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Research Article

Analysis of Farmers' Willingness to Use Blockchain and Influencing Factors Based on the Binary Logit Model

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Blockchain is the frontier of modern science and technology, and promoting its application in agriculture is of great significance to agricultural development. Taking the farmers who are essential agricultural subjects as the research object, this paper applies the binary Logit model to investigate the farmers' willingness to apply blockchain and its influencing factors. Based on rigorous analyses of research data and models, the main research conclusions are obtained. First, at the current stage, Chinese farmers are not very receptive to the blockchain, most of whom are unwilling to apply it to agricultural production and operation. Second, farmers' age and participation in agricultural training exert a remarkable negative impact on their willingness to apply blockchain. Third, the education level of farmers, the highest education level of their family, the annual income of crops per *mu*, government subsidies, the application of agricultural information technology, and the degree of their understanding of blockchain impose a remarkable positive impact on their willingness to apply blockchain. According to the analysis results, the following suggestions are put forward: (1) strengthen education and training to improve farmers' understanding of blockchain; (2) strengthen financial support and provide equipment subsidies and tax relief for farmers who apply blockchain; and (3) implement demonstration projects and take the lead in applying blockchain by supporting family farms, large planters, and other agricultural business entities with demonstration effects.

1. Introduction

As the key technology of Bitcoin [1], blockchain first appeared in the white paper "Bitcoin: A Peer-to-Peer Electronic Cash System" [2]. The blockchain is essentially a decentralized ledger that keeps transaction records on multiple computers simultaneously [3]. In the blockchain, the header of each block contains a pointer to the location of the previous block, i.e., the hash value of the data in the previous block. Blockchain possesses some essential characteristics like decentralization, security, transparency, immutability, smart contracts, and verifiability [4] [5] [6] [7]. They could effectively tackle the problem of trust and safety between users [8], which is a revolution in information technology. Blockchain is a rapidly developing technology with extensive applicability, whose application will impose an essential impact on social development. It has been applied in many different fields and has produced positive effects, like finance [9] [10], transportation [11] [12], Smart City [13] [14], and energy [15] [16] [17].

As the foundation of society, agriculture directly affects human survival [18]. Various problems that occur during the production process of agricultural products seriously affect food safety and pose a huge threat to the health of consumers, which has attracted extensive attention [19] [20] [21]. Agricultural product safety issues might occur in all aspects of agricultural product production and processing [22]. For example, during the production process of agricultural products, excessive use of pesticides, fertilizers, and additives and chemical substances or heavy metal residues caused by wastewater irrigation will affect the safety of agricultural products [23]. The most essential reason for these problems lies in the lack of an effective monitoring or tracking system [24]. The ability of blockchain in product traceability, authenticity, and execution of real-time transactions will significantly improve food traceability, thus imposing a positive impact on food quality, safety, and sustainability [25] [26] [27]. The significance of the application of blockchain to agricultural development has been widely recognized by relevant scholars. In recent years, the amount of relevant research on the application of blockchain to promote agricultural development has been increasing [28] [29].

As the direct subjects of agricultural production, farmers are an essential foundation for agricultural development. The application of blockchain to the agricultural field is inseparable from the support of farmers, who are the essential port to obtain the initial information of agricultural production. The application of blockchain by farmers directly determines the information quality of the blockchain and affects its function. Without the support and recognition of farmers, the application of blockchain to the agricultural field will lose its foundation. Observed from the existing research, the researchers have barely discussed farmers' willingness to apply blockchain but have paid more attention to the application of blockchain in the follow-up links of agricultural product supply chains like agricultural finance and agricultural product processing [30] [31] [32].Whether the blockchain technology can be adopted by farmers is affected by factors such as the participants and the market environment. However, without the participation of farmers, the role of blockchain in the follow-up links of the agricultural product supply chain will be significantly reduced. First of all, farmers can make use of the information asymmetry of the blockchain, which can also solve many problems of farmers' information disclosure; The anonymity and consensus mechanism of the blockchain require all nodes to pay more attention to the credibility of participants when trading on the blockchain so that agricultural enterprises will not mix personal feelings when selecting partners, and the two sides do not need to be familiar with each other to trade. The traceability of the blockchain ensures that the transaction records of the funds of both parties are traceable on the blockchain and cannot be tampered with, regardless of the quality of the traded agricultural products. To this end, the farmers' willingness to apply blockchain is discussed and the factors that affect their application of it are further analyzed to provide suggestions for the application of blockchain to the agricultural field, which could provide solid support for the effective use of blockchain.

