between people and organizations, formed based on social capital. This paper mainly reflects on the two aspects of interpersonal trust and institutional trust. First, the trust mechanism in the process of information technology dissemination is mainly based on the relationship networks established in the family, and based on different degrees of trust, which show different degrees of willingness to adopt new technology [46]. Wu [47] took energy-saving and emission-reducing technology as the research object, and found that social networks—as an internal incentive mechanism that affects farmers' technology adoption—influence farmers' attitudes and ability to adopt technology through interpersonal trust which, in turn, affects their willingness to adopt new technology. Second, in the process of researching transgenic rice technology, expert trust, government trust, and institutional trust all belong to institutional trust, and they all have a significant positive correlation with the adoption of transgenic technology [48]. Ma [49] found that at the beginning of the technology's introduction, both the trust in the trading system and the trust in the government system positively influenced the use of standardized technology for pollution-free apple production. Studies have shown that in areas with higher trust, the higher the frequency of cooperation and communication among farmers, the stronger their willingness to adopt new technology.

Given the dynamic nature of the trust structure, Kuang [50] took the adoption of new technology for pig-rearing as the research object, and believed that in the process of technology promotion, different levels of social trust have different effects on farmers' adoption of new agricultural technologies. Taking the clan relationship network as an example, the size of the trust radius causes a difference in the degree of intimacy between farmers, resulting in different decision-making behaviors of those farmers. In the middle and late stages of technology diffusion, affected by behaviors such as going out to work and study, farmers broadened their relationship networks, increased their understanding of new agricultural technologies, and increased their willingness to adopt new agricultural technologies.

The impact of social trust on farmers' technology adoption has been widely recognized in academia. On the one hand, social trust can reduce the cost of technology learning and effectively increase farmers' willingness to adopt the technology by establishing an internal incentive and restraint mechanism. On the other hand, as social trust is a process of continuous and dynamic development, farmers can establish a long-term maintenance mechanism of social trust and enhance their willingness to adopt new technology. Based on this, Hypothesis H1c is proposed:

H1c. *Social trust has a significant positive impact on farmers' willingness to adopt new agricultural technologies.*

2.4. Regional Heterogeneity of the Influence of Social Capital on Farmers' Willingness to Adopt New Agricultural Technologies

In recent years, the regional economic development in China has presented an obvious differentiation trend due to the differences in social capital, economic development, and strategic orientation. In order to scientifically reflect the social and economic development of different regions in China, and provide a theoretical basis for the government to formulate regional development policies, the National Bureau of Statistics has divided China's economic regions into four major economic zones: the eastern region, the central region, the western region, and the northeastern region. Social capital is the resource endowment accumulated by farmers in their living environment over a long time. In view

of the changes in population scale, population structure, and relationship networks brought about by the differences between China's four major economic regions, farmers' social capital will inevitably show distinct regional differences [51]. Based on this, Hypothesis H1d is proposed:

H1d. *Social capital has a significant impact on farmers' willingness to adopt new agricultural technologies in different regions.*

2.5. The Moderating Effect of Demographic Change

Demographic change is the behavioral activity produced by farmers in the process of maintaining their livelihood and seeking development. Its essence is that individuals form a new social environment through changes in quantity, quality, and structure. In recent years, most of the research on the outflow of the rural labor force and technology promotion has focused on demographic changes. These labor forces build new social capital through communication in the initial process of migration, effectively broadening the channels for farmers' dissemination of technical information. However, with the deepening of urbanization, farmers in some areas have begun to transfer their hukou due to the influence of social welfare and development concepts in developed areas, resulting in changes in population quality. The study of the impact of demographic changes on social capital and farmers' adoption of technology is of great practical significance for understanding the internal relationship between population mobility and farmers' decision-making behavior.

The number of agricultural laborers in China has shown a solid downward trend under the influence of the economy and policies. Yan [52] found that with the acceleration of China's urbanization and the transformation and upgrading of the industrial structure, the outflow of population from rural areas has shown a continuous growth trend, and an effective technical information sharing platform could not be formed, resulting in the efficiency of agricultural technology adoption being affected by population changes, showing a continuous downward trend. In addition, Tshikala [53], Liu et al. [54], and Jiang et al. [55] believe that the relationship between labor migration and farmers' adoption of new agricultural technologies is affected by many factors, such as the degree of agricultural factor market perfection and the degree of farmers' organization. To further explore the internal relationships between population changes and farmers' technology adoption, we selected the number of instances of hukou migration as a moderating variable in the relationship between social capital and farmers' willingness to adopt new agricultural technologies. Based on this, Hypothesis H1e is proposed:

H1e. *Demographic change and social capital have a significant moderating effect on farmers' willingness to adopt new agricultural technologies.*

3. Data and Methodology

3.1. Data Sources

The China Labor Dynamics Survey (CLDS) database focuses on the status quo and changes in China's labor force, covering education, work, migration, health, social participation, economic activities, grassroots organizations, and many other research topics. It is a large-scale, interdisciplinary tracking survey. To ensure the national representativeness of the sample, the CLDS sample covers 29 provinces and cities in China (excluding Hong Kong, Macao, Taiwan, Tibet, and Hainan), and the survey objects are all laborers (family members aged 15 to 64 years) in the sample households. In the sampling method, a multistage, multilevel probability sampling method proportional to the size of the labor force is adopted. In terms of the tracking survey method, the CLDS is the first in China to adopt the rotation sample tracking method. By collecting data in this field, scholars have established tracking databases at the three levels of social labor, family, and community in China, which provide basic data for researchers' theoretical research and policymaking.

Combined with the research content of this paper, the data were processed as follows: First, in the method of survey data selection, a probability sampling method in proportion to the size of the labor force was adopted under the premise of multistage, multilevel, and full coverage. Second, in this study, rural residents over 18 years old with specific behavioral abilities were selected to represent the agricultural labor force, as suggested by Miao [43]. Third, the samples with missing critical information such as age, family income, social capital, and political status were excluded. Finally, the sample size obtained in our study was 11,547.

