Propensity Score Matching Method Based on STATA Analysis of Influencing Factors of Knowledge Sharing on Farmers' Green Production

Xiwen Zhang[1], Jixuan Wang[2], Yixuan Chen*
657409225@qq.com[1], 491754948@qq.com[2], 18428321511@163.com*

College of Management, Sichuan Agricultural University, Chengdu, 611130

Abstract. Based on the micro-survey data of 671 households in Sichuan Province, the propensity score matching method was used to establish a model to empirically study the effect of knowledge sharing on farmers' green production. The results show that under the counterfactual hypothesis, the average processing effect of the adoption degree of green production technology increases by 0.704 due to the knowledge sharing of farmers without knowledge sharing. That is, knowledge sharing has a significant positive impact on farmers' green production behavior.

Keywords: Green development of agriculture; Propensity score matching

1 Introduction

Excessive resource consumption and non-point source pollution caused by excessive use of agricultural resources such as pesticides and fertilizers pose a huge threat to agricultural and rural development [1]. It is urgent to promote the green agricultural production and promote the profound reform of agriculture from "quantity" to "quality". As the main body of agricultural production decision-making, the change of farmers' production behavior is very important for the promotion of green production technology and the realization of agricultural green development goals. Through the exchange and study of agricultural technology knowledge with others, farmers can improve their own green cognition, enhance the new green production technology information, so as to adopt green production technology. Form a long-term mechanism for the green transformation of agricultural production and realize the green development of agriculture [2]. According to existing studies, personal characteristics of farmers [3], government regulatory penalties [4] and social networks [5] will promote the adoption of green production technologies by farmers. Therefore, on the basis of existing research, based on the micro-survey data of 671 households in Sichuan province, this paper uses propensity score matching method to construct a counterfactual framework for empirical research on the specific impact of knowledge sharing on farmers' green production.

MSIEID 2022, December 09-11, Chongqing, People's Republic of China
Copyright © 2023 EAI
DOI 10.4108/eai.9-12-2022.2327634

2 Research methods

2.1 Data sources

The data used in this paper are from the field research of 11 cities in Sichuan Province with a good foundation for agricultural development in 2020. After eliminating invalid questionnaires, 671 pieces of plantation industry related subject data were returned for this part of research.

2.2 Variable selection

Explained variables. Green production technology adoption degree. Referring to the existing studies [6]-[8], five green production behaviors including fertilizer reduction, physical biological control, biological pesticide use, organic fertilizer application and soil testing and formula fertilization were selected for the study, and the sum of the number of green production technologies adopted was taken as the index to measure the adoption behavior.

Core explanatory variables. In this paper, knowledge sharing is defined as "whether to communicate agricultural technology with others", and "yes" is assigned a value of 1, and "no" is assigned a value of 0.

Match variables. For the control variables matching propensity scores, the correlation variables affecting both the explained variable and the core explanatory variable were considered. Existing studies have shown that farmers' personal characteristics, social connection, organizational relationship and information access have significant impacts on farmers' participation in knowledge sharing and adoption of green production[9]-[10]. The specific variables are shown in Table 1.

2.3 Propensity score matching

Farmers' knowledge sharing behavior will be affected by their own capital endowment and other complex factors, which may lead to sample selection bias and model endogeneity problems, resulting in biased parameter estimation results. Propensity score matching (PSM) builds a "counterfactual framework" to match sample data before sampling, so as to improve the randomness of experimental data as much as possible and reduce the bias of observation data.

Table 1 Variable definitions and descriptive statistics

Variable name	Variable definition	Mean difference
Adoption of green production technology	Number of green production technologies	-6.47***
Knowledge sharing	Yes=1, No=0	—
Gender	Male =1, female =0	-1.525
Age	Age	-0.886
Education level	Education level of household head 1 - primary school and below 2 - junior high school 3 - senior high school/vocational high school 4 - junior college 5 - undergraduate and above	-2.002*

Whether they are village cadres	yes=1，no=0	-3.205***
How much land do you own	Land scale	-2.946**
Agricultural labor force	Number of agricultural labor force in the family	-2.145*
Annual household non farm income	Non agricultural income	0.044
Family population	Family population	-1.587
Whether to join the cooperative	yes=1，no=0	-4.144***
Annual training times	Number of agricultural technology training in 2019 (times)	-1.17
Internet usage	Number of agricultural Internet platforms used	-4.284***

Note: *, ** and *** are significant at the level of 10%, 5% and 1% respectively, the above results are obtained by nearest neighbor matching, k=3, and the results of radius matching and kernel matching are the same. the same below.

2.4 Research methods

$$P(Z_i) = P(D_i = 1 | Z_i) = \Lambda(Z_i'\beta) / (1 + \exp(Z_i'\beta)) \quad (1)$$

In Formula (1), P is the matching score or probability of farmers' propensity to share knowledge, and is the matching variable. Meanwhile, the average processing effect (ATT) of farmers' knowledge sharing is defined as:

$$ATT = E(Y_1 | D = 1) - E(Y_0 | D = 1) = E(Y_1 - Y_0 | D = 1) \quad (2)$$

In formula (2), Y_1 is the adoption of green production by sharing households and Y_0 Is the adoption of green production by non-sharing households.

3 Empirical results analysis

3.1The impact of knowledge sharing on farmers' green production behavior

In order to match the sharing households and non-sharing households, STATA software is used to estimate the possibility of knowledge sharing by farmers with the experimental data, and the estimated results are shown in Table 3.