China is a vital agricultural country in the world. The Chinese government attaches great importance to the development of blockchain and actively promotes its application to the agricultural field. In 2020, the No. 1 Document released by the Central Government of China specifically proposed to "accelerate the application of blockchain to the agricultural field." The essential role of blockchain in the development of China's agriculture has been concerned by many scholars. For example, Sun et al. [33] analyzed the current situation of China's agriculture, the necessity of developing smart agriculture, and the possibility of applying blockchain to China's agriculture; Li et al. [34] analyzed the convenience of blockchain for sustainable e-agriculture based on a survey in five rural areas in China. Taking Beijing Liaomiying Ecological Farm as an example, Chen et al. [35] integrated the circular agriculture mode of the whole ecological farm into the blockchain and proposed the development framework and challenges of "e-agriculture based on blockchain."

The authors have long been determined to study the coupling of blockchain technology and ecological agricultural products, and before that, they published a study on the willingness of consumers to pay using blockchain, the purpose of which is to promote the use of blockchain technology in agriculture [36]. There are few studies on farmers' willingness to apply blockchain, which is not conducive to the application of blockchain to agriculture. Therefore, based on the survey of Chinese farmers, this paper investigates the farmers' willingness to apply blockchain and its influencing factors to provide suggestions for the application of blockchain to agriculture.

The structure of this paper proceeds as follows. The first section introduces the research background; the second section presents the research area, methods, and variable setting; the third section briefly analyzes the survey data; the fourth section analyzes the factors that affect the farmers' willingness to apply blockchain; the fifth section summarizes the findings and makes recommendations.

2. Research Settings

2.1. Study Area. This paper is aimed at exploring the farmers' willingness to utilize blockchain, i.e., whether they are willing to use blockchain in agricultural production and operation activities. To this end, farmers in three typical provinces in China were selected for investigation, namely, Heilongjiang, Henan, and Jiangxi, which are all major agricultural provinces in China, but each of them exhibits different characteristics. Located in the northernmost part of China, Heilongjiang province has fertile soil, vast land, sparse population, large arable land per capita, and a high degree of agricultural mechanization and scale of agricultural operations; Henan province is located in the central plain of China, which is one of the provinces with the largest population and the largest agricultural population in China; located in the south of China, Jiangxi province possesses hilly terrain, a low degree of agricultural scale and mechanization, and intensive agricultural management. Thus, with these three provinces as the research object, this paper selected a typical village and distributed 100 questionnaires for investigation in each of them.

2.2. Research Methods. The explained variables investigated in the survey are two options, i.e., farmers' willingness to apply blockchain and unwilling to apply it. The explained variable studied in this paper is binary; hence, this paper applies the binary Logit model to analyze the factors that affect the choice of farmers.

The binary Logit model as a modeling method to estimate the influence of exogenous factors on individual selection has been widely applied in statistical research (Washington et al., 2020; Amir Pooyan Afghari et al., 2020). This model is based on the theory of random utility. According to this theory, individuals choose between two (or more) alternatives based on observed and unobserved factors.

The details of the model are as follows: $i(i = 1, 2, 3, \cdots N)$ being a substitute index for farmers, the utility of farmers using blockchain is expressed as

$$U_i = \beta X_i + \varepsilon_i. \quad (1)$$

U_i represents the utility of blockchain use, β is the vector of estimable parameters (including the intercept), X_i denotes the vector of individual explanatory variables, and ε_i signifies a random interference term. According to McFadden (1981), the research hypothesis ε_i is a generalized extreme value distribution; hence, the probability of using blockchain is expressed as

$$P(\text{BC use}) = \frac{e^{\beta X_i}}{1 + e^{\beta X_i}}. \quad (2)$$

During the research process, to evaluate the impact of explanatory variables on the probability of farmers using the blockchain, this paper calculates the marginal utility as the change in the continuous explanatory variable (or "0" to the dummy variable in "1" change) while retaining all other explanatory variables in its way. The marginal effect $\text{ME}(x_i)$ of the variable x_i is expressed as follows:

$$\text{ME}(x_i) = \frac{d\left(e^{\beta_{xi}} / \left(1 + e^{\beta_{xi}}\right)\right)}{dx_i}. \quad (3)$$

2.3. Variable Setting

2.3.1. Explained Variable. The explained variable of this paper is farmers' willingness to apply blockchain, i.e., whether farmers are willing to apply blockchain in agricultural production and operation.

