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How Does Trust Influence Farmers' Low-Carbon Agricultural Technology Adoption? Evidence from Rural Southwest, China

Wenfeng Zhou [1], Jia He [1], Shaoquan Liu [2,*] and Dingde Xu [1,3,*]

[1] College of Management, Sichuan Agricultural University, Chengdu 611130, China
[2] Institute of Mountain Hazards and Environment, Chinese Academy of Sciences and Ministry of Water Resources, Chengdu 610041, China
[3] Sichuan Center for Rural Development Research, College of Management, Sichuan Agricultural University, Chengdu 611130, China
* Correspondence: liushq@imde.ac.cn (S.L.); dingdexu@sicau.edu.cn (D.X.); Tel.: +86-130-7280-7630 (S.L.); +86-134-0859-8819 (D.X.)

Abstract: Carbon emission reduction in agriculture is an important link to achieving green agricultural development and a rural ecological environment, and Low-Carbon Agricultural Technology (LCAT) of farmers is an important means to achieve carbon emission reduction in agriculture. Based on data obtained from a survey of 540 farmers in Sichuan province in 2021, the Tobit model was used to empirically analyze the effect of trust on farmers' LCAT adoption. The results show that (1) the trust level of farmers is high and the order is special trust > institutional trust > general trust. At the same time, the intensity of adoption of LCAT by farmers is not high, and the average number of LCAT adopted by each family is 1.13. Among them, straw-returning technology was adopted to a high degree, with 54.63% of farmers using it. (2) Farmers' trust significantly enhances farmers' LCAT adoption behavior, and the magnitude of the effect is characterized by specific trust > general trust > institutional trust chain. (3) Heterogeneity analysis shows that the influence of farmers' specific trust and institutional trust in plain areas on the intensity of LCAT adoption is stronger than that of farmers in non-plain areas, and the influence of general trust of farmers in non-plain areas on the intensity of LCAT adoption is stronger than that of farmers in plain areas. The impact of specific trust, general trust, and institutional trust on LCAT adoption was stronger for the new generation of farmers than for the older generation of farmers. (4) Herding effect plays a mediating role in special trust, institutional trust, and LCAT adoption. This study can deepen our understanding of the relationship between farmers' trust and LCAT adoption behavior, and then provide theoretical reference and practical basis for the promotion of LCAT and the improvement of farmers' LCAT adoption level from the perspective of trust.

Keywords: general trust; special trust; institutional trust; Low-Carbon Agricultural Technology (LACT); herd effect; intermediary effect

Citation: Zhou, W.; He, J.; Liu, S.; Xu, D. How Does Trust Influence Farmers' Low-Carbon Agricultural Technology Adoption? Evidence from Rural Southwest, China. *Land* **2023**, *12*, 466. https://doi.org/10.3390/land12020466

Academic Editors: Baojie He, Linchuan Yang and Junqing Tang

Received: 27 January 2023
Revised: 6 February 2023
Accepted: 8 February 2023
Published: 13 February 2023

1. Introduction

Agricultural CO_2 emissions are one of the culprits of climate change. In recent years, China's agricultural carbon emissions have been increasing according to the IPCC (2010) report. To date, greenhouse gas emissions from agricultural ecosystems account for 17 percent of total emissions in China [1]. Climate change is exerting a devastating impact on the natural environment on which humans depend, including an increase in extreme weather events, such as rising sea levels, drought, and floods, which affect the growth of crop [2–6]. Therefore, the need to guide farmers to change their agricultural production mode and promote green and low-carbon agricultural production is an urgent issue.

The implementation of Low-Carbon Agricultural Technology (LCAT) is one of the best ways to reduce agricultural carbon emissions [7,8]. On the one hand, LCAT can reduce soil layer structure damage, and then reduce carbon emissions (in various ways such as

producing less tillage and no-tillage, deep tillage and loose tillage, etc.) [9–11]. On the other hand, waste can also be treated as fertilizer, feed, and energy, thus effectively reducing carbon emissions (e.g., straw return to the field) [9,12]. In recent years, LCATs such as no-till direct seeding of rice fields, straw return, and biopesticides have been adopted to some extent in rural areas of China and have achieved positive results [10,13]. However, in practice, a significant proportion of Chinese farmers are still not adopting LCAT and are less motivated to do so [14,15]. Therefore, it is worth further exploring the kinds of factors restricting the adoption of LCAT by farmers.