3.2. Model

This paper divides the dependent variable (farmers) into five decision-making stages of adopting new agricultural technologies (1 = strongly agree; 2 = somewhat agree; 3 = generally agree; 4 = not quite agree; 5 = strongly disagree). In this study, since the explained variables are multi-category variables ranked based on certain rules, we chose the multivariate logistic model for analysis. Moreover, following the methods of Nusrat et al. [56] and Chakraborty et al. [57], we used a step-by-step analysis method to measure the impact of social capital on farmers' willingness to adopt new agricultural technologies, including the following three steps:

First, to prevent serious collinearity problems in this study, using the method of Shobhika [58], six independent variables were selected as proxy variables and converted into potential public factors after dimensionality reduction through factor analysis, narrowing the scope of the study and helping to reduce the error of the results. The specific form is as follows:

$$X_i = \mu_i + a_{i1}f_1 + \cdots + a_{im}f_m + \varepsilon_i, \ \ (m \le p) \tag{1}$$

where $f_1, f_2, \cdots, f_p$ are common factors, which are unobservable variables; their coefficients are expressed in the form of factor loadings. ε_i is a special factor that cannot be included in the common factor.

Second, given that the dependent variable is a multi-category variable, an ordered multi-category logistic model was selected for empirical analysis. The specific form is as follows:

$$p_j = p(y \le j|x) = \frac{exp\left(\alpha_j + \sum_{i=1}^{n} \beta_i x_i\right)}{1 + exp\left(\alpha_j + \sum_{i=1}^{n} \beta_i x_i\right)} \tag{2}$$

where p_j represents the willingness of farmers to actively adopt new agricultural technologies, α_j is the constant term regression coefficient, β_i is the coefficient, x_i represents the independent variable $(i = 1, 2, \ldots, n)$, and $j = 1, 2, 3, 4, 5$ represent five levels of willingness to adopt new agricultural technologies.

Finally, as described by Zhou [59], we selected demographic change as a moderating variable to explore the moderating effect of demographic change on social capital on farmers' willingness to adopt new agricultural technologies. The specific form of the model is as follows:

$$y_i = \beta_0 + \beta_1 Social\_cap + \beta_2 Demo\_change + \beta_3 Social\_cap \times cha + \delta_i \tag{3}$$

where y_i represents the willingness of farmers to actively adopt new agricultural technologies, $Social\_cap$ represents social capital, $Demo\_change$ represents demographic change (i.e., the number of instances of hukou migration), $Social\_cap \times cha$ is the interaction term between social capital and demographic change, and δ_i is the error term.

Accordingly, we also give a series of model-specific expressions:

$$y_i = \beta_0 + \beta_1 Social\_net + \beta_2 Demo\_change + \beta_3 Social\_net \times cha + \delta_i \tag{3a}$$

$$y_i = \beta_0 + \beta_1 Social\_par + \beta_2 Demo\_change + \beta_3 Social\_par \times cha + \delta_i \tag{3b}$$

$$y_i = \beta_0 + \beta_1 Social\_tru + \beta_2 Demo\_change + \beta_3 Social\_tru \times cha + \delta_i \tag{3c}$$

where *Social_net*, *Social_par*, and *Social_tru* represent social networks, social participation, and social trust, respectively. *Social_net* × *cha*, *Social_par* × *cha* and *Social_tru* × *cha* are the interaction terms between social networks, social participation, social trust, and demographic change, respectively. Other variables are consistent with those in Equation (3).

3.3. Variable Selection and Descriptive Statistics

1. Dependent variable: As described by Chatzimichael et al. [60], Zeng [61], and Tzemi [62], we selected farmers' willingness to adopt new agricultural technology as the dependent variable. See Table 1 for the definition and assignment of variables.
2. Independent variable: When referring to relevant theories in this field, we found that some scholars often use a single indicator as a proxy variable of social capital when selecting independent variables. For example, using the "number of gifts given by families" as a proxy variable of social capital [63] may not cover all of the characteristic angles of social capital. In recent years, with the deepening of relevant theoretical research, some scholars have pointed out that through the factor analysis method, the social capital is measured, and then multidimensional indicators are used to construct a comprehensive index, which can cover more social capital information and facilitate a more detailed examination of social capital characteristics. As described by Putnam et al. [64] and Miao [43], we divided social capital into three characteristic perspectives: social networks, social trust, and social participation. Doing so can not only effectively help researchers to process the data and mitigate possible collinearity issues, but also provide insight into the inherent link between farmers' social networks and technology adoption.

Table 1. Descriptive statistics.

Variable	Variable Definition	Mean	Standard Deviation
Willingness to adopt new agricultural technologies	Actively adopt new agricultural technologies (1 = strongly agree; 2 = somewhat agree; 3 = generally agree; 4 = not quite agree; 5 = strongly disagree)	2.54	0.89
Social networks:			
Homogeneous networks	Range of gifts for relatives and friends in the village for wedding events (1 = all of them go; 2 = most of them go; 3 = few of them go; 4 = rarely)	1.92	0.92
Heterogeneous networks	The range of other people in the village (not relatives and friends) for wedding events and gifts (1 = all of them go; 2 = most of them go; 3 = few of them go; 4 = very few go)	2.68	1.1
Social participation			
Participate in union activities	Participate in agricultural union activities (1 = yes; 2 = no)	1.37	0.48
Repair the village road	Are you willing to participate/donate to repair village roads (1 = very willing; 2 = more willing; 3 = average; 4 = unwilling; 5 = very unwilling)	1.92	0.83
Social trust			
Neighborhood mutual aid	Number of times you help your neighbors (1 = very much; 2 = somewhat; 3 = average; 4 = less; 5 = very little)	2.54	0.98
Trust in neighbors	Do you trust the neighbors and other residents of this community (village)? (1 = very trust; 2 = trust; 3 = fair trust; 4 = distrust; 5 = very distrust)	2.28	0.81
Moderator			
Demographic change	The number of instances of hukou migration	1.17	0.55
Control variable			
Gender	1 = male; 2 = female	1.52	0.5
Income	2017 total revenue (CNY)	39,015.68	72,112.93
Political landscape	1 = member of the Communist Party of China; 2 = democratic party; 3 = the masses	2.86	0.5
Expenditures	Total consumption expenditure in 2017 (CNY)	55,853.99	99,975.45

