Effects of Technology Cognition and Information Acquisition on Farmers' Green Production Behavior -- A Case Study of Biopesticides Technology

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Abstract. Based on the micro-survey data in rural areas of Sichuan Province, with the help of Stata15.0 software, the effects of technology cognition and information acquisition on farmers' behavior of applying biopesticide were empirically studied using the binary Logistic model. The results showed that: (1) Among the technical cognition variables, farmers' environmental cognition of biopesticides could significantly improve. The variables had a significant positive impact on farmers' behavior of applying biopesticides. For biopesticides, the cognitive variables that can increase the production cost significantly negatively affect the behavior of farmers applying biopesticides. (2) Among the information acquisition variables, whether farmers participated in the technical training of biopesticide and the variables of their satisfaction with the obtained technology had a significant positive effect on the behavior of farmers applying biopesticide. (3) Among the control variables, the number of family labor force and the highest level of family education had a significant positive effect on the behavior of farmers applying biopesticides. Based on this, some countermeasures and suggestions were put forward to enhance the production of biological pesticides applied by farmers.

Keywords: Farmer; Technology perception; Information acquisition; Green technology; Biopesticides

1 Introduction

Promoting the green development of agriculture is one of the main development directions of the rural revitalization strategy, and whether farmers can adopt green production technology is the key[1]. Biopesticides technology have the advantages of clear target, harmless to plants, animals and the environment. The behavior of farmers applying biopesticides technology has typical green production characteristics. The academic community has made beneficial exploration on the factors influencing the behavior of farmers applying biopesticide from the perspectives of individual characteristics of farmers[2], family characteristics[3], green cognition[4], market trust[5]and institutional constraints[6].

The theory of peasant household behavior is based on the assumption of "rational economic man", which is the basic economics. The benefit maximization is the key factor of whether farmers adopt green production technology. The intention of farmers to adopt green production technology is mainly affected by the cognition of technology connotation and the degree of technology acquisition[7]. In terms of farmers' application behavior of biopesticides, it not only depends on farmers' technical perception of biopesticides; It also depends on the farmers' access

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to biopesticides and other relevant information. Based on this, combined with the survey data of rural areas in Sichuan Province, the binary Logistic model was used to analyze the influence of technology perception and information acquisition on the behavior of farmers applying biopesticide, in an attempt to supplement the existing studies and provide references for the formulation of incentive policies for farmers applying biopesticide.

2 Research data and empirical methods

2.1 Source of Data

The data came from a field survey in 11 cities of Sichuan Province from July to October 2020, and 653 questionnaires were collected. After deleting the logical contradiction and information error questionnaires, 598 valid samples were obtained, and the effective rate was 91.58%.

2.2 Selection of variables

The explained variable was the behavior of farmers applying biopesticide. The core variables are farmers' technology cognition and information acquisition. The technical cognition was measured from three aspects in turn: the improvement of agricultural product quality, significant improvement of environment and increase of production cost by biopesticides[8]. The control variables in this paper are based on relevant studies[9]. The individual characteristics are selected as gender, age, whether the household head is a village cadre, and years of farming; the household characteristics are selected as the number of labor force, the education background of family members, the area of cultivated land, and the distance from the nearest market town[10]. As shown in Table 1.

Table 1 Variable description and descriptive statistics

Name of variable	Define and assign values	Mean	Standard deviation
Whether to apply biological pesticides (y)	Yes=1;No=0	0.629	0.483
Improving the quality of agricultural products (x_1)	Strongly disagree =1; Disagree =2; Uncertainty =3; More agree =4; Agree =5	4.475	0.731
Significantly improve the environment (x_2)	Strongly disagree =1; Disagree =2; Uncertainty =3; More agree =4; Agree =5	4.587	0.709
Increase production cost (x_3)	Strongly disagree =1; Disagree =2; Uncertainty =3; More agree =4; Agree =5	3.679	1.142
Technical training of biopesticide (x_4)	Yes=1;No=0	0.590	0.492
Satisfaction with the technology acquired (x_5)	Dissatisfied =1; More satisfied =2; Usually =3; More satisfied =4; Very satisfied =5	3.691	1.441
Gender (x_6)	Male =1; Female =0	0.853	0.359
Age (x_7)	Actual age of respondent	48.622	10.199
Village cadres (x_8)	Yes=1;No=0	0.167	0.373