The need to effectively improve farmers' adoption of LCAT has been the focus of academic attention, and the impact of trust on farmers' production decisions cannot be ignored [16–18]. Farmers are limited by their conditions, information channels, and other factors, which prevents them from understanding LCAT [19,20], and their production behavior decisions are influenced by the advice of others; whether farmers are willing to adopt the advice of others depends largely on their trust in the "advice giver" [21]. In many informal institutions, "trust" is regarded as the main social capital that determines a country's economic growth and social progress, in addition to material and human capital. The rural society has the distinctive characteristics of a "semi-acquaintance society" [22,23], in which community members are relatively homogenous; they have similar life experiences and similar moral codes and values, which are conducive to the cultivation of trust [24]. However, with the deepening of the market economy, the isolation of the community has been broken, and the interests and needs of rural community members present a diversified trend [25]. This shifts the object of trust from context-specific interpersonal relationships to abstract social systems, meaning that trust has shifted from interpersonal trust in traditional society to institutional trust in a market economy and other modern social characteristics. Therefore, when we conduct rural social governance, we must rely not only on interpersonal trust, but also the corresponding national laws, regulations, policies, and other institutional trust, and should pay equal attention to both.

Most studies have determined that through trust, farmers assess the values and actions of others, which in turn have an impact on their own behavioral decisions. However, scholars' opinions differ on the impact of trust and farmers' behavioral decisions [26], and some scholars believe that interpersonal trust is much more important in the farmer's decision-making process than institutional trust [27]. Other scholars argue that institutional trust plays a more important role in farmers' trust [28]. The reason for disagreement is due to three main reasons. First, the degree of farmers' trust varies from one issue to another, and most scholars have not further classified interpersonal trust [29]. Interpersonal trust includes both farmers' trust in acquaintances and farmers' trust in other members of the community [21]. Second, for different generations of farmers, there are also differences between trust and adoption of LCAT. With the development of society, the structure of the rural population has also changed, and farm households are gradually divided into two generations (new generation and old generation), and because of this, there are differences in their temporal backgrounds, social networks, and values. Third, the level of farmers' trust varies from one region to another. The plains are economically developed and there is a lot of economic cooperation between farmers, so the phenomenon of "killing the familiar" is common and the trust between farmers is affected. In mountainous areas with backward economic development where farmers live more centrally and communicate frequently, a farmer cheating and lying to others can earn a poor reputation in the village.

In addition, there is a significant "herd effect" in farmers' adoption decisions [30]. When new technologies emerge in rural societies, agricultural technology learning relies on trusted farmers due to incomplete information reception by most farmers, resulting in "homogeneity" of behaviors among village groups [31]. Farmers' trust in intra-household members, surrounding neighbors, technicians, and village cadres motivates farmers to communicate and learn from them or even imitate their behavior, which in turn has an impact on farmers' LCAT adoption behavior [32].

Throughout the existing studies regarding the exploration of farmers' trust and LCAT, most scholars have studied the impact of trust as a branch of social capital on farmers' LCAT adoption [27]. Few scholars have included general trust and institutional trust in the study model to investigate in-depth and systematically the impact of trust on farmers' LCAT adoption. Instead, scholars have mostly focused on the effect of trust on a particular type of LCAT (e.g., organic fertilizer application or soil testing and fertilization) among farmers, and few studies have focused on the effect of trust on the adoption of multiple LCATs among farmers. The question remains: Does trust have an impact on farmers' LCAT adoption? If so, what is the mechanism of its role in farmers' LCAT adoption decisions? How does it differ across groups in different categories?

Based on this, the Tobit model was used to empirically analyze the effects of special trust, general trust, and institutional trust on the adoption of LCAT by farmers and their mechanisms of action using data from a survey of 540 farm households in Sichuan Province in 2021. Compared to previous studies, the marginal contributions are the following: First, the research content is innovative. Instead of taking farmer trust as a part of social capital, it explores the mechanism of farmers' adoption of LCAT from the overall perspective of farmers' special trust, general trust, and institutional trust. This is of great theoretical significance for understanding residents' behavior and decision-making from the perspective of farmers' trust. Second is the innovation of the research perspective. Instead of focusing solely on the adoption of a certain type of LCAT by farmers (such as straw returning to the field or soil testing and fertilization), the indicator system of LCAT for farmers is constructed from the perspective of the whole process of pre-production, mid-production, and post-production of planting industry. Third is in-depth mechanism analysis. The herding effect was incorporated into the model, and the mediating effect model was used to deeply analyze the action mechanism of special trust, general trust, and institutional trust on the adoption of LCAT in the whole process of farming production.

2. Theoretical Analysis and Research Hypotheses

For the examination of influence of trust on farmers' behavioral decisions, the social capital theory is the most influential one [33]. According to the theory of social capital, the social network in rural areas is based on the relationship between blood, geography, and business connections [34]. Social capital can provide mutual benefit and increase trust between people by improving the cohesion of social groups and formulating various norms [24]. Social ties established by common interests, occupations, regions, cultural traditions, etc., can increase trust between individuals and reduce costs, thus facilitating collective action [21,24]. Chinese rural society is a society of acquaintances, and Fei Xiaotong believes that trust in rural areas is based on the pattern of difference, and people clearly distinguish themselves from outsiders through the scope of trust based on mutual understanding [35]. The rural social environment is characterized by a "semi-acquaintance society", and the community members are homogeneous; they have similar life experiences, moral norms, and values which are conducive to the cultivation of trust [24]. Luhmann's dichotomy is used to divide trust into interpersonal trust and institutional trust. However, Luhmann's dichotomy neglects to pay attention to the trust of strangers. Therefore, based on Luhmann's dichotomy, interpersonal trust is divided into special trust and general trust, and the trust of farmers is divided into three dimensions: special trust, general trust, and institutional trust.