We drew on the practice of Wang et al. [65] and chose "the range of relatives and friends in the village to send gifts for wedding events" and "the range of other people in the village (non-relatives) to send gifts for wedding events" as the proxy variables of the social network. The reason for this is that rural areas have close relationship networks, and the information network platform formed by the happy event management helps the agricultural technicians in and outside of the villages to share information freely. As described by Wu et al. [66], "respondents participating in agricultural trade union activities" and "whether the respondents are willing to donate money to repair the roads in their hometown" were selected as proxy variables for social participation. The reason for this is that the exchanges and interactions generated by farmers participating in trade union activities facilitate the formation of relationship networks. This can help technology adopters to share their successful personal experiences, reduce the difficulty of technology adoption, and increase farmers' recognition of agricultural technologies in the region. In addition, considering the current economic development situation and industrial transformation in rural areas, some enterprises and farmers may adopt new agricultural technologies to adapt to their development. A good road environment is a lifeline connecting towns and cities, a bridge for enterprises and farmers to introduce agricultural technology, and a vital link to ensure that enterprises and farmers can obtain information on agricultural technology. Whether the farmers are willing to donate money to repair the roads reflects the individuals' willingness to adopt agricultural technology. As described by Xiong et al. [67], "several times of mutual assistance among neighbors" and "whether to trust neighbors" were selected as proxy variables of social trust. Trust capital is an essential factor for farmers to share technical information. Trusting neighbors and helping one another in life is beneficial to increase rural farmers' identity and sense of belonging, and encourages farmers to be more likely to adopt new agricultural technologies.

Before factor analysis, we used STATA 15.0 software to calculate the KMO value of these survey data to be 0.52, indicating that the sample is suitable for factor analysis (it is generally considered that the KMO value should be >0.5). To make the factor analysis results more reasonable, three common factors (data with eigenvalues > 1) were extracted by factor rotation, and the cumulative variance contribution rate was 68.33%. Common Factor 1 had a larger load on the last, fifth, and sixth indicators, and the variance contribution rate was 26.99%, reflecting the social networks. Common Factor 2 had a larger load on the first and second indicators, with a variance contribution rate of 23.77%, reflecting social participation. Common Factor 3 had a larger load on the third and fourth indicators, and the variance contribution rate was 17.57%, reflecting social trust. The variance contribution rate of each factor was weighted to obtain the calculation formula of the comprehensive index of social capital: social capital = (26.99% × social network + 23.77% × social participation + 17.57% × social trust)/68.33%.

3. Moderator: We selected the number of instances of hukou migration as a proxy variable to examine whether demographic change has a moderating effect on the relationship between social capital and farmers' decision-making behavior [35]. Based on the heterogeneity of regional culture and economic development, the floating population is affected by the surrounding environment and reintegrated into the new innovative technology consumption system. This may cause apparent differences in the willingness of farmers to adopt the technology.
4. Control variables: We selected some possible influencing factors as control variables. One type consisted of the individual characteristics of the household head, including gender, political status, and income. The other type was family characteristics, i.e., family income. The definitions of variables and descriptive statistical analysis are shown in Table 1.

4. Estimated Results and Discussion

4.1. Social Capital and Farmers' Adoption of New Agricultural Technologies

Based on the previous analysis, the total social capital score was selected as a proxy variable to examine the influence of social capital on farmers' willingness to adopt new agricultural technologies. As described by Quisumbing [28], we used the stepwise regression method for analysis. Based on this, Model 1 mainly analyzed the influence of the total score of social capital and the control variables on farmers' willingness to adopt new agricultural technologies. Models 2–5 examined the influence of social networks, social participation, social trust, and the control variables on the farmers' willingness to adopt new agricultural technologies.

4.1.1. The Influence of Social Capital on Farmers' Willingness to Adopt New Agricultural Technologies

It can be seen from Model 1 in Table 2 that social capital has a positive impact on farmers' willingness to adopt new agricultural technologies, and the coefficient is significant at the 1% level. The higher the level of social capital, the stronger the willingness of the farmers to actively adopt new agricultural technologies. The results of this study preliminarily verify Hypothesis H1, and confirm the role of social capital in promoting farmers' willingness to adopt new agricultural technologies. Moreover, the conclusions of this study are consistent with those of Liu [15] and Husen [18] et al., showing that there is a close relationship between social capital and farmers' adoption of new technology.

Table 2. The impact of social capital on farmers' willingness to adopt new agricultural technologies.

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Social capital					
Comprehensive indicators	0.634 *** (0.15)				
Social networks					0.286 *** (0.09)
Homogeneous networks		0.166 *** (0.03)			
Heterogeneous networks		−0.003 (0.02)			
Social participation					0.123 (0.09)
Participate in agricultural union activities			0.183 (0.22)		
Repair village roads			0.523 *** (0.14)		
Social trust					0.272 *** (0.11)
Neighborhood mutual aid				0.090 *** (0.27)	
Trust in neighbors				0.083 ** (0.03)	
Control variables					
Gender	0.289 (0.22)	0.187 *** (0.04)	0.372 (0.22)	0.176 *** (0.04)	0.292 (0.22)
Income	−2.00 (2.03)	5.260 (4.65)	−1.72 (2.05)	2.71 (4.65)	−1.60 (2.06)
Political landscape	−0.158 (0.13)	0.203 *** (0.05)	−0.202 (0.135)	0.197 *** (0.48)	−0.228 * (0.14)
Expenditure	−1.73 (1.51)	2.11 (2.95)	−4.81 (1.52)	1.37 (2.93)	−3.88 (1.52)

Note: *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

4.1.2. The Influence of Social Networks on Farmers' Willingness to Adopt New Agricultural Technologies

According to Model 2 and Model 5, Hypothesis H1a is partially verified. Among them, in the homogeneous and heterogeneous networks, the "range of gifts for relatives and friends in the village" is significant at 1%—that is, the more times relatives in the village participate in wedding events, the greater the willingness of farmers to adopt new agricultural technologies. However, "the range of other people in the village (not relatives and friends)" for wedding events has little impact on farmers' active adoption of new agricultural technologies. These results are not consistent with those of Kuang [50]. A possible reason for this is that due to economic development and industrial upgrading, most of the rural population has migrated to cities, and the once-solid rural social networks and interpersonal relationships in rural areas gradually decline. As a result, other people in the village who can participate in marriage are the relatives of the head of the household, and an effective information dissemination platform cannot be formed.

