ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202305_6(5).0049

The Impact of Leaders Green Cognition on the Adoption of Green Production Technology of Cooperatives: Based on the Survey of Planting Cooperatives in 10 Districts and Counties in Sichuan

Fan Xu

Sichuan University, Chengdu 610065, China

Abstract

With the increasingly serious global ecological and environmental problems, the promotion of green agriculture is imminent.In order to acceleraate the development of green agriculture, it is urgent to promote green production technology in farmers' cooperatives.The existing studies mostly analyze the influencing factors of the adoption of green production technology from the perspective of farmers, and less explore the impact of leaders' cognition on the adoption of green production technology of cooperatives from the perspective of cooperatives.Based on the theory of cognitive behavior and cost-benefit, this study uses the research data of 453 cooperative leaders in 10 districts and counties in Sichuan Province to analyze the influence of leaders on green production technology adoption of cooperatives.The research results show that the cooperative leaders' cognition of green benefit and environmental health positively affect the adoption of green production technology in cooperatives, while the green cost cognition has a negative impact on the adoption of green production technology in cooperatives.Therefore, the following suggestions are put forward: (1) Strengthen the training and publicity of green production technology, and improve the cognition of cooperative leaders on green production technology.(2) Accelerate the improvement and innovation of green production technology, and reduce the use cost of green production technology.(3) Improve the market recognition of products using green production technology, and appropriately increase the price of green products.(4) Increase investment in public health undertakings and improve the environment for cooperatives to conduct agricultural production.

Keywords

Green cognition; Green production technology; Cooperative leader; Counting model.

1. Introduction

After entering the 21st century, global ecological and environmental issues are becoming increasingly serious, and the promotion of green agriculture is imminent. In 2021, the No. 1 central document pointed out that it is necessary to promote the green development of agriculture, continue to promote the reduction of chemical fertilizers and pesticides, and promote the green prevention and control products and technologies of crop diseases and pests. Currently, the development of China's agriculture is transitioning from initially relying excessively on resource consumption to meet the shallow needs of "quantity" to pursuing green, ecological, safe, sustainable, and more focused on meeting the high-level needs of "quality". Therefore, green ecological agriculture has received widespread attention from people (Zhang Weihua et al, 2020).

Green production technology refers to a series of comprehensive measures that can minimize the production of pollutants for the pursuit and development of green ecological agriculture. Currently, due to factors such as agricultural practitioners' cognition of green production, the

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availability of green production technologies, and the cost of implementation, the adoption of green production technologies in agricultural practice is not optimistic. Currently, farmers' cooperatives, which carry a large number of rural agricultural practitioners, are the providers and users of agricultural production and operation services and an important carrier of agricultural product supply, and are in a strategic position in the process of agricultural development in China. At the same time, with the development of agricultural modernization, new agricultural management entities such as cooperatives and family farms are gradually replacing traditional decentralized small farmers (Zhu Zeyi et al,2021). Therefore, doing a good job in green production of farmers' cooperatives has far-reaching significance for promoting the green transformation and development of agriculture.

In addition, the chairman of the core leader of a farmer cooperative plays a leading role in the daily operation, management, and decision-making of the cooperative. His personal cognition and decision-making behavior have an important impact on the decision-making of the cooperative's operation, management, and even the healthy development of the cooperative (Chen Jianghua et al,2014). Currently, cooperative leaders mainly have green perceptions of environmental policies, health impacts, and environmental impacts (Zhu Zeyi et al,2021). So what impact will leaders' green cognition have on the adoption of green production technologies in cooperatives? In reality, can we promote the adoption of green production technologies by cooperatives by improving the green cognition of different aspects of leaders? If this problem can be solved, there will be a clear direction for cooperatives to vigorously develop green production.

Based on the above analysis, this study hopes to explore the interaction and internal relationship between leaders' green cognition in different aspects and the adoption of green production technology in cooperatives through studying the green cognition of leaders in planting cooperatives, explain and reason from an empirical perspective, and propose practical policy recommendations, with a view to promoting the green development of cooperatives, achieving ecological benefits Modern ecological agricultural production mechanism with win-win social and economic benefits.