Years of farming (x_9)	The respondent has worked in agriculture for years	16.012	13.066
Quantity of labor force (x_{10})	Number of people in the labor force in the household actually surveyed	2.555	1.164
Highest degree for family members (x_{11})	Primary school and below =1; Junior high school =2; High school/vocational high =3; Specialty =4; Undergraduate =5; Graduate students and above =6	3.401	1.236
Area of cultivated land (x_{12})	Household cultivated land area	4.348	6.422
Distance from home to nearest market town (x_{13})	The distance from the nearest market town to the actual surveyed households	4.060	4.286

2.3 Model setting

Whether farmers apply biopesticides or not is a binary discrete variable, so the binary Logistic model is used for regression, and the expression is as follows:

$$y = \ln\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_i x_i + \mu \quad (1)$$

3 Results and Analysis

Considering that there may be internal correlation between farmers' technical cognition, information acquisition and variables such as farmers' individual characteristics and family characteristics, multicollinearity test was conducted for each variable. According to variance inflation factor test results, no collinearity was found among the selected variables (VIF<0), so regression analysis is suitable. In this paper, with the help of Stata15.0 software, the Logistic model was built to estimate the behavior of farmers applying biopesticide. The specific estimation results are shown in Table 2.

Table 2 Model regression results

Variable	Model (1)		Model (2)	
	Coefficient	SE	Coefficient	SE
Improving the quality of agricultural products			0.183	0.170
Significantly improve the environment			0.619***	0.173
Increase production cost			-0.149*	0.088
Technical training of biopesticide			0.702***	0.202
Satisfaction with the technology acquired			0.164**	0.074
Gender	0.018	0.246	-0.275	0.268
Age	-0.154	0.107	-0.010	0.011
Village cadres	0.228	0.239	0.670	0.254
Years of farming	0.001	0.008	0.005	0.009

Quantity of labor force	0.208	0.078***	0.164**	0.082
Highest degree for family members	0.170	0.070**	0.165**	0.075
Area of cultivated land	0.164	0.018	0.020	0.018
Distance from home to nearest market town	-0.014	0.020	0.018	0.023
Term of constant	0.937	0.590	-3.881***	0.915
Log Likelihood	-383.409		-346.611	
Chi-square test	22.08***		95.67***	

Note: *, ** and *** respectively indicate that the variables are statistically significant at the level of 10%, 5% and 1%.

The influence of technology cognition. The results showed that significantly improving environmental cognition variables had a significant positive effect, which was statistically significant at 1% level. However, it has a significant negative effect on increasing the cognitive variables of production cost, which is statistically significant at the level of 10%. With the extensive use of chemical pesticides, problems such as agricultural production environment, agricultural product quality and safety are particularly serious. This trend increases farmers' sense of identity for green production technology, so farmers' tendency to apply biological pesticides will be greatly enhanced. Profitability is one of the key concerns of farmers. If the application of biopesticide increases the production cost, it is equivalent to reducing the expected income of farmers, and the willingness of farmers to apply biopesticide will be reduced.

The influence of information acquisition degree. The results showed that whether farmers participated in the technical training of biopesticide and the satisfaction degree of the acquired technology had significant positive effects on the two variables, which were both significant at the statistical level of 1%. Limited by their own abilities, it is difficult for farmers to fully grasp the application technology and information. By participating in relevant training, farmers can help improve the ability to apply technology, and the marginal cost of technology adoption will be lower[11]. However, the more satisfied farmers are with the technology, they tend to show a more resolute attitude towards the technology, believing that the more they can achieve the expected effect, the more inclined they are to use the technology.

Control the influence of variables. The number of labor force in a family and the highest level of education in a family have significant positive effects, and both are statistically significant at the 5% level. Since the increase of labor force means the increase of agricultural productivity cost, farmers are willing to reduce the use of biological pesticides and other agricultural materials in order to reduce the total cost of agricultural production. The higher the education level of farmers, the stronger their understanding and cognitive ability, the more likely they are to accept the new green production technology.

4 Conclusions and policy implications

First, increase the channels for farmers to obtain the information of biopesticide, give full play to the role of publicity media, through television, radio, publicity bars, distribution of biopesticide knowledge manuals and hold knowledge lectures, improve farmers' awareness of ecological civilization and the degree of understanding of biopesticide technology; Second, the

government and institutions need to increase support, make certain government investment to attract social investment, and constantly improve the compensation mechanism of biopesticide; Third, formulate targeted strategies to gradually reduce the restriction effect of household characteristics in the application of biopesticide.

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