4.1.3. The impact of Social Participation on Farmers' Willingness to Adopt New Agricultural Technologies

It can be seen from Model 3 that Hypothesis H1b is partially verified. The variable "respondents are willing to donate money to repair roads in the village" is significant at the 1% level, and the coefficient is positive, indicating that the more respondents donate money to repair roads in the village, the stronger the willingness of farmers to adopt new agricultural technologies. The variable "participation in agricultural trade union activities" is not significant at the 1% level, and the coefficient is positive, indicating that farmers' participation in trade union activities has little effect on adopting new technologies. It can be seen that the internal relationship between social participation and farmers' adoption of new technology is somewhat different from the results of Ayodeji et al., Miao, and Addai et al. [42–44]. The possible reasons for this include, on the one hand, the fact that at present, agricultural trade unions in rural areas are mainly informal social groups that are organized spontaneously based on shared interests, and trade union personnel are easily influenced by objective factors, leading to the convergence of intentions. In rural areas, due to the profound background of traditional agriculture and farmers' uneven economic status and levels of development, the conditions for farmers to adopt new technologies are insufficient, and trade unions still dominate traditional agricultural technologies. On the other hand, the accelerated urbanization process has accelerated the transformation and upgrading of industries in some areas, resulting in a significant transfer of surplus labor. Accordingly, the proxy variable "participation in agricultural trade union activities" selected in this study has no significant impact on the adoption of new technologies by farmers.

4.1.4. The Influence of Social Trust on Farmers' Willingness to Adopt New Agricultural Technologies

It can be seen from Model 4 that the variables "trusting neighbors" and "neighborhood mutual" are both significant at the 1% level, and the coefficients are positive. This shows that with the improvement of social trust, farmers' willingness to adopt new agricultural technologies also gradually increases. The results of this study preliminarily verify Hypothesis H1c, and confirm the role of social trust in promoting farmers' willingness to adopt new agricultural technologies. Moreover, the conclusions of this study are consistent with those of Weng [46], illustrating the link between social trust and the adoption of new technology by farmers.

4.2. Heterogeneity of the Influence of Social Capital on Farmers' Willingness to Adopt New Agricultural Technologies

From Models 6–9 in Table 3, the impact of social capital on farmers' adoption of new agricultural technologies presents apparent regional heterogeneity. First, the influence of social capital on the willingness of farmers to adopt new agricultural technologies in

the eastern economic zone is significant at the 1% level, and the coefficient is positive. The results of this study preliminarily prove Hypothesis H1d—that social capital can promote the willingness of farmers to adopt new agricultural technologies—in the eastern region. Second, the influence of social capital on the willingness of farmers to adopt new agricultural technologies in the central economic zone is significant at the level of 5%, and the coefficient is positive, proving that Hypothesis H1d is established in this region. Third, the ability of social capital to promote farmers' adoption of new agricultural technologies in the western region is significant at the 1% level, and the coefficient is negative. The results of this study preliminarily prove Hypothesis H1d for this region—that is, that the influence of social capital on the willingness of farmers to adopt new agricultural technologies in the western region shows a significant adverse effect. Fourth, the effect of social capital on the willingness of farmers to adopt new agricultural technologies in the northeastern region is not significant. The possible reasons for this are, on the one hand, affected by the strategic positioning of the northeastern region, where most industrial clusters are dominated by heavy industry, the number of people involved in agriculture is small, and people lack confidence in agricultural technology, making social capital unable to form an effective transmission chain. In addition, given the harsh climatic conditions in the region, the permafrost layer hinders the promotion and popularization of agricultural technologies, resulting in no significant impact of social capital on the willingness of farmers to adopt new agricultural technologies in the northeastern region.

Table 3. Heterogeneity of social capital's effect on farmers' willingness to adopt new agricultural technologies in four regions.

Variable	Model 6	Model 7	Model 8	Model 9
Eastern region	0.285 ***			
	(0.04)			
Central region		0.132**		
		(0.51)		
Western region			−0.381 ***	
			(0.04)	
Northeast region				0.042
				(0.09)
Control variables				
Gender	0.184 ***	0.187 ***	0.185 ***	0.184 ***
	(0.04)	(0.04)	(0.04)	(0.42)
Income	−2.87	1.43	−3.14	8.98
	(4.60)	(4.69)	(4.60)	(4.66)
Political landscape	0.212	0.209 ***	0.200 ***	0.211 **
	(0.05)	(0.05)	(0.05)	(0.05)
Expenditure	7.60	1.93	1.16	1.86
	(2.94)	(2.95)	(2.95)	(2.95)

Note: ** and *** indicate statistical significance at the levels of 5%, and 1%, respectively.

4.3. The Moderating Effects of Demographic Change and Social Capital on Farmers' Willingness to Adopt New Agricultural Technologies

We found that the latent variable in this study is continuous. To reduce the occurrence of non-essential multicollinearity, we centralized the moderator variable and the independent variable, and used their product as the interaction term. Stepwise regression was used to test the moderating effect. The results are shown in Models 10–13 in Table 4. The interaction terms of social capital, social network, and the number of instances of hukou migration are negative and significant at the 10% and 5% levels, respectively. This shows that the greater the number of instances of hukou migration, the lower the willingness of farmers to adopt new agricultural technologies.

Table 4. The moderating effects of demographic change.