2.3.2. Explanatory Variables. Based on actual investigations and references to certain existing studies, this paper classifies explanatory variables into four types, i.e., the surveyed person's characteristics, family characteristics, agricultural production situation, and blockchain knowledge apart from regional dummy variables.

(1) Personal characteristics of respondents: they mainly include the gender, age, education, and the part-time job of the surveyed person

(2) Family characteristics of respondents: they mainly include the number of family members and the highest degree of family education of the surveyed person

(3) Agricultural production of respondents: it mainly includes the surveyed person's agricultural production time, crop planting area, annual income per *mu* of crops, government subsidies for agricultural activities, application of agricultural information technology, and agricultural technology training

(4) Blockchain understanding of respondents: it mainly includes the surveyed person's knowledge about the blockchain, familiarity with the application of blockchain, and participation in the blockchain training

The variable assignment situation is presented in Table 1:

3. Data and Statistics

A total of 300 questionnaires were distributed in this survey, among which 100 questionnaires were distributed in each selected typical village in Heilongjiang, Henan, and Jiangxi, respectively. After the questionnaires were collected, 207 valid questionnaires were finally retained, among which 69 were from Heilongjiang province, 67 were from Henan province, and 71 were from Jiangxi province. As indicated by the results of the questionnaire survey, 70.53% of the surveyed farmers are not willing to apply blockchain projects to agricultural production and operation, which might be due to their insufficient understanding of the blockchain at the current stage. According to the survey, 45.89% of the surveyed farmers do not understand the blockchain while 45.41% of farmers only have little understanding of the blockchain. Due to the insufficient understanding, farmers have doubts about the application effect of blockchain and most farmers are not willing to apply blockchain at the current stage considering the application cost. Without the participation of farmers, it is difficult to obtain enough production information for the application of blockchain to the agricultural field, which hinders the traceability and other functions of the blockchain and ultimately affects its application value in the agricultural field. Although China is vigorously promoting the application of blockchain to the agricultural field, its acceptability among farmers is not high at the current stage; hence, further analyses of the factors that affect farmers' application of blockchain are needed to make recommendations. The statistics of the questionnaire survey are shown in Table 2.

It can be seen from Table 2 that among the respondents, 70.53% are unwilling to apply, which shows that farmers are not willing to accept blockchain technology in the initial stage. The education level of the respondents is mostly below junior middle school, and the number of full-time farmers accounts for a relatively small proportion. Most of them have been engaged in agricultural production for 10 to 20 years, and 32.37% of them have a planting area of 50 mu to 100 mu. Few farmers know about agricultural information technology, accounting for only 39%, and 91.3% of the people have little or no knowledge of blockchain technology.

4. Analysis of Influencing Factors of Farmers' Access to Block Links

4.1. Model Estimation and Testing. Combined with the above variable setting and survey data, a binary Logit analysis was conducted via the Stata software, as presented in Table 3. Meanwhile, to verify the stability of the model estimation, this paper also performs binary Probit regression, whose results are also presented in Table 3. The explanatory

Table 1: Variable assignment.