2. Theoretical Assumptions and Model Construction

2.1. Research Assumptions and Theoretical Analysis

Cognitive behavior theory emphasizes the importance of cognition in the process of solving problems, emphasizes the interaction between internal cognition and the external environment, and believes that both external behavioral changes and internal cognitive changes will ultimately affect individual behavior changes. Only by improving people's values and transforming them into behavioral responses can green development be fundamentally promoted. Therefore, the green cognition of cooperative leaders is likely to directly determine whether and how many green production technologies the cooperative adopts. In addition, previous studies have shown that individual farmers' cognition of ecological pollution significantly and positively affects farmers' behaviors such as plastic film recycling and resource treatment, but strengthening farmers' cognition of ecological protection costs will reduce their willingness to ecological behavior (Hou Linqi et al,2019). Relevant research also starts from the cognitive conflict theory and believes that knowledge of biopesticides, perceived behavioral efficacy, social normative identification, and peer behavioral expectations positively affect drug use intentions, while price difference sensitivity negatively affects drug use intentions (Guo Lijing et al,2017). Based on this, this study believes that leaders' green cognition in different aspects will have different impacts on the adoption of green production technologies by cooperatives.

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This study assumes that cooperative leaders are rational economic individuals who, while pursuing maximum economic benefits, set long-term goals, and use basic behaviors as the main practical basis for achieving goals. The basic code of conduct is that expected benefits exceed expected costs, which effectively ensures the economic benefits of cooperative leaders themselves (Xue Hongyan,2019), in farmers' cooperatives, when cooperative leaders seek to maximize their own interests, they also seek better benefits for the organization and make relatively "satisfactory" decisions in the process of agricultural production. They can adjust to the constantly fluctuating prices in the market, and improve production efficiency by improving the allocation of production factors. Therefore, the decision of cooperative leaders to adopt green production technologies and how many types of green production technologies are usually based directly on economic benefits. If the marginal benefit of adopting a green production technology is greater than the marginal cost, cooperative leaders will increase the adoption of that green production technology, and vice versa.

In addition, as a "rational person", cooperative leaders will also comprehensively consider external environmental factors for the adoption of green agricultural production technologies in addition to production costs and benefits. With the continuous strengthening of environmental protection concepts such as green and health, people's demand for traditional polluting industrialized agricultural products is declining, and they are more inclined to produce organic agricultural products in a green ecological environment. As one of the main providers of agricultural products, the transition from traditional production mode to ecological organic production mode directly determines the benefits and survival possibilities of farmers' cooperatives in the new era. Therefore, cooperative leaders' perceptions of the ecological and environmental benefits and additional health impacts of adopting green production technologies in cooperatives will also greatly affect their adoption of green production technologies.

Based on the above analysis, combined with the green cognition of business leaders, cooperative agricultural production practices, and the actual situation of the survey sample area, this article divides the green cognition of cooperative leaders into three categories: first, green cost cognition, which mainly refers to all relevant costs incurred by cooperatives in using green production technologies for agricultural production, including the costs of conservation tillage technologies such as rotation and no-tillage in the prenatal stage, The costs of green prevention and control technologies such as the use of low toxic pesticides, the use of commercial organic fertilizers, the adoption of biological pest control methods, and the reduction of sewage discharge in the production process, as well as the costs of green storage and processing of agricultural products and the consumption of straw returning to the field in the post production process, are more likely to reduce the use of certain green production technologies if cooperative leaders believe that the cost of using such green production technologies is high. The second is green benefit cognition, which mainly refers to the cooperative's ability to improve the quality of agricultural products through green production technology, obtaining relevant organic product certification and green product certification, thereby enhancing the perceived value of consumers, and increasing the price of agricultural products. If the leader of the cooperative believes that the use of a certain green production technology brings high benefits, it will be more inclined to increase the use of that green production technology. The above two green perceptions are the basic green perceptions of cooperative leaders, and cooperative leaders will make the most fundamental trade-offs based on the two, thereby affecting whether cooperatives adopt green production technologies. The third is environmental health cognition, which mainly refers to the cognition of the impact of the entire process of using green production technology on the surrounding environment and physical health. This is a higher level of green cognition. The environmental health cognition of cooperative leaders can assist them in making decisions about whether to adopt a certain green

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202305_6(5).0049

production technology. If cooperative leaders believe that using a green production technology has a positive impact on the environment and physical health, they will be more inclined to increase the use of that green production technology.

Based on this, the following three assumptions are proposed:

Hypothesis 1: The higher the cognition of green costs among cooperative leaders, the less use of green production technologies by cooperative societies.

Hypothesis 2: The higher the cognition of green benefits among cooperative leaders, the greater the use of green production technologies by cooperative societies.

Hypothesis 3; The higher the cognition of cooperative leaders about environmental health, the greater the use of green production technologies in cooperative societies.