Variable	Model 10	Model 11	Model 12	Model 13
Social_cap	0.903 *** (0.29)			
Social_net		0.774 (0.20)		
Social_par			0.127 (0.17)	
Social_trust				0.349 (0.22)
Moderator				
Demo_change	0.676 (0.42)	0.854 ** (0.43)	0.687 * (0.42)	0.630 (0.42)
Interaction terms				
Social_cap × *cha*	−0.974 * (0.57)			
Social_net × *cha*		−1.239 ** (0.58)		
Social_par × *cha*			−0.801 (0.56)	
Social_tru × *cha*				−0.805 (0.56)
Control variables				
Gender	0.462 (0.48)	0.599 (0.49)	0.569 (0.47)	0.451 (0.48)
Income	0.462 (0.48)	0.599 (0.49)	0.569 (0.47)	0.451 (0.48)
Political landscape	−0.113 (0.24)	−1.333 (0.24)	−0.20 (0.24)	−1.390 (0.24)
Expenditure	6.50 (5.98)	5.46 (6.11)	4.72 (5.92)	5.77 (6.00)

Note: *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

However, we found that social participation and trust had no significant moderating effect on farmers' willingness to adopt new agricultural technologies after adding "the number of times of hukou migration". Therefore, it is easy to see that demographic changes do not fully moderate the relationship between social capital and the active adoption of new agricultural technologies by farmers. Peng and Lin [37] suggested that demographic change can effectively improve the efficiency of agricultural technology adoption. However, our results show that incorporating demographic change into social capital and technology adoption shows some negative effects. A possible reason for this is that based on the trust mechanism, farmers participating in the new network structure after the population change may experience emotions such as resistance, doubt, and unfamiliarity with the environment, resulting in an insignificant adjustment effect. Thus, Hypothesis H1e is partially verified.

4.4. Endogeneity Problem

Theoretically, the decision-making of farmers' behavior may affect farmers' social capital, so the two may be mutually causal. In this study, as suggested by Wang [68], we selected "the health level of farmers" as an instrumental variable, and used the Iv-reg2 model to test endogeneity. The Iv-reg2 model not only reflects the essence of the instrumental variables, but also is the most effective instrumental variable method when the spherical disturbance terms are distributed independently.

According to the social capital theory, the health level of an individual has an interactive relationship with the operation of social capital. In the empirical research, as reported by Abel [69], taking the COVID-19 pandemic as the research object, it is believed that social capital is not only affected by individual health levels and the scale of social capital, but

also depends on the amount of capital with a healthy level in the process of individual communication. According to Model 14 in Table 5, health levels significantly impact social capital at the level of 1%. At the same time, when the F statistic = 13.67 > 10 when testing the results for weak instrumental variables, it can be considered that the null hypothesis is rejected—that is, the instrumental variable we constructed through virtual experiments is not a weak instrumental variable. Moreover, after the Durbin–Wu–Hausman test, the empirical results showed that the *p*-value was less than 0.1, indicating that there is an endogeneity problem—that is, adding the instrumental variable "health level of farmers" can improve the data quality of this study and overcome the endogeneity.

Table 5. IV-reg2 regression results.

Variable	Model 14		Model 15		Model 16		Model 17	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Social_cap		0.996 ***						
		(0.36)						
Social_net				0.501 ***				
				(0.19)				
Social_par						4.24		
						(8.00)		
Social_trust								1.938
								(1.37)
Health level	0.240 ***		0.472 ***		0.056		0.122	
	(0.07)		(0.12)		(0.10)		(0.09)	
Control variables	Control	Control	Control	Control	Control	Control	Control	Control
Gender	0.098	−0.040	0.177	−0.033	0.100	−0.368	−0.036	0.126
	(0.10)	(0.14)	(0.16)	(0.13)	(0.16)	(1.00)	(0.14)	(0.28)
Income	−1.82	−9.04	2.43	−1.23	4.17	−2.88	−1.75	2.28
	(1.08)	(1.43)	(1.23)	(1.33)	(1.38)	(6.32)	(1.16)	(3.39)
Political landscape	0.010	−0.126	0.055	−0.062	−0.013	0.019	0.290 ***	−0.597
	(0.06)	(0.09)	(0.10)	(0.08)	(0.10)	(0.40)	(0.07)	(0.44)
Expenditure	−0.799	2.02	−3.52	1.62	−7.32	2.95	8.22	−1.75
	(0.26)	(8.94)	(7.88)	(6.37)	(1.22)	(7.97)	(9.94)	(2.06)
Constant	−0.771 ***	3.009 ***	−1.166 ***	2.824 ***	−0.222	3.18 *	0.908 ***	3.99 ***
	(0.26)	(0.33)	(0.41)	(0.29)	(0.40)	(1.66)	(0.29)	(1.06)

Note: The explanatory variable in the first stage is social capital, and the explanatory variable in the second stage is the adoption of new agricultural technologies. * and *** indicate statistical significance at the 10% and 1% levels, respectively.

5. Conclusions and Policy Implications

Using the survey data of 399 villages in the China Labor Dynamics Survey (CLDS) database from 2017, this study examined the impact of social capital on farmers' willingness to adopt new agricultural technologies. Through the division of the four major economic zones, the regional heterogeneity of the impact of social capital on farmers' willingness to adopt technology was verified.

Accordingly, the conclusions of this study are as follows: First, the impact of social capital on farmers' willingness to adopt new agricultural technologies has a significant positive impact. Second, social networks, social trust, and social participation are partially significant in the study of farmers' willingness to adopt new technologies. Third, demographic change (i.e., the number of number of instances of hukou migration) negatively affects the impact of social capital on farmers' adoption of new technologies. Fourth, the influence of farmers' social capital on the willingness to adopt agricultural technology varies between different regions. Fifth, through the endogeneity test, we found that adding the instrumental variable "health level of farmers" can effectively improve the accuracy of empirical analysis and alleviate endogeneity.