Special trust refers to the judgment and trusts in the goodwill of acquaintances based on interpersonal relationships and emotional connections [36]. In rural society, interpersonal relationships formed by individual farmers are strongly geopolitical, and information transmission is mainly obtained through non-institutional channels such as family members or neighbors and relatives. Farmers with special trust have completed self-education and training on LCAT through frequent discussions and exchanges, which is another way of promotion and popularization of relevant policies and systems. Farmers with a high frequency of communication have more information sources, and therefore are more active

in adopting LCAT [16,37]. In addition, special trust is based on mutual care and concern between people, which in turn leads to more interdependence and care among farmers.

General trust refers to farmers' expectations that those members with whom they maintain social interactions will act by role norms [36]. Through continuous information exchange with the outside world, farmers with a strong sense of trust will actively learn new technologies, have a more comprehensive cognition of new technologies, and gradually enhance their operation ability, thus effectively promoting the adoption of technologies by farmers [38]. Joffre et al. [39] determined that individuals evaluate the value orientation and actions of others through general trust. Farmers with higher general trust are more likely to carry out environmental protection because they believe in others and the effectiveness of the system.

Institutional trust refers to the use of laws or systems to regulate punishment to reduce the possibility of speculation by others, and it reflects the confidence and dependence on the modern social system [36]. On the one hand, institutional trust can guide or constrain farmers' behavior and has the function of regulating behavior; the people who interact with each other share their perceptions and opinions and expect their peers to abide by the norms, which can result in good reputation; otherwise, there is the possibility of being isolated [40,41]. For example, He et al. [28] determined that farmers' trust in environmental regulations had a "pull" effect on the implementation of agricultural waste recycling by farmers. On the other hand, an increase in farmers' institutional trust can gradually form an informal system within rural communities that reduces risk as well as uncertainty in all aspects and increases farmers' confidence in accessing policy support and technical guidance [42]. For example, Le et al. [43] determined that farmers who trusted each other continuously exchanged environmental knowledge and learned from each other, breaking the "long-whip effect" and motivating farmers to use the rich information resources to manage the environment.

Based on this, the following hypothesis was formulated.

Hypotheses 1 (H1). *Special trust, general trust, and institutional trust significantly promote LCAT adoption among farmers.*

In addition, one study determined that the herd effect plays an important role in farmer trust and LCAT. The herd effect, also known as "peer influence" or "herd behavior", refers to the formation of peer group circles in which the performance or output of the individual person will be susceptible to the influence of their peers [44]. Zeng et al. argued that farmers' LCAT adoption behavior is the result of revision after integrating the views and actions of others. Information-closed farmers communicate and learn LCAT from individuals they trust, leading to a "homogeneity" of behaviors in rural groups [45–47]. For example, Robert determined that due to the referential effect of neighbors' behavior, after communication with neighbors, most agricultural producers change their behavior. In general, there are two paths for different groups to influence farmers: first, farmers directly imitate the LCAT behavior of their trusted neighbors, other people, technicians, or village cadres, which can be called the "imitation effect". Second, through information communication with trust groups, farmers enhance their understanding and knowledge of LCAT, and thus indirectly change their LCAT adoption behavior, which can be called the "learning effect" [34].

Based on this, the following hypothesis was formulated.

Hypotheses 2 (H2). *The herd effect plays a mediating role in specific trust, general trust, and institutional trust in LCAT adoption by farmers.*

Studies have determined that different regions and different types of farmers have different impacts on their adoption of LCAT. The older generation of farmers is the group with the most main decision makers in the adoption of LCAT; however, there are now many new generations of migrant workers returning to farming for reasons such as children's education and caring for the elderly and the proportion of new generations of farmers

engaged in agricultural production is gradually increasing. In reality, there are intergenerational differences between new and old generations of farmers in terms of their knowledge, learning ability, and realistic needs for LCAT which cannot be generalized [44]. Meanwhile, for farmers living in mountainous and hilly areas, even though farmers trust village cadres and neighbors more, there may be a lack of publicity and technical guidance on LCAT and, as a consequence, a lower level of adoption of LCAT by farmers due to the resource level of grassroots organizations and their capacity. Figure 1 shows the conceptual framework of this paper.