Table 1. Variable Definition

Variable Type	Observation Indicators	Code	Options
Dependent variable	Adoption of green production technologies	Y	number of green production technologies adopted
Core explanatory variables	Green cost cognition	X1	Level 5 scale
	Green benefits cognition	X2	Level 5 scale
	Environmental Health cognition	X3	Level 5 scale
Leader characteristics	Years of education	Educate	Number of years of education the respondent has received
	Agricultural experience	Farming	Years of agricultural production
	Family income	Income	Annual household income
	Public official	Officer	Yes=1; No=0
	Risk Attitude	Risk	High risk=1; Medium risk=2; Low risk=3
Cooperative characteristics	Cooperative level	Level	Normal=1; County level=2; City level=3; Provincial level=4; National level=5
	Total existing assets	Asset	Total existing assets of the cooperative
	Financing loan	Loan	Yes=1; No=0
Environmental characteristics	Agricultural characteristic town	Characteristic	Yes=1; No=0
	Instructor system	Instructor	Yes=1; No=0

2.2. Data sources and model settings

2.2.1. Data sources

The data in this article is based on a questionnaire survey of planting cooperatives in 10 districts, counties, and cities in Sichuan Province (Anzhou, Enyang, Hanyuan, Jiangyou, Luojiang, Mianzhu, Pingshan, Tianquan, Xuzhou, and Yilong). A stratified sampling method is adopted, and 500 questionnaires are finally collected. After eliminating invalid questionnaires, 453 valid questionnaires are selected, with a questionnaire efficiency of 90.6%. The questionnaire covers five aspects: the basic information of the cooperative leaders, the operation and management of the cooperative, the external support of the cooperative, the impact of the COVID-19

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202305_6(5).0049

epidemic on the cooperative, and the problems and policy appeals faced by the cooperative. The part closely related to this study is the internal governance of the cooperative in the operation and management of the cooperative, the operation quality of the cooperative, the adoption and promotion of cooperative technology Cooperative performance and influence.

2.2.2. Model settings

Assuming that the choices of cooperatives for different green production technologies are homogeneous, it is therefore possible to use the sum of the numbers to represent them; The more the quantity, the greater the degree of adoption of green production, and the more conducive to promoting the green development of cooperatives. The explained variable is the number of green production technologies adopted by cooperatives, which is a counting variable. Therefore, this study selects a Count Model for analysis. There are usually two types of counting models: Poisson model and negative binomial model. If there are many zeros in the sample, zero expansion testing and processing should also be performed. In this study, the likelihood ratio test was used to determine which counting model was selected, and the goodness of fit chi-square test was used to determine the degree of fit of the model.

The basic forms of the density function and regression model of the Poisson distribution are:

$$P_r(Y = y) = p(y) = \frac{e^{-\lambda}\lambda^n}{y_l!}$$

$$ln(\lambda) = X_{l_i}\beta_l = \sum_{k=0}^{k} \beta_{lk} x_{l_i k}$$

3. Empirical Analysis

3.1. Descriptive statistical analysis of variables

Descriptive statistical analysis of existing observations is conducive to initially grasping the overall trend and distribution of data.

Use Stata16 software to output the basic results of statistical analysis.

Table 2. Descriptive statistics of variables

Variable Type	Observation Indicators	Sample size	Mean	S.D.	Min	Max
Dependent variable	Adoption of green production technologies	453	3.917	1.783	0	7
Core explanatory variables	Green cost cognition	453	3.765	1.018	1	5
	Green benefits cognition	453	4.296	0.780	1	5
	Environmental Health cognition	453	4.518	0.659	1	5
Leader characteristics	Years of education	453	11.46	3.315	1	30
	Agricultural experience	453	17.84	11.71	0	50
	Family income	453	2.404	1.247	1	5
	Public official	453	0.327	0.470	0	1
	Risk Attitude	453	2.020	0.576	1	3
Cooperative characteristics	Cooperative level	453	3.853	1.317	1	5
	Total existing assets	453	405.7	754.3	-60	9274
	Financing loan	453	0.428	0.495	0	1
Environmental characteristics	Agricultural characteristic town	453	0.607	0.489	0	1
	Instructor system	453	0.261	0.440	0	1

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202305_6(5).0049

3.2. Analysis of regression results

In order to verify the impact of cooperative leaders' green cognition on cooperative green production technology adoption, this study used Stata16 statistical analysis software to conduct a regression analysis between the three types of green cognition of cooperative leaders and the number of cooperative green production technology adoption, and established a Poisson counting model. The logarithmic likelihood ratio of the negative binomial model is 0.000, less than 1.96, and Prob≥chibar2=1.00, indicating that there is no over discrete distribution, that is, the Poisson model is superior to the negative binomial model. The chi-square test of goodness of fit for the model showed that the test results were not statistically significant, indicating that the data were in good agreement with the model.