This study's conclusions lead to the following policy implications: First, under the current situation, the traditional cultural resources in each region should be utilized to

build informal community organizations that are conducive to villagers' exchanges and supervision by villagers to facilitate emotional exchanges and trust exchanges between farmers. Second, considering that population changes have a significant negative moderating effect on farmers' adoption of new technologies, relevant departments should promote the transformation of farmers' traditional thinking through government subsidies, community publicity, and village leaders, attracting some talents to return to their hometowns to start businesses, and reducing the number of farmer changes. Third, it is suggested that relevant departments should formulate technology promotion policies for the western and northeastern regions, while actively advocating the establishment of county-level comprehensive pilot projects for scientific and technological poverty alleviation in the western and northeastern regions. The relevant departments should popularize the advantages of new technologies deeply at the grassroots level, change the traditional thinking of farmers, and enhance the willingness of farmers to adopt agricultural technologies. Fourth, it is recommended to promote the advantages of "new countryside" construction by printing leaflets, posting posters, etc. Other informal organizations, such as village committees and cooperatives, should actively guide farmers to participate in the transformation and upgrading of local industries, and accurately promote agricultural technology. In addition, the government should actively create conditions to encourage and guide large technology households to return to their villages to start businesses and stimulate the enthusiasm of local farmers to adopt new agricultural technologies.

There are two main limitations to this study: First, due to data access, the use of data in this article does not distinguish between specific types of technologies. Therefore, this study only briefly examines the subjective willingness of farmers to adopt new agricultural technologies. Second, this study does not examine regional heterogeneity in the adoption of new agricultural technologies by farmers at a smaller regional scale, such as smaller counties, cities, or even townships.

Author Contributions: Conceptualization, R.L. and M.H.; Validation, R.L. and H.M.; Formal Analysis, R.L., J.W. and H.M.; Data Curation, R.L. and M.H.; Writing—Original Draft Preparation, R.L. and M.H.; Writing—Review and Editing, R.L., J.W., K.Z., Y.X. and H.M.; Project Administration, R.L. and H.M.; Funding Acquisition, R.L. and H.M. All authors have read and agreed to the published version of the manuscript.

Funding: The work was supported by the National Natural Science Foundation of China (72173037); the Humanities and Social Science Research Project of the Ministry of Education of China (21YJA790039); the Key Scientific Research Project for Colleges and Universities of Henan Province (21A790011); the Philosophy and Social Science Planning Project of Henan Province (2021BJJ046); the Scientific and Technological Innovation Talents (Humanities and Social Sciences) Support Program for Colleges and Universities of Henan Province (2017-cxrc-002); and the Humanities and Social Science Research Project for Colleges and Universities of Henan Province (2023-ZDJH-368).

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

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

References

1. Yu, H.P. Innovations of modern Chinese history studies since reform and opening. *J. Mod. Chin. Hist.* **2009**, *3*, 95–110.
2. Ge, D.; Long, H.; Zhang, Y.; Ma, L.; Li, T. Farmland transition and its influences on grain production in China. *Land Use Policy* **2018**, *70*, 94–105. [CrossRef]
3. Jyoti, H.A.; Ranjan, S.R. Smart indoor farms: Leveraging technological advancements to power a sustainable agricultural revolution. *Agri Eng.* **2021**, *3*, 728–767.
4. Barnes, A.; Soto, I.; Eory, V.; Beck, B.; Balafoutis, A.; Sánchez, B.; Vangeyte, J.; Fountas, S.; van der Wal, T.; Gómez-Barbero, M. Exploring the adoption of precision agricultural technologies: A cross regional study of EU farmers. *Land Use Policy* **2019**, *80*, 163–174. [CrossRef]