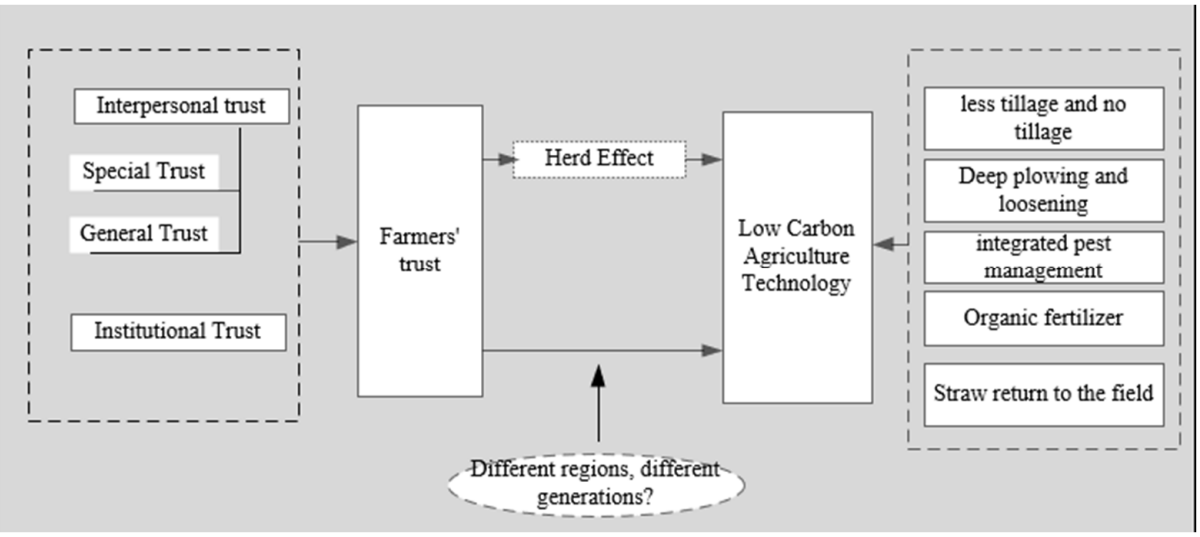

Figure 1. Research framework diagram.

Based on this, the following hypothesis was proposed.

Hypotheses 3 (H3). *The promotion of special trust, general trust, and institutional trust on LCAT adoption among farmers are different across generations and different regions.*

3. Data and Methods

3.1. Data Source

The data were collected through a questionnaire survey that the research team implemented in three Sichuan Province districts and counties in July 2021, namely in Jiajiang County, Yuechi County, and Gaoxian County, through one-on-one interviews with households. The questionnaire covers the basic family situation, the perception and adoption of LCAT, and other aspects. Each questionnaire requires 1–1.5 h to complete. The research sample was primarily selected using a combination of general random sampling and stratified equal-probability random sampling to ensure the typicality and representativeness of the sample chosen for the study. Finally, the districts and counties of Jiajiang, Yuechi, and GaoXian were identified for the survey. Specifically, according to the different levels of economic development, three sample districts and counties of Jiajiang, Yuechi, and GaoXian were selected. Each county was investigated in 3 townships, and each township was investigated in 3 villages according to the difference in economic development levels. Each village was randomly investigated with 20 farmers as a sample. To exclude the differences in information processing and understanding by individual characteristics and planting scale, farmers with similar individual characteristics, planting scale, and degree of part-time farming were mainly selected as survey respondents. Finally, 16 strictly trained researchers were led by village cadres to conduct one-on-one research in farmers' homes. Finally, a total of 540 valid farm questionnaires were obtained from 27 villages in 9 townships in 3 districts and counties.

3.2. Selection of Model Variables

(1) Dependent variable is the adoption of farmers' LCAT. LCAT refers to various methods and means used by agricultural producers in the process of agricultural production and management to reduce carbon emissions before, during, and after agricultural production. LCAT is not a specific technology, but a collection of technologies that contribute to carbon reduction and sequestration in the agricultural production process. This study constructs an LCAT adoption index system for farming households. There are two main reasons for considering the planting industry: on the one hand, the system takes into account the role of agricultural emission reduction and carbon sequestration; on the other hand, the system pays more attention to the carbon emission of each link of planting production (pre–middle–post), which is more comprehensive. Among them, pre-production LCAT is low-carbon farming technology; mid-production LCAT includes low-carbon fertilizer application technology and low-carbon medicine application technology; post-production LCAT includes straw return technology. Low-carbon production behavior refers to the behavior of farmers in the agricultural production process that can reduce agricultural carbon emissions compared to traditional production behavior. Specifically, they include five major categories: (1) input reduction and alternative application; (2) emerging low-carbon production technologies; (3) conservation tillage measures; (4) agricultural farming management measures; and (5) new integrated agricultural models. Therefore, one indicator was selected for measurement in each of the five categories of LCAT. In the specific operation, farmers were directly asked in the questionnaire whether they adopted the following five types of low-carbon farming techniques: organic fertilizer, deep tillage and loosening, less tillage and no tillage, integrated pest management, and straw return to the field.