Variable type	Variable name	Variable symbol	Explanation
Explained variable	Willingness to apply blockchain	y	1: application; 0: no application
Explanatory variables	Gender	X_1	1: male; 0: female
	Age	X_2	1: under 18 years old (including 18 years old); 2: 19-30 years old (including 30 years old); 3: 31-45 years old (including 45 years old); 4: 45-60 years old (including 60 years old); 5: over 60 years old
	Education level	X_3	1: primary school and below; 2: junior middle school; 3: senior high school and technical secondary school; 4: junior college; 5: bachelor degree and above
	Part-time employment	X_4	1: focus on other businesses, supplemented by agriculture; 2: pay equal attention to other businesses and agriculture; 3: agriculture as the main business, other business as a supplement; 4: full-time farmers
	Number of family members	X_5	1: up to 3 persons; 2: 4; 3: 5; 4: 6 or more
	Family's highest level of education	X_6	1: primary school and below; 2: junior middle school; 3: senior high school and technical secondary school; 4: junior college; 5: bachelor degree or above
	Engaged in agricultural production time	X_7	1: less than 1 year; 2: 1-10 years (including 10 years); 3: 10-20 years (including 20 years); 4: 20-30 years (including 30 years); 5: over 30 years
	Crop planting area	X_8	1: 10 mu and below; 2: 10-50 mu (including 50 mu); 3: 50-100 mu (including 100 mu); 4: 100-200 mu (including 200 mu); 5: more than 200 mu
	Annual crop income per mu	X_9	1: up to $500; 2: 500-1000 yuan (including 1000 yuan); 3: 1000-1500 yuan (including 1500 yuan); 4: 1500-2000 yuan (including 2000 yuan); 5: over 2000 yuan
	Government subsidies	X_{10}	1: subsidy 500 yuan and below; 2: subsidy 500-1000 yuan (including 1000 yuan); 3: subsidy of 1000-1500 yuan (including 1500 yuan); 4: subsidy 1500-2000 yuan (including 2000 yuan); 5: subsidy over 2000 yuan
	Application of agricultural information technology	X_{11}	1: no application; 2: less application; 3: general application; 4: more applications; 5: extensive use
	Participation in agricultural training	X_{12}	1: no participation; 2: less participation (1-2 times); 3: general participation (3-5 times); 4: more participation (6-10 times); 5: many applications (more than 10 times)
	Blockchain understanding	X_{13}	1: do not understand; 2: less understanding; 3: general understanding; 4: more understanding; 5: very well
	The application of acquaintance blockchain	X_{14}	1: no application; 2: less participation; 3: general participation; 4: more participation; 5: many applications
	Participation in blockchain training	X_{15}	1: no participation; 2: less participation (1-2 times); 3: general participation (3-5 times); 4: more participation (6-10 times); 5: participate a lot (more than 10 times)
	Heilongjiang province	X_{16}	1: yes; 0: no
	Henan province	X_{17}	1: yes; 0: no

variable and the explained variable are consistent with the binary Logit regression. As demonstrated in Table 3, the Logit estimation and Probit estimation coefficients are similar in direction and significance, indicating that the model is stable.

Based on the test of the stability of the model, further analysis is conducted on the fit of the model. It could be seen from Table 3 that LR $\text{chi}^2(17) = 169.21$ and $\text{Prob} > \text{chi}^2 = 0.00$, implying that the model's likelihood ratio test has passed; hence, the model is effective. In addition, pseudo $R^2 = 0.67$, indicating that the selected explanatory variables have a high degree of explanation for the farmers' willingness to apply blockchain, and the selection of explanatory variables is more appropriate. To further test the goodness of fit of the model, this paper applies the Stata software to analyze the model's accuracy of prediction. The results are

Table 2: Statistics.

Content	Option	Frequency	Frequency	Content	Option	Frequency	Frequency
Application intention	Willing	61	29.47%	Annual income of crops per mu	500 yuan and below	61	29.47%
	Unwilling	146	70.53%		500-1000 yuan (including 1000 yuan)	85	41.06%
Gender	Male	36	17.39%		1000-1500 yuan (including 1500 yuan)	55	26.57%
	Female	171	82.61%		1500-2000 yuan (including 2000 yuan)	6	2.90%
Age	Under 18 years old (including 18 years old)	5	2.42%		Over 2000 yuan		0.00%
	19-30 years old (including 30 years old)	83	40.10%	Government subsidies	Subsidy 500 yuan and below	8	3.86%
	31-45 years old (including 45 years old)	106	51.21%		Subsidy 500-1000 yuan (including 1000 yuan)	78	37.68%
	45-60 years old (including 60 years old)	13	6.28%		Subsidy of 1000-1500 yuan (including 1500 yuan)	107	51.69%
	Over 60 years old	0	0.00%		Subsidy 1500-2000 yuan (including 2000 yuan)	14	6.76%
Education status of respondents	Primary school and below	77	37.20%		Subsidy over 2000 yuan		0.00%
	Junior middle school	83	40.10%	Application of agricultural information technology	No application	29	14.01%
	Senior high school and technical secondary school	37	17.87%		Less application	73	35.27%
	Junior college	10	4.83%		General application	66	31.88%
	Bachelor degree or above	0	0.00%		More applications	39	18.84%
Part-time employment	Mainly in other businesses, supplemented by agriculture	38	18.36%		Extensive use		0.00%
	Pay equal attention to other business and agriculture	85	41.06%	Participation in agricultural training	No participation	16	7.73%
	Agriculture as the main business, other business as a supplement	62	29.95%		Less participation (1-2 times)	49	23.67%
	Full-time farmers	22	10.63%		General participation (3-5 times)	71	34.30%
Number of family members	Up to 3 persons	32	15.46%		More participation (6-10 times)	52	25.12%
	4	89	43.00%		Participate a lot (more than 10 times)	19	9.18%
	5	58	28.02%	Understanding of blockchain	Do not understand	95	45.89%
	6 or more	28	13.53%		Less understanding	94	45.41%
The highest level of family education	Primary school and below	0	0.00%		General understanding	17	8.21%
	Junior middle school	34	16.43%		More understanding	1	0.48%
		111	53.62%		Very well		0.00%