5. Chen, C.R. Technology adoption, capital deepening, and international productivity differences. *J. Dev. Econ.* **2020**, *143*, 102388. [CrossRef]
6. Makate, C.; Makate, M.; Mango, N.; Siziba, S. Increasing resilience of smallholder farmers to climate change through multiple adoption of proven climate-smart agriculture innovations. Lessons from Southern Africa. *J. Environ. Manag.* **2019**, *231*, 858–868. [CrossRef]
7. Abdul, R.A.; Issahaku, G.; Zereyesus, Y.A. Improved rice variety adoption and farm production efficiency: Accounting for unobservable selection bias and technology gaps among smallholder farmers in Ghana. *Technol. Soc.* **2021**, *64*, 101471. [CrossRef]
8. Elahi, E.; Khalid, Z.; Zhang, Z.X. Understanding farmers' intention and willingness to install renewable energy technology: A solution to reduce the environmental emissions of agriculture. *Appl. Energy* **2022**, *309*, 118459. [CrossRef]
9. Wu, F. Adoption and income effects of new agricultural technology on family farms in China. *PLoS ONE* **2022**, *17*, e0267101. [CrossRef]
10. Rie, M.; Jun, F.; Akira, H.; Sakurai, T. Climate risk and agricultural technology adaption: Evidence from rice farmers in the Ayeyarwady River Delta of Myanmar. *Paddy Water Environ.* **2022**, *20*, 23–36.
11. Feder, G. Farm size, risk aversion and the adoption of new technology under uncertainty. *Oxf. Econ. Pap.* **1980**, *2*, 263–283. [CrossRef]
12. Razzaq, A.; Xiao, M.; Zhou, Y.; Anwar, M.; Liu, H.; Luo, F. Towards sustainable water use: Factors influencing farmers' participation in the informal groundwater markets in Pakistan. *Front. Environ. Sci.* **2022**, *24*, 944156. [CrossRef]
13. Conley, T.; Udry, C. Social learning through networks: Adoption of new agricultural technologies in Ghana. *Am. J. Agric. Econ.* **2001**, *83*, 668–673. [CrossRef]
14. Thirtle, C.G.; Ruttan, V.W. The role of demand and supply in the generation and diffusion of Technical Chang. *Taylor Fr.* **2014**, *21*, 11–77.
15. Liu, C.H.; Zheng, H.W. How social capital affects willingness of farmers to accept low-carbon agricultural technology (LAT)? A case study of Jiangsu, China. *Int. J. Clim. Chang. Strateg. Manag.* **2021**, *13*, 286–301. [CrossRef]
16. Gramzow, A.; Sseguya, H.; Sefa, A.V.; Bekunda, M.; Lukumay, P.J. Taking agricultural technologies to scale: Experiences from a vegetable technology dissemination initiative in Tanzania. *Int. J. Agric. Sustain.* **2018**, *16*, 297–309. [CrossRef]
17. Elahi, E.; Zhang, H.; Lirong, X.; Khalid, Z.; Xu, H. Understanding cognitive and socio-psychological factors determining farmers' intentions to use improved grassland: Implications of land use policy for sustainable pasture production. *Land Use Policy* **2021**, *102*, 105250. [CrossRef]
18. Husen, N.A.; Loos, T.K.; Siddig, K. Social capital and agricultural technology adoption among Ethiopian farmers. *Am. J. Rural. Dev.* **2017**, *5*, 65–72. [CrossRef]
19. Burton, R.J.F. The influence of farmer demographic characteristics on environmental behavior: A review. *J. Environ. Manag.* **2014**, *135*, 19–26. [CrossRef]
20. Li, Z.J. Human capital and technology change of Chinese agriculture. *J. Adv. Agric. Technol.* **2019**, *66*, 96–100. [CrossRef]
21. Wossen, T.; Berger, T.; Falco, S.D. Social capital, risk preference and adoption of improved farmland management practices in Ethiopia. *Agric. Econ.* **2015**, *46*, 81–97. [CrossRef]
22. Lin, J.Y. Hybrid rice innovation in China: A study of market-demand induced technological innovation in a centrally planned economy. *Rev. Econ. Stat.* **1992**, *74*, 14–20. [CrossRef]
23. Jiang, B.; Kim, J.S.; Li, C.; Yang, O. Social network structure and risk sharing in villages. *BE J. Econ. Anal. Policy* **2018**, *18*, 1–7. [CrossRef]
24. Elijah, M.M.; Ronoh, B.J.; Kamau, G.J. Linking farmers' risk attitudes, livelihood diversification and adoption of climate smart agriculture technologies in the Nyando basin, South-Western Kenya. *Heliyon* **2022**, *8*, e09305.
25. Bourdiera, P. The forms of capital. *Handb. Theory Res. Sociol. Educ.* **1986**, *1*, 241–258.
26. Portes, A. On the sociology of national development: Theories and issues. *Am. J. Sociol.* **1976**, *82*, 55–85. [CrossRef]
27. Lin, N. Building a network theory of social capital. *Connections* **1999**, *22*, 28–51.
28. Quisumbing, A.R.; Kumar, N. Does social capital build women's assets? The long-term impacts of group-based and individual dissemination of agricultural technology in Bangladesh. *J. Dev. Eff.* **2011**, *3*, 220–242. [CrossRef]
29. Sunday, O.A. Effects of social capital on adoption of improved technology and productivity of cassava among farmers' cooperative societies in Osun State. *Sci. Res.* **2019**, *7*, 14.
30. Uphoff, N. *Learning from Gal Oya: Possibilities for Participatory Development and Post Newtonian Social Science*; Cornell University Press: Ithaca, NY, USA, 1992.
31. Lee, B.C. The impact of social capital on tourism technology adoption for destination marketing. *Curr. Issues Tour.* **2015**, *18*, 561–578. [CrossRef]
32. Tong, D.J.; Huang, W. Research on rice farmers' adoption of water-saving irrigation technology from the perspective of social capital. *Water Sav. Irrig.* **2018**, *9*, 108–111, 115.
33. Hunecke, C.; Engler, A.; Rojas, R.J.; Poortvliet, P.M. Understanding the role of social capital in adoption decisions: An application to irrigation technology. *Agric. Syst.* **2017**, *153*, 221–231. [CrossRef]
34. Li, F.; Chen, F.Y.; Wang, Y.H.; Gao, X. Technology diffusion and population migration reflected in blade technologies in northern China in the Late Pleistocene. *Sci. China Earth Sci.* **2016**, *59*, 1540–1553. [CrossRef]