(2) Independent variables. The core variable is farmer trust, which is classified into special trust, general trust, and institutional trust according to Lu et al. [48]. Of these, special trust is measured by "how much you trust your neighbors and friends". General trust is measured by "you trust the majority of people in society". Institutional trust is measured by "you trust environmental regulations so much that you would adopt green production technologies if they required it". All three questions were assigned using a Likert scale: 1 = strongly disagree, 2 = disagree, 3 = fair, 4 = agree, 5 = strongly agree.

(3) Mediating variables. The mediating variable is the herding effect. Referring to the study by Li et al. [49], the herd effect was measured using village LCAT adoption (the mean of the number of LCAT adopted by the other farmers in the village except for that farmer).

(4) Control variables. Referring to the studies of He et al. [28] and Xu et al. [50], respondent characteristics, household characteristics, and farming land characteristics were introduced as control variables.

3.3. Methods

The Tobit model is an econometric model with a limited dependent variable, which is suitable for situations where the value of the dependent variable is limited and there is a chosen behavior. Some farmers may not use low-carbon agricultural technology; in that case, the value of the dependent variable is 0, and Low-Carbon Agricultural Technology is a limited dependent variable. Therefore, considering the distributional characteristics of the variables, an attempt was made to construct a Tobit regression econometric model to explore the causal relationship between farmers' specific trust, general trust, and institutional trust with the adoption of LCAT, with the following simple expressions for the model:

$$Y = \alpha_0 + \alpha_1 X_i + \varepsilon_i \quad (1)$$

where Y represents the farmers' LCAT adoption, X_i is the core independent variable of the model, indicating general trust, special trust, and institutional trust, α_0 and α_1 represent

the parameters to be estimated for the model, respectively, and ε_i is the residual term of the model. The estimation of the entire study model was implemented through stata16.0.

4. Data and Methods

4.1. Descriptive Statistics of the Variables

Table 1 shows the results of the descriptive statistical analysis of the variables involved in the model. As shown in Table 1, the average number of LCAT adopted per household was 1.13 among 540 households, which indicates a low level of adoption of LCAT among farmers. For the core independent variables, the mean values of special trust, general trust, and institutional trust are 4.12, 3.24, and 3.84, respectively, which indicates that farmers' special trust is the strongest, followed by institutional trust, and general trust being the weakest. For the control variables, the respondents were approximately 58 years old, the proportion of males (60%) was higher than the proportion of females (40%), and the average number of years of education was only 6.55 years. In 2020, the average household size was 4.54, the average labor force aged 16–64 was 2.57, the average annual cash income of the family was 20,064 Yuan, and the average cultivated land area of the family was 1.43 mu. The mean value of cultivated land type, land fertility, and soil erosion was 1.88, 2.95, and 2.42, respectively.

Table 1. Variable definition and descriptive statistics.

	Variables	Definition	Mean	SD [a]
Dependent variables	Low-Carbon Agriculture Technology	Number of types of LCAT used (number)	1.130	0.850
Independent variables	Special Trust	You trust your neighbor a lot (1 = strongly disagree − 5 = strongly agree)	4.120	0.840
	General Trust	You trust the most people in the community (1 = strongly disagree − 5 = strongly agree)	3.240	1.040
	Institutional Trust	You trust environmental regulations so much that you would adopt green production techniques if regulations required them (1 = strongly disagree − 5 = strongly agree)	3.840	1.120
Respondent characteristics	Age	Respondents' age (age)	58.48	11.84
	Gender	Respondents' gender	0.400	0.490
	Education	Respondent's education level (year)	6.550	3.440
	Married or not	Whether the respondent is married or not (no = 0; yes = 1)	0.910	0.280
	Health	The health level of the respondent (1 = very unhealthy – 5 = very healthy)	3.670	1.140
Family Characteristics	Population	The total household size in 2020 (persons)	2.570	1.460
	Per capita income	Per capita household income in 2020 (Yuan [c])	20,064	35,403
	Labor	The labor force in your household aged 16–64 (number of persons)	4.540	1.970
	Land	Household operating area per capita in 2020 (mu [b])	1.430	4.260
Arable land characteristics	Type of cultivated land	Type of cultivation of your land: (1 = sloping; 2 = terraced; 3 = flat)	1.880	0.960
	Land fertility	The fertility of your land is good (1 = strongly disagree − 5 = strongly agree)	2.950	1.070
	Soil erosion	Soil erosion on your land is severe (1 = strongly disagree − 5 = strongly agree)	2.420	1.180
Intermediate variables	Herd Effect	Mean value of the number of LCAT adopted by farmers in the same village other than oneself	1.130	0.370

Note: [a] SD = Standard deviation; [b] 1 mu tandard2 or 0.667 ha; [c] 1 USD = 6.19 Yuan (at the time of the study).