Table 2: Continued.

Content	Option	Frequency	Frequency	Content	Option	Frequency	Frequency
	Senior high school and technical secondary school						
	Junior college	42	20.29%		No application	44	21.26%
	Bachelor degree or above	20	9.66%	Application of acquaintance blockchain	The number of users is small	112	54.11%
Time of agricultural production	Less than 1 year	8	3.86%		The number of users is average	51	24.64%
	1-10 years (including 10 years)	67	32.37%		Many people use it		0.00%
	10-20 years (including 20 years)	71	34.30%		A lot of people use it		0.00%
	20-30 years (including 30 years)	46	22.22%	Participation in blockchain training	No participation	142	68.60%
	Over 30 years	15	7.25%		Less participation (1-2 times)	65	31.40%
Crop planting area	10 mu and below	31	14.98%		General participation (3-5 times)		0.00%
	10-50 mu (including 50 mu)	55	26.57%		More participation (6-10 times)		0.00%
	50-100 mu (including 100 mu)	67	32.37%		Participate a lot (more than 10 times)		0.00%
	100-200 mu (including 200 mu)	42	20.29%	Heilongjiang	Yes	69	33.33%
	More than 200 mu	12	5.80%	Henan	Yes	67	32.37%
				Jiangxi	Yes	71	34.30%

Table 3: Estimated results of binary Logit and Probit.

	Logit		Probit	
y	Coef.	Std. err.	Coef.	Std. err.
x_1	-1.41	1.06	-0.90	0.55
x_2	-1.62**	0.75	-0.73**	0.33
x_3	1.10**	0.50	0.68	0.27
x_4	0.00	0.39	0.05	0.20
x_5	-0.24	0.44	-0.17	0.24
x_6	1.21***	0.43	0.71***	0.23
x_7	0.23	0.35	0.12	0.19
x_8	-0.52	0.50	-0.33	0.27
x_9	1.77***	0.54	0.93***	0.27
x_{10}	2.95***	0.95	1.49***	0.47
x_{11}	0.92**	0.39	0.54***	0.21
x_{12}	-0.76**	0.35	-0.48**	0.20
x_{13}	1.75***	0.65	1.01***	0.34
x_{14}	0.11	0.62	0.07	0.33
x_{15}	-0.93	0.87	-0.58	0.46
x_{16}	-0.58	1.19	-0.20	0.65
x_{17}	-0.33	0.99	-0.24	0.54
_cons	-16.85***	4.09	-9.18***	2.05
LR chi^2 (17)	169.21		168.44	
Prob > chi^2	0.00		0.00	
Log likelihood	-40.90		-41.29	
Pseudo R_2	0.67		0.67	
Ob	207.00		207.00	

***, **, and * indicate remarkable levels of 1%, 5%, and 10%, respectively.

Table 4: Model prediction accuracy (a).

	True		
Classified	D	$\sim D$	Total
+	53	7	60
−	8	139	147
Total	61	146	207

Note: classified + if predicted Pr (D) ≥ .5 true D defined as $y! = 0$.

Table 5: Model prediction accuracy (b).

Sensitivity	Pr $(+\mid D)$	86.89%
Specificity	Pr $(-\mid \sim D)$	95.21%
Positive predictive value	Pr $(D \mid +)$	88.33%
Negative predictive value	Pr $(\sim D\mid -)$	94.56%
False + rate for true $\sim D$	Pr $(+\mid \sim D)$	4.79%
False − rate for true D	Pr $(-\mid D)$	13.11%
False + rate for classified +	Pr $(\sim D\mid +)$	11.67%
False − rate for classified −	Pr $(D \mid -)$	5.44%
Correctly classified		92.75%

presented in Tables 4 and 5 where the model prediction accuracy rate reaches 92.75%, which shows that the model fits well.