35. Rutten, R.; Boekema, F. Regional social capital: Embeddedness, innovation networks and regional economic development. *Technol. Forecast. Soc. Chang.* **2007**, *74*, 1834–1846. [CrossRef]
36. Olawuyi, S.O.; Mushunje, A. Social capital, and adoption of alternative conservation agricultural practices in South-Western Nigeria. *Sustainability* **2019**, *11*, 716. [CrossRef]
37. Peng, L.L.; Lin, L. Social organization, social capital and social integration of floating population: An empirical study. *J. Nanjing Agric. Univ. (Soc. Sci. Ed.)* **2022**, *22*, 43–52.
38. Zhang, Y.L.; Wang, B.W. The impact of rural labor mobility on agricultural development: Based on the trans logarithmic production function. *Econ. Manag.* **2012**, *26*, 42–45.
39. Zhang, W.E.; Luo, Y.; Zhao, M.J. Social network, information acquisitions and farmer's agricultural film recycling behavior: Taking farmers in the Yellow River Basin as a Sample. *J. Agric. For. Econ. Manag.* **2022**, *97*, 40–48.
40. Francesco, C.; Alain, D. Bounded rationality, social capital, and technology adoption in family farming: Evidence from cocoa-tree crops in ivory coast. *Sustainability* **2021**, *13*, 7483.
41. Genius, M.; Koundouri, P.; Nauges, C.; Tzouvelekas, V. Information transmission in irrigation technology adoption and diffusion: Social learning, extension services, and spatial effects. *Am. J. Agric. Econ.* **2014**, *96*, 328–344. [CrossRef]
42. Ayodeji, O.; Ayodeji, K.; Ashok, M.; Ogundeji, A. Impacts of farmers' participation in social capital networks on climate change adaptation strategies adoption in Nigeria. *Heliyon* **2021**, *7*, e08624.
43. Miao, S.S. Research on the cooperative participation behavior of farmers in small water conservancy facilities from the perspective of multidimensional heterogeneity of social capital. *China Popul. Resour. Environ.* **2014**, *24*, 46–54.
44. Addai, K.N.; Temosom, O.; Ng'ombe, J.N. Participation in farmer organizations and adoption of farming technologies among rice farmers in Ghana. *Int. J. Soc. Econ.* **2021**, *49*, 529–545. [CrossRef]
45. Cai, S.H. *Research on Farmers' Satisfaction in Minhang District Village Transformation*; Shanghai Jiaotong University: Shanghai, China, 2012.
46. Weng, Y.Q.; Li, J.; Huang, S.W. The influence of role orientation and social trust on farmers' willingness to govern the environment: An empirical analysis based on structural equation model. *J. Fujian Agric. For. Univ. (Philos. Soc. Sci. Ed.)* **2020**, *23*, 88–95.
47. Wu, X.R.; Li, X.L.; Zuo, X.L. The influence of social network on farmers' willingness to adopt agricultural machinery energy saving and emission reduction technology: The mediating effect based on value cognition. *World Agric.* **2020**, *11*, 54–64.
48. Chen, J. *Institutional Trust, Risk Perception and Public Acceptance of Genetically Modified Rice Technology*; Huazhong Agricultural University: Huhan, China, 2016.
49. Ma, X.D.; Huo, X.X. The influence of institutional trust on fruit farmers' compliance with standardized production technical specifications: Taking apple's pollution-free production as an example. *J. Hunan Agric. Univ. (Soc. Sci. Ed.)* **2019**, *20*, 9–16.
50. Kuang, H.Y. Research on the relationship between rural social network and agricultural technology diffusion: Taking the diffusion of pig raising technology in G Township as an example. *Sci. Res.* **2014**, *32*, 1518–1524.
51. Li, H. The Structure and performance of social capital of Chinese rural households: Based on the investigation of Shandong, Henan and Shaanxi provinces. *Agric. Econ. Issues* **2015**, *36*, 39–45.
52. Yan, C. *Research on the Impact of Rural Population Changes on Agricultural Production in the Process of Urbanization*; Anhui Agricultural University: Hefei, China, 2013.
53. Tshikala, K.S.; Kostandini, G.; Fonsah, E.G. The impact of migration, remittances and public transfers on technology adoption: The case of cereal producers in Rural Kenya. *J. Agric. Econ.* **2019**, *70*, 316–331. [CrossRef]
54. Liu, Y.W.; Wang, H.M. Agricultural technological progress, labor transfer and high-quality agricultural development. *Tax Econ.* **2022**, *2*, 88–97.
55. Jiang, X.; Liu, W.P. The impact of labor transfer on farm households' adoption of forestry technology: Based on the survey data in Hunan, Jiangxi, and Fujian provinces. In Proceedings of the 2017 9th International Economics, Management and Education Technology Conference (IEMETC 2017), Taiyuan, China, 12–14 July 2017; Volume 7, pp. 301–304.
56. Nusrat, H.; Mohammad, A.; Rob, C.; Rankin, P. A differential analysis for men and women's determinants of livelihood diversification in rural rain-fed region of Pakistan: An ordered logit model (OLOGIT) approach. *Soc. Sci. Humanit. Open* **2022**, *5*, 100257.
57. Chakraborty, B.; Maji, S.; Sen, A.; Mallik, I.; Baidya, S.; Dwibedi, E. A study on happiness and related factors among Indian college students. *J. Quant. Econ.* **2019**, *17*, 215–236. [CrossRef]
58. Shobhika, M.; Prashant, K.; Sushil, C. Reliability and factor analysis of Hindi version of IES-R scale: Effect of Rajyoga meditation on perceiving the impact of COVID-19. *Dialogues Health* **2022**, *12*, 100024.
59. Zhou, L.Y. The impact of labor transfer and its differentiation on the technical efficiency of agricultural production: Taking rice cultivation as an example. *J. Jiangxi Norm. Univ. Sci. Technol.* **2020**, *3*, 61–67.
60. Chatzimichael, K.; Genius, M.; Tzouvelekas, V. Informational cascades, technology adoption: Evidence from Greek and German organic growers. *Food Policy* **2014**, *49*, 186–195. [CrossRef]
61. Zeng, Y.M.; Zhang, J.B.; He, K.; Cheng, L. Who cares what parents think or do? Observational learning and experience-based learning through communication in rice farmers' willingness to adopt sustainable agricultural technologies in Hubei Province, China. *Environ. Sci. Pollut. Res. Int.* **2019**, *26*, 12522–12536. [CrossRef]
62. Tzemi, D.; Breen, J. Climate change and the agricultural sector in Ireland: Examining farmer awareness and willingness to adopt new advisory mitigation tools. *Clim. Policy* **2019**, *19*, 611–622. [CrossRef]

63. Zhou, G.S.; Fan, G.; Shen, G.J. Income gap, social capital, and health level: An empirical analysis based on China family tracking survey (CFPS). *Manag. World* **2014**, *7*, 12–21.
64. Putnam, R.D. Bowling alone: America's declining social capital. *J. Democr.* **1995**, *6*, 65–78. [CrossRef]
65. Wang, J.; Wang, L.L.; Wang, Y.A. Research on the influence of social capital on farmers' willingness to participate in farmers' water associations. *Agric. Mod. Res.* **2018**, *39*, 309–315.
66. Wu, J.; Wang, T.Y.; Wang, Z.B. The influence of social network and perceived value on farmers' choice of farmland quality protection behavior. *J. Northwest AF Univ. (Soc. Sci. Ed.)* **2021**, *21*, 138–147.
67. Xiong, A.H.; Song, T.T. Research on the influence of social capital on farmers' willingness to green production. *Stat. Decis. -Mak.* **2020**, *36*, 76–80.
68. Wang, H.F.; Tian, Z.Z. A review of the application of Bourdieu's social practice theory in health promotion at home and abroad. *J. Med. Soc.* **2021**, *34*, 47–51.
69. Abel, T.; Frohlich, K.L. Capitals, capabilities: Linking structure and agency to reduce health inequalities. *Soc. Sci. Med.* **2012**, *74*, 236–244. [CrossRef] [PubMed]