4.2. Model Results

Model 1 demonstrated in Table 2 displays the regression insights for farmers' institutional, general, and special trust and LCAT adoption intensity. In addition, Model 2 illustrates the regression outcomes by including control variables based on Model 1. All models are significant at a 0.01 level, as shown by the overall significance test statistic (F value) of the model, which may be applied to further regression analysis. At the same time, to facilitate understanding, graphics are further used to show the relationship between trust and low-carbon agricultural technology (Figure 2).

As shown in Table 2, in terms of special trust, general trust, and institutional trust, regardless of whether control variables are considered, special trust, general trust and institutional trust of farmers can significantly promote their adoption of LCAT, and the results are robust, which verifies the research hypothesis H1. The results of Model 2 show that the adoption intensity of LCAT of farmers increases by 0.171 units for every unit increase in special trust. This is in line with the conclusions of Guo et al. [51]. The possible reasons are as follows: on the one hand, the long-term high frequency of interaction between neighbors has enhanced their mutual identity, and the trust, reciprocity, and reputation generated in the long-term interaction have gradually formed "institutionalized" precipitation, making each other's words and deeds constrained by common norms. On

the other hand, neighbors' favorable evaluation of LCAT, as a kind of word-of-mouth information, can be spread in the mutual communication of rural public space, thus forming a radiating and driving effect. The results of Model 2 show that farmers' LCAT adoption intensity increases by 0.168 units for every unit increase in general trust. This is consistent with the research of Bisung et al. [52]. The possible reasons are as follows: the higher the trust of farmers towards strangers, the higher the openness of farmers [53], and the smoother the information exchange between unfamiliar farmers. This reduces the transaction cost of cooperation between farmers to a certain extent, and therefore promotes the adoption of LCAT by farmers. The results of Model 2 show that the adoption intensity of LCAT of farmers increases by 0.121 units for every unit increase in institutional trust. This is in line with the conclusions of He et al. [28]. The possible reasons are as follows: farmers with high trust in the system are more likely to carry out agricultural production under the guidance and constraints of policies and regulations rather than to ignore or even contradict the correct guidance of relevant policies and regulations. Therefore, farmers with high trust in the system are more inclined to actively adopt LCAT.

Table 2. The regression results of farmers' trust in LCAT.

Variables	Model 1	Model 2
Special Trust	0.146 **	0.171 ***
	(0.062)	(0.059)
General Trust	0.192 ***	0.168 ***
	(0.051)	(0.049)
Institutional Trust	0.117 ***	0.121 ***
	(0.043)	(0.042)
Age		0.010 **
		(0.005)
Gender		0.066
		(0.101)
Education		−0.009
		(0.016)
Marriage status		0.025
		(0.158)
Health		0.007
		(0.041)
Labor		0.106 **
		(0.048)
Population		0.040
		(0.034)
Ln (person income)		−0.077
		(0.062)
Ln (person land)		0.650 ***
		(0.113)
Type of cultivated land		−0.065
		(0.046)
Land fertility		−0.008
		(0.042)
Soil erosion		0.111
		(0.132)
_cons		−0.153
	(0.191)	(0.531)
F	17.258 ***	7.088 ***
N	540	540

Note: ***, **, * mean that the estimated results are significant at 0.01, 0.05, 0.1; the results reported in the table are marginal effects; the robustness standard error is reported in parentheses.

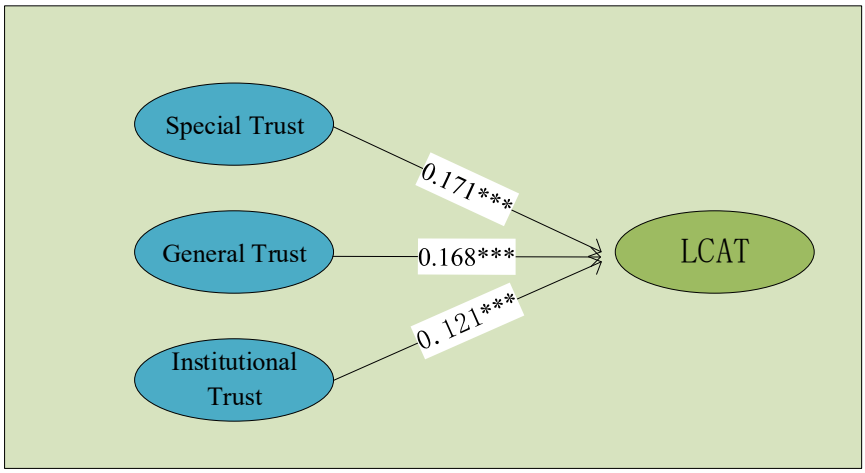

Figure 2. The regression results of farmers' trust in LCAT. Note: ***, **, * mean that the estimated results are significant at 0.01, 0.05, 0.1.