In order to test the multicollinearity in the model, this study examined the variance expansion factor (VIF) of the model. The statistical results show that the average VIF value is 1.15, and the VIF values of each variable are between 1.04-1.54, which is far less than the threshold value of 10, indicating that the model does not have serious multicollinearity issues. Due to the cross-sectional nature of the survey data, robust standard error regression is used in all models to prevent heteroscedasticity.

Table 3. Regression results

Variables	Coefficient (standard error)
Green cost cognition	-0.039**(0.020)
Green benefits cognition	0.000(0.029)
Environmental Health cognition	0.086**(0.036)
Years of education	0.020***(0.008)
Agricultural experience	-0.002(0.002)
Family income	-0.018(0.017)
Public official	-0.003(0.047)
Risk Attitude	0.016(0.036)
Cooperative level	-0.032*(0.017)
Total existing assets	-0.000(0.000)
Financing loan	-0.008(0.042)
Agricultural characteristic town	0.062(0.044)
Instructor system	0.028(0.049)
Constants	1.020***(0.238)
Sample	453
Wald chi2(13)	29.34***
Pseudo R2	0.0116
Pseudo likelihood	-894.35793

Note: *, * * and * * * indicate significant at the 10%, 5%, and 1% levels, respectively

3.2.1. Core explanatory variables

The green cost perception of cooperative leaders has a significant negative effect on the adoption of green production technologies in cooperatives and has passed the test at a significance level of 5%. This result validates hypothesis 1. Further calculating its marginal effect, the result shows that each level of improvement in the green cost perception of cooperative leaders reduces the number of cooperatives adopting green production technologies by 3.9%. Cost is an important determining factor in deciding whether to implement green production technologies. If cooperative leaders believe that the higher the

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202305_6(5).0049

green cost of adopting green production technologies in cooperatives, they will be more inclined to make decisions not to adopt such green production technologies.

The environmental health cognition of cooperative leaders has a significant positive effect on the adoption of green production technologies in cooperatives and has passed the test at a significance level of 5%. This result validates hypothesis 3. Further calculating its marginal effects, the results show that the number of cooperatives adopting green production technologies increases by 8.6% for each level of environmental health cognition of cooperative leaders. With the continuous improvement of living standards, people increasingly pursue a good environment and a healthy body. After considering the costs and benefits, environmental health cognition becomes a key factor. If cooperative leaders believe that adopting green production technologies will lead to a better environment and good health, cooperative leaders will be more inclined to make decisions to adopt such green production technologies.

Cooperative leaders' perception of green benefits did not pass the significance test. However, from the perspective of correlation coefficient, green benefit cognition has a positive impact on the adoption of green production technologies in cooperatives, which meets the expectations of hypothesis 2. The insignificant regression results may be influenced by the limitations of questionnaire interviews, bias in sample selection, and the actual situation of interviewees.

3.2.2. Control variables

In terms of leader characteristics, the number of years of education has a significant positive effect on the adoption of green production technologies in cooperatives and has passed the test at a significance level of 1%. As a new type of agricultural technology, green production technology has certain requirements for users' cognitive level, understanding ability, and operational skills. Leaders of cooperatives with high academic qualifications have a stronger ability to understand new agricultural technologies, and the greater the probability of adopting green production technology. "Farming experience hinders the adoption of green production technologies, but its effect is not significant. The longer the farming experience, the more likely leaders will follow the previously fixed agricultural production model for agricultural production. Considering time costs and learning costs, it is more difficult and unwilling to learn new models, thereby impeding the adoption of green production technologies.". The negative impact of household annual income on the adoption of green production technologies is not significant. Leaders of cooperatives with higher household annual income tend to be more conservative in operation and management, and are not highly receptive to transactions that may pose higher risks, so they are not willing to adopt green production technologies. The possible reason why public officials have a negative impact on the adoption of green production technologies in cooperatives is that in order to avoid the risk of failure and reduce policy penalties, they are more willing to choose traditional business methods and technologies to obtain guaranteed benefits, rather than taking high-risk decisions, thereby reducing the adoption of emerging technologies, thereby reducing the use of green production technologies. Risk attitudes have a positive but not significant impact on the adoption of green production technologies in cooperatives. Risk predictors tend to choose high-risk and high-return options, and therefore have a stronger willingness to use new technologies, which will increase the use of green production technologies.