Table 2 Estimation Results of Logit Equation for Farmers' Knowledge Sharing Decision

Variable name	Coefficient estimate	Standard error	Z-value
Age	0.023**	0.009	2.32
Whether they are village cadres	0.534**	0.250	2.14
Land scale	0.055**	0.025	2.15
Whether to join the cooperative	0.709***	0.204	3.48
Internet usage	0.262***	0.068	3.85

(Rest Omitted)			
Constant term	-2.583	0.774	-3.34
LR statistic		58.48	
Pseudo R2		0.07	
sample size		671	

3.2 Common support area and balance test

In this paper, three matching methods, nearest neighbor matching, radius matching and core matching, are selected to demonstrate the matching effect. The common support domain sample loss of the three matching methods is 8, the loss is small, the matching result is good. As can be seen from Table 3, PseudoR2, LR statistic, mean deviation and median deviation all decreased significantly. It can be seen that the total sample bias is greatly reduced after matching, and the two groups of samples have similar characteristics, that is, the balance test results pass.

Table 3 Balance test results of control variables before and after matching.

Matching method	Pseudo R	LR value	P value	Mean deviation (%)	Median deviation (%)
Before matching	0.067	57.930	0.000	17.300	16.400
NNM (1 to 1)	0.006	6.790	0.815	4.100	3.700
NNM (1 to 3)	0.007	8.000	0.713	4.300	2.500
Kernel matching (0.06)	0.003	4.030	0.969	3.800	4.600
Radius matching	0.003	4.100	0.967	3.900	4.700

As shown in Table 4, the results of the three matching estimates are consistent, and ATT all passes the test at the significance level of 1%. From the average point of view, the average processing effect of the degree of green production behavior of farmers participating in knowledge sharing increased to 3.330, increasing by 0.704. It can be seen that knowledge sharing has a significant promoting effect on farmers' green production behavior.

Table 4 Overall effect of knowledge sharing driving farmers to adopt green production

Matching method	experience group	control group	ATT	T value
Nearest neighbor matching (1-to-1 matching)	3.330	2.555	0.617***	3.47
Nearest neighbor matching (1 to 3 matching)	3.330	2.610	0.716***	4.83
Kernel matching (0.06)	3.330	2.587	0.743***	5.48
Radius matching	3.330	2.589	0.741***	5.46
average value	3.330	2.585	0.704***	—

4 Conclusions and policy implications

Based on the research data of 11 cities in Sichuan Province from November to December 2020, this paper uses propensity score matching (PSM) to empirically study the effect of knowledge

sharing on farmers' adoption of green production technology. The results show that knowledge sharing can significantly promote farmers' green production. Based on the above research conclusions, this paper proposes the following policy implications: First, attach importance to professional technical training, improve the frequency of technical training, correct the cognitive bias of farmers, improve the current situation of information asymmetry, and improve the initiative of farmers to learn and master green agricultural production technology. Second, make full use of the rural social environment, encourage farmers to play a role as a benchmark, and make reasonable use of demonstration effect to form a wider range of influence and positive interaction mechanism.

References

[1] Li Lipeng, Ding Xiuling, Li Hua. Regional brand, relative deprivation and green production of agricultural products: A case study of tea farmers' application quantity selection [J]. Journal of Agriculture and Forestry Economics and Management,202,21(02):156-166.

[2] Mao Hui, Cao Guangqiao. Research on Operation Subsidies and Farmers' Green Ecological Agricultural Technology Adoption Behavior [J]. China Population, Resources and Environment, 2020, 30 (01): 49-56

[3] Li Hao, Cao Chen, Li Linzhe. Can Green Cognition Promote farmers' green production Behavior? Analysis on the locking effect of social norms [J]. Journal of Arid Land Resources and Environment,202,36(09):18-25.

[4] Shen Yuwen, Luo Xiaofeng, Yu Weizhen. How incentives and constraints affect farmers' application behavior of biopesticide: A discussion on the moderating effect of constraints _ SHEN Yuwen. Resources and Environment in the Yangtze Basin, 2020, 29(4): 1040-1050.

[5] Ma Qianhui, Zheng Shaofeng, Lu Qian. Social Network, Internet Use and farmers' green Production technology Adoption Behavior: Based on the survey data of 708 vegetable farmers [J]. Journal of Arid Land Resources and Environment,202,36(03):16-21+58.

[6] Zhou Zhou, Zhang Lixia, Jia Lei, Zhang Xiaoyu. Factors influencing the green production behavior of rural households in metropolitan suburbs: An analysis based on the data of Shanghai Jinshan District [J]. Chinese Journal of Agricultural Resources and Regional Planning, 201,42(09):1-7.

[7] Guo Qinghui, Li Shiping, Nan Ling. Social learning, social network and pesticide reduction: Empirical evidence from farmers' micro-data [J]. Journal of Arid Land Resources and Environment,2020,34(09):39-45.

[8] Cheng Pengfei, Yu Zhiwei, Li Jie, Cheng Guanghua. Research on farmers' cognition, External Environment and Green Production Behavior: Based on the survey data of Xinjiang [J]. Journal of Arid Land Resources and Environment, 201,35(01):29-35.

[9] Li Hao, Cao Chen, Li Linzhe. Can Green Cognition Promote farmers' green production Behavior? Analysis on the locking effect of social norms [J]. Journal of Arid Land Resources and Environment,202,36(09):18-25.

[10] Huang Yanzhong, Luo Xiaofeng. Eating and selling: Analysis on the difference of biological pesticide application behavior of rice farmers [J]. China Rural Economy,2018(07):63-78. (in Chinese)