As shown in Table 3, to further test the impact of trust in different dimensions on the adoption of LCAT, the standardized coefficient of the variable was calculated to compare its magnitude. According to the size of the standardization coefficient, general trust has a greater promoting effect, followed by special trust and institutional trust. Possible reasons are the following: First, the institutional system of rural society is not yet well established, and farmers lack recognition of institutional trust and are skeptical of the fairness of the system. Second, the decision-making behavior of farmers with a high level of emotional trust is easily influenced by relatives or other villagers, which increases their distrust of new things to a certain extent, and then reduces the adoption intensity of LCAT. Finally, farmers with a high level of social trust are conducive to information exchange and transmission with strangers, which increases their trust in strangers to a certain extent, and then improves their willingness to cooperate with strangers and consider the adoption of unfamiliar things.

Table 3. Standardized coefficients of trust in different dimensions.

Variables	Regression Coefficient	Variance	Standardization Coefficient
Special Trust	0.171	0.840	0.079
General Trust	0.168	1.040	0.096
Institutional Trust	0.121	1.120	0.075

4.3. Testing the Mechanism of the Herd Effect between Trust and LCAT Adoption

As mentioned earlier, special trust, general trust, and institutional trust have significant effects on the adoption of farmers' LCAT; however, their specific mechanisms of action are not clear. Based on this, the mediating effect model was used to further explore the specific mechanism of the effect, that is, to verify the research hypothesis H2.

Table 4 shows the results of the stepwise regression test of the herd effect in specific trust, general trust, institutional trust, and LCAT adoption by farmers. The results show that the herding effect has a mediating effect on special trust/general trust and LCAT; that is, families with high degree of special trust and general trust will actively learn and imitate the behavior of their neighbors, and then promote the adoption of LCAT. This partly verifies the research hypothesis H2.

Table 4. Mediating effect analysis of herding effect.

Variables	Mechanism: Farmers' Trust→Herd Effect→Low-Carbon Agriculture Technology		
	Low-Carbon Agriculture Technology	Herd Effect	Low-Carbon Agriculture Technology
Special Trust	0.171 ***		0.118 **
	(0.059)		(0.057)
General Trust	0.168 ***		0.125 **
	(0.049)		(0.049)
Institutional Trust	0.121 ***		0.131 ***
	(0.042)		(0.040)
Special Trust		0.072 ***	
		(0.019)	
General Trust		0.060 ***	
		(0.015)	
Institutional Trust		−0.014	
		(0.015)	
Herd Effect			0.706 ***
			(0.112)
Control	Yes	Yes	Yes
F	7.088 ***	4.876 ***	9.308 ***
N	540	540	540

Note: ***, **, * means that the estimated results are significant at 0.01, 0.05, 0.1; the results reported in the table are marginal effects; the robustness standard error is reported in parentheses.

4.4. Impact of Farmers' Trust on LCAT under Different Conditions

Theoretically speaking, there will be great differences in farmer behavior among different regions, which may change with regional differences and the age of farmers. Therefore, the farmers were divided into different groups according to whether they were in a plain area or not and the age of the farmers [54,55]. Additionally, the heterogeneity of trust within various groups were investigated with regard to farmers' adoption of LCAT using the Tobit model.

First, the terrain was selected as the classification standard, the samples were divided into plain and non-plain levels, and the Tobit model was used for estimation (Table 5). The results showed that special trust and institutional trust were positively and significantly correlated with the adoption intensity of LCAT among farmers in plain areas. The special trust, general trust, and institutional trust of farmers in non-plain areas are positively and significantly correlated with the adoption intensity of LCAT. This partly verifies the research hypothesis H3.

Table 5. Heterogeneity analysis regression results.

Variables	Terrain		Inter-Generational	
	Plain	Non-Plain	New Generation	Old Generation
Special Trust	0.221 **	0.133 *	0.365 ***	0.152 *
	(0.092)	(0.074)	(0.138)	(0.087)
General Trust	0.061	0.198 ***	0.006	0.161 *
	(0.079)	(0.060)	(0.094)	(0.082)
Institutional Trust	0.123 *	0.113**	0.212 **	0.080
	(0.072)	(0.051)	(0.105)	(0.065)
Control	Yes	Yes	Yes	Yes
F	3.458 ***	6.291 ***	3.463 ***	5.527 ***
N	180	360	291	249

Note: ***, **, * means that the estimated results are significant at 0.01, 0.05, 0.1; the results reported in the table are marginal effects; the robustness standard error is reported in parentheses.