4.2. Analysis of Influencing Factors. Given the above analysis, the model estimation accuracy rate is relatively high. Thus, the binary Logit estimation results in Table 3 are combined to analyze the factors that affect farmers' willingness to apply blockchain. Overall, 8 explanatory variables, i.e., X_2, X_3, X_6, X_9, X_{10}, X_{11}, X_{12}, and X_{13}, will impose a remarkable impact on farmers' willingness to choose blockchain. Among them, the coefficient of age (X_2) and agricultural training (X_{12}) is negative, indicating that these two variables impose a negative impact on farmers' willingness to apply blockchain; education level (X_3), highest family education level (X_6), annual crop income per *mu* (X_9), government subsidies (X_{10}), agricultural information technology application (X_{11}), and blockchain understanding (X_{13}) coefficients are positive, which indicates that these 6 variables will positively affect farmers' willingness to apply blockchain. To further understand the marginal effect of each variable on the farmers' willingness to apply blockchain, the marginal effect of each explanatory variable is calculated via the Stata software in combination with Formula (3); hence, Table 6 is obtained.

Table 6: Marginal effects.

	Delta method					
	dy/dx	Std. err.	z	$P>\|z\|$	[95% conf. interval]	
x_1	-0.08	0.06	-1.36	0.18	-0.21	0.04
x_2	-0.10	0.04	-2.24	0.03	-0.18	-0.01
x_3	0.07	0.03	2.26	0.02	0.01	0.12
x_4	0.00	0.02	-0.01	0.99	-0.05	0.04
x_5	-0.01	0.03	-0.54	0.59	-0.07	0.04
x_6	0.07	0.02	3.06	0.00	0.03	0.12
x_7	0.01	0.02	0.66	0.51	-0.03	0.05
x_8	-0.03	0.03	-1.04	0.30	-0.09	0.03
x_9	0.11	0.03	3.76	0.00	0.05	0.16
x_{10}	0.18	0.05	3.38	0.00	0.07	0.28
x_{11}	0.05	0.02	2.60	0.01	0.01	0.10
x_{12}	-0.04	0.02	-2.27	0.02	-0.08	-0.01
x_{13}	0.10	0.04	2.91	0.00	0.03	0.17
x_{14}	0.01	0.04	0.18	0.86	-0.07	0.08
x_{15}	-0.06	0.05	-1.07	0.29	-0.16	0.05
x_{16}	-0.03	0.07	-0.49	0.63	-0.17	0.10
x_{17}	-0.02	0.06	-0.34	0.73	-0.13	0.09

As observed from Table 3, the age (X_2) is remarkable at the 5% statistical level, whose coefficient is negative, i.e., the older the farmers are, the more they tend to be unwilling to utilize the blockchain. According to Table 6, when the age of the farmer increases by one unit level, his/her willingness to apply the blockchain will be reduced by 10%. This might be because the difficulty of farmers' acceptance of new technologies increases as their age increases, and the older they are, the less willing they will be to change the status quo. Therefore, compared with younger farmers, the elderly are less willing to utilize blockchain. The level of education (X_3) is remarkable at the 5% statistical level, whose coefficient is positive, i.e., the higher the level of education of farmers, the more likely they will be to employ blockchain. According to Table 6, when the education level of farmers increases by one unit level, their willingness to employ blockchain will increase by 7%, which is mainly because the behavior of farmers is affected by their family members. The higher the education level of family members, the more likely they will be to understand the positive role of blockchain and the more enthusiasm they will have to apply blockchain. Meanwhile, highly educated family members could support farmers to apply blockchain, thus reducing their resistance to applying blockchain.

The annual income per *mu* of crops (X_9) is remarkable at the 1% statistical level, whose coefficient is positive, i.e., the higher the annual income of crops per *mu*, the more willing the farmers will be to apply blockchain. According to Table 6, when the annual income of farmers' crops per *mu* increases by one unit level, the willingness of farmers to apply blockchain will increase by 11%. This might be because farmers with higher incomes are more capable of bearing risks and thus more willing to use blockchain than those with lower incomes.