In terms of cooperative characteristics, cooperative hierarchy has a significant negative effect on the adoption of green production technologies in cooperatives and has passed the test at a significance level of 10%. Cooperatives with higher demonstration levels may face greater resistance to implementing green production technologies due to their larger scale and membership, complex organizational structures, higher degree of freedom of members, and higher difficulty in management and control. The possible reason why total assets of cooperatives hinder the adoption of green production technologies in cooperatives is that

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202305_6(5).0049

cooperatives with more assets tend to operate and manage prudently, thereby reducing the use of green production technologies that may pose high risks.

In terms of environmental characteristics, whether financing loans have a negative impact on cooperatives' adoption of green production technologies. According to research data, most cooperatives with financing loans have financial difficulties or other market business development phenomena, so they do not have sufficient capital and energy to use green production technologies. Whether it is an agricultural characteristic town has a positive impact on the adoption of green production technologies by cooperatives. Cooperatives located in agricultural characteristic towns will be more proactive in adopting green production technologies due to preferential policies and centralized advantages of the local government. Whether to establish a mentoring system to promote the adoption of green production technologies in cooperatives? After establishing a cooperative mentoring system, the mentors will provide corresponding guidance on the development direction and production and operation of the cooperatives. They will also regularly conduct training on new technologies and policies for the senior management of the cooperatives, enabling the leaders of the cooperatives to have a deeper understanding of green production technologies, thereby strengthening the adoption of green production technologies.

4. Conclusions and Suggestions

4.1. Conclusions

Based on the survey data of 453 leaders of planting cooperatives in 10 counties in Sichuan Province, this study uses Poisson model to empirically analyze the impact of cooperative leaders' green cognition on cooperative green production technology, and uses Oprobit model to verify the robustness of the conclusions. Furthermore, it further analyzes the heterogeneity between cooperatives of different sizes, in order to guide cooperative leaders to establish correct green cognition, This will further influence cooperatives to vigorously develop green agriculture through the adoption of green production technologies and provide a credible basis for transformation and upgrading.

The conclusions are as follows: (1) Overall, the green cognition of cooperative leaders has a significant impact on the adoption of green production technologies in cooperatives. (2) Specifically, the green cost perceptions of cooperative leaders negatively affect the adoption of green production technologies in cooperatives, while green benefit perceptions and environmental health perceptions positively affect the adoption of green production technologies in cooperatives.

4.2. Suggestions

First, strengthen the training and promotion of green production technologies, and improve the cognition of cooperative leaders on green production technologies. The local government can engage university professors or industry professionals to carry out relevant training courses, develop a training plan for cooperative leaders based on the assessment system, and incorporate it into the assessment management of the cooperative in the current year. Actively promote and promote green production technologies through media and the Internet, scientifically guide farmers' cooperatives in green production, and establish a research system for green agricultural technology.

Second, accelerate the improvement and innovation of green production technologies, and reduce the cost of using green production technologies. As a user of green production technology, cooperatives are essentially passive recipients of green production technology. When cooperative leaders believe that the cost of using green production technology in cooperatives is too high, they will reduce the use of green production technology. Therefore,

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202305_6(5).0049

greater efforts should be made to promote the research and development and marketization of green production technologies, reduce the cost of use from the perspective of market mechanisms, and ensure the applicability and reliability of the technology. In addition, for some green production technologies that are being piloted, policy subsidies can be used to promote the pilot adoption of such technologies by cooperatives, thereby reducing the trial and error costs of cooperatives. Increase risk avoidance mechanisms, address talent and technical challenges in the development of green agriculture, and reduce the risk cost of green agriculture (Wang Xin et al, 2021).

Third, improve the market recognition of products using green production technologies, and appropriately increase the price of green products. Selling agricultural products is one of the important ways for cooperatives to obtain revenue. Therefore, compared to traditional production methods of agricultural products, it is necessary to establish differentiated prices for agricultural products that use green production technologies, and encourage cooperatives to adopt green production technologies through a benefit driven mechanism. The government should also strengthen guidance and improve public trust. By establishing standardized green product labels, consumers can distinguish between them, thereby building confidence in consumption.

Fourth, increase investment in public health and improve the environment for agricultural production by cooperatives. A healthy body is a prerequisite for individuals to engage in economic activities and transform knowledge into productivity. With the improvement of people's living standards, traditional agricultural production practices that may cause health hazards to producers and consumers, such as the use of highly toxic pesticides and inferior chemical fertilizers, are being abandoned by people, while organic production, green production, and ecological production are being pursued by more and more people. Therefore, it is necessary to improve the environment for agricultural production in cooperatives and strengthen the cognition of health, ecology, and environmental protection among cooperative members (Huang Yanzhong et al, 2018**)**.

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