Second, the age of the respondents was selected as the classification standard, and according to the research of Mandrik et al. [56], the respondents were divided into the

new-generation farmers (farmers born after 1980) and the old-generation farmers (farmers born before 1980) according to the "age of the respondents" criterion which was estimated by the Tobit model (Table 5). The results showed that special trust, general trust, and institutional trust were positively and significantly correlated with the adoption intensity of LCAT for both the new generation and the old generation of farmers. Among them, the special trust, general trust, and system trust of the new-generation farmers are stronger than those of the old-generation farmers. This partly verifies the research hypothesis H3.

5. Conclusions and Implications

5.1. Conclusions

To thoroughly examine the impact and mechanism of trust on farmers' adoption of LCAT, the Tobit model and mediating effect model were applied according to the survey data of 540 rural families in 27 villages across three counties in Sichuan Province in 2021. The following core conclusions were obtained.

Farmers have a high level of trust, with the following specific order: special trust > institutional trust > general trust. At the same time, the adoption intensity of LCAT by farmers was not high, and the average number of LCAT adopted by each household was 1.13. Among those, the adoption of straw-returning technology is relatively high, with 54.63% of farmers adopting straw-returning technology.

Special trust, general trust, and institutional trust can significantly improve the adoption behavior of LCAT of farmers, and general trust has a greater promoting effect, followed by special trust and institutional trust. The results of heterogeneity analysis showed that the impact of special trust and institutional trust on the adoption intensity of LCAT of farmers in plain areas was stronger than that in non-plain areas, and the impact of general trust on the adoption intensity of LCAT of farmers in non-plain area was stronger than that in plain area. The special trust, general trust, and institutional trust have a stronger impact on the adoption intensity of LCAT of the new-generation farmers than on the old-generation farmers.

The mediating effect analysis determined that herding plays a mediating role between special trust and general trust and the intensity of LCAT adoption.

Moreover, there are some limitations to this study. First of all, this paper only discusses the correlation between trust and the adoption of low-carbon agricultural technologies in Sichuan Province. Whether the results of this study apply to other regions remains to be further explored. Second, this study only uses 2021 data to explore the correlation between farmers' trust and Low-Carbon Agricultural Technology adoption. Future research can further explore whether farmers continue to adopt low-carbon agricultural technologies.

5.2. Policy Implications

Given the above conclusions, policy suggestions are put forward from the following aspects.

First, we intend to intensify publicity on LCAT and environmental protection. Governments at all levels and rural environmental public welfare organizations can intensify publicity efforts through household communication and new media such as WeChat and Weibo to help farmers deeply understand the importance of environmental protection for rural development and to stimulate farmers' LCAT behavior.

Second, it is necessary to strengthen general trust and institutional trust among farmers. On the one hand, rural grassroots cadres can carry out various forms of activities, strengthen communication among farmers, and create a rural social environment of mutual trust and mutual benefit. Enhance farmers' sense of honor and pride in participating in low-carbon agricultural technology, and effectively promote farmers' awareness of environmental protection. On the other hand, strengthening rural system construction promotes rural social system trust. Grassroots cadres should focus on the interests of the people to carry out their work, constantly enhance their cultural literacy and workability, play a leading

role in rural environmental governance, and gradually improve the level of serving the people to effectively strengthen the institutional trust in rural areas.

Third, it is essential to emphasize the exemplary role of neighbors. Large farmers and professional farmers are encouraged to actively carry out LCAT demonstrations for ordinary farmers to imitate and learn to eliminate the technical and economic concerns of some farmers with consequences in practice.

Fourth, we suggest improvement of mechanical operation conditions and promotion of moderate-scale land management. It is necessary to improve the conditions of mechanical operation, strengthen and widen the roads for mechanical farming, and gradually promote the "joint farming and joint planting" and "joint management and joint operation" models. Farmers in a certain area should be encouraged to uniformly develop low-carbon agricultural technologies, effectively reduce transaction costs, and better promote the use of low-carbon agricultural technologies. At the same time, it is necessary to adapt measures to local conditions, and promote moderate-scale land management and land consolidation projects where conditions permit. In all, we suggest to learn from relevant experience, focus on solving the problem of land fragmentation, realize the contiguous and large-scale land area, further reduce the cost of farmers' technology adoption, and realize economies of scale.

Author Contributions: Conceptualization, W.Z. and J.H.; methodology, D.X.; formal analysis, W.Z.; investigation, D.X.; writing—original draft preparation, S.L. and D.X.; writing—review and editing, W.Z. and D.X.; supervision, D.X.; funding acquisition, D.X. All authors have read and agreed to the published version of the manuscript.

Funding: This project was funded by Special Program for Cultivating Excellent Young Talents under the Dual Support Plan of Sichuan Agricultural University, a Key research base project of Sichuan Province Philosophy and Social Science (SC22EZD038) and Research interest Training program for College students (2023820, 2023242).

Data Availability Statement: Not applicable.

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

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