The government subsidy situation (X_{10}) is remarkable at the 1% statistical level, whose coefficient is positive, i.e., the higher the government subsidies enjoyed by farmers in the past, the more likely they are to apply blockchain. According to Table 6, when farmers enjoy government subsidies to upgrade a unit level, farmers' willingness to apply blockchain will increase by 18%. This is mainly because farmers who enjoy higher government subsidies tend to develop inertial thinking that the application of new technologies like blockchain might be heavily subsidized by the government for implementation; hence, they are more willing to apply blockchain.

The application of agricultural information technology (X_{11}) is remarkable at the 1% statistical level, whose coefficient is positive, i.e., the better the application of agricultural information technology by farmers, the more likely they are to apply blockchain. According to Table 6, when the application of agricultural information technology by farmers increases by one unit level, their willingness to apply blockchain will increase by 5%, which is because their application of technology will affect their willingness to apply new technologies. When farmers applied agricultural information technology more in the past, it would benefit them more and thus they would accumulate a certain amount of technology application experience, which will increase their willingness to apply blockchain and other technologies.

The agricultural training situation (X_{12}) is remarkable at the 5% statistical level, whose coefficient is negative, i.e., the more farmers participate in training, the more unwilling they tend to be to apply blockchain. According to Table 6, when farmers' participation in training is increased by one unit level, their willingness to apply blockchain will be reduced by 4%, which is in contradiction with the general situation. After further investigation, it is found that the content of some farmer training activities contains little substantive significance, which causes farmer households to reject the promotion of new technologies.

Blockchain understanding (X_{13}) is remarkable at the 1% statistical level, whose coefficient is positive, i.e., the more farmers understand the blockchain, the more likely they are to apply it. According to Table 6, when farmers' understanding of blockchain increases by one unit level, their willingness to apply blockchain will increase by 10%. This is because the application of blockchain is conducive to the realization of information sharing in the supply chain of agricultural products and the improvement of transaction efficiency, thereby increasing the benefits of supply chain members. When farmers understand the blockchain, the more they could foresee the benefits of using the blockchain; hence, they will be more willing to apply it.

5. Conclusions and Countermeasures

This paper conducted strict inspections during the research process and strictly required the quality of the questionnaires to be filled during the data survey process. In addition, during the process of binary Logit regression, the model's stability, the goodness of fit and prediction accuracy, and independent variable selection were tested to ensure the accuracy of the research. The main conclusions drawn are as follows. (1) At the current stage, Chinese farmers are not very receptive to the blockchain, most of whom are unwilling to apply blockchain to agricultural production and operation. (2) Farmers' age and participation in agricultural training impose a remarkable negative impact on their willingness to apply blockchain. (3) The education level of farmers, the highest education level of their family, the annual income of crops per *mu*, government subsidies, the application of agricultural information technology, and the degree of blockchain understanding exert a substantial positive impact on farmers' willingness to apply blockchain.

It is of great significance to promote the application of blockchain to the agricultural field. But at the current stage, farmers are not willing to apply it; hence, measures needed to be taken to enhance their willingness to apply blockchain are as follows. (1) Strengthen relative education and training of farmers to improve their understanding of the blockchain and enhance education and publicity on the application benefits of blockchain in the agricultural field by encouraging experts to publicize it in villages and establishing farmers' schools to make farmers clearly understand the application value of blockchain and enhance their application willingness. (2) Strengthen financial support and provide equipment subsidies and tax relief for farmers to reduce their application cost of blockchain and enhance their enthusiasm to apply it. Scientifically control the use cost of blockchain technology, while improving the quality of agricultural products, ensure the increase of farmers' market income, and indirectly improve farmers' enthusiasm to use blockchain. (3) Implement demonstration projects by supporting agricultural business entities with demonstration effects like family farms and large growers to take the lead in applying blockchain. After they benefit from it, conduct demonstration publicity of the application of blockchain and then gradually promote it. During the use of the demonstration unit, it has continuously improved the internal operation mechanism of the blockchain, standardized the operation procedures, and made the upstream and downstream participants of the blockchain more willing to use the blockchain.

Discussing the application of blockchain from the perspective of farmers is an area not covered by existing research, which is also the innovation of the present study. However, the sample of this study needs to be further expanded to better reflect the willingness of farmers in various provinces in China. Meanwhile, the variable setting needs to be further optimized, which will be the focus of future research.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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