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Individual Endowment, Risk Preference and Peasants' Selection of Green Pesticides

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The selection of green pesticides is the result of peasants' comprehensive tradeoff between individual characteristics and external environment. Based on 286 rice farmers in China and through the use of Logit model, this paper analyzed the influencing factors of peasants' selection of green pesticide from three aspects, which are individual endowment, risk preference and technical policy environment. It found that factors like age, educational level, technical training experience, risk preference and government technical support exerted a significant positive impact on the peasants' selection. Therefore, this paper proposed to pay attention to the difference of individual endowment of farmers, improve the pertinence of technology promotion, provide policy-oriented green pesticide insurance products and increase the technical support from the government.

1. Introduction

In the past, large amount use of pesticides plays an important role in ensuring the yield increase of grains in China. However, the effective utilization rate of pesticides is only 35% and nearly half of the pesticides applied remain in soil while the remaining 10% to 20% remain in crops (Shao and Zhang,2014). The excessive use of pesticides leads to a series of social problems such as environmental pollution, food safety and health risks. Therefore, it's urgent for China to change the traditional way of pesticide usage.

The academic community has just started the research on the green pesticide selection behavior of peasants. The reduction of the cost of green pesticides and the increase of penalties was conducive to the promotion of farmers' willingness to adopt green pesticides (Mitchell and Hurley, 2006; Wang, 2018). The sales and service system, technical training, commercialization of agricultural products affect the willingness of farmers to buy green pesticides (Yang et al., 2011). The significance of pesticide labeling, little damage to health and low level of environmental risk also increase' farmers purchasing willingness (Hasing, 2010). Individual characteristics of farmers are also an important reference, such as poisoning experience, income status and education level (Adetonah, 2007). Finally, there is a deviation phenomenon of the purchasing willingness and behavior, and this phenomenon can be eliminated through improving the promotion methods of green pesticides, increasing policy guidance and improving the security inspection system of agricultural products (Jiang et al., 2017).

However, relatively fewer achievements have been made in the research and interpretation from the perspective of farmers. Farmers' selection behavior is the result of synergistic effect of multiple factors. These factors can be divided into three aspects: the individual characteristics of farmers and household management condition, the trade-off between the costs and benefits of new technologies, and the environment for the promotion of government policies. The first two are the factors that affect the selection of green pesticides from the individual level, while the latter is the impact of the external policy environment. Therefore, this study was closely linked to the subjectivity of farmers, and conducted the investigation from individual endowments, farmers' risk preference and government policy support.

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2. Data sources and research assumptions

2.1 Data source

The data used in this paper come from the survey of 300 rural peasants in Feidong, Lujiang and Shucheng counties in Chaohu Lake Basin in China in 2017. A random sampling method was used. Two towns were selected from every county, and 50 peasants were randomly selected from each town. A total of 286 valid questionnaires were obtained, of which 97 were from Feidong County, 94 from Lujiang County and 95 from Shucheng County. The effective rate of questionnaires reached up to 95.3%. The reason why the above three counties are selected as the survey areas is mainly based on the following considerations: these 3 counties are all rice-planting agricultural counties in China's Chaohu Lake Basin and key counties to promote the use of green pesticides in Anhui Province.

2.2 Research hypotheses

The selection behavior of green pesticides of pheasants is a complex process influenced by multiple factors. According to the existing researches, main factors that affect the selection of green pesticides by farmers are summarized as follows: individual endowment characteristics of farmers, risk preference and policy support.

Table 1. Assignment of variables and direction of influence

Variables	Definition of variables	Direction of influence
green pesticide selection behavior (y)	0=no, 1=yes	
age (x_1)	0=below 29 years old, 1=30-39 years old, 2=40-49 years old, 3=above 50 years old	+ / -
gender(x_2)	0=female, 1=male	+ / -
educational level (x_3)	0= illiteracy, 1=elementary school, 2= junior high school, 3=senior high or technical secondary school, 4=junior college and above	+
planting experience (x_4)	0=under 5 years, 1=5-10 years, 2=10-15 years, 3=15-20years, 4=above 20 years	+
cognition of green pesticides (x_5)	0= never heard of, 1=heard of	+
whether receiving training of green pesticide technology (x_6)	0=no, 1=yes	+
household income per capita in previous year (x_7)	0=under 2500 Yuan, 1=2501-4000 Yuan, 2=4001-5500 Yuan, 3=above 5501 Yuan	+
planting area of rice (x_8)	actual planting area	+
control of diseases and pests in agricultural production (x_9)	control of diseases and pests in last 3 years 0=bad, 1=general, 2=good	+ / -
expected market price of agricultural products (x_{10})	price of agricultural products in the year to come 0=decline, 1=stabilize, 2=increase	+ / -
risk of crop yield reduction (x_{11})	the most severe natural disaster suffered by famers in last 3 years 0=decline 10% or under, 1=decline 30%-59%, 2=decline 60%-79%, 3=decline 80%-99%, 4=decline100%	—
subsidies for promotion (x_{12})	actual amount	+
government technical support (x_{13})	0=very small, 1=relatively small, 2=general, 3=relatively large, 4=very large	+

Note: " + " represents positive impact; " - " represents negative impact.

(1) Individual endowment of farmers. It refers to a variety of resources and capabilities possessed by individual farmer. Variables were selected as representatives such as age, gender, educational level, family income level. The assumptions are made: the higher educational level of farmers, the higher family income level, the richer the planting experience, the larger the planting area, and the more inclined to select green pesticides.

(2) Risk preference of farmers. It has a significant impact on the selection of new technologies. The stronger awareness of risk aversion, the less inclined to adopt new technologies (Rogers, 2002). The risk preference of farmers is measured through the following three variables in this paper: the control of pests and diseases in agricultural production, the expected market price of agricultural products and the risk of crop yield reduction. This study assumes that the higher risk preference, the more inclined to choose to buy green pesticides.
(3) Policy support. The main approach to promote green pesticides in China is promoted and controlled by top-down agricultural departments and the policy supports from government have a direct impact on farmers' choices. In this study, two variables, "subsidies for green pesticides promotion" and "government technical support" were selected to reflect the policy support. Assuming that the greater the support from the government, the more inclined to choose to buy green pesticides. The assignment of each independent variable and its direction of influence on peasants' green pesticide selection behavior are shown in Table 1.

3. Analysis of influencing factors of peasants' selection of green pesticide

3.1 Descriptive analysis of samples

The statistical description of each variable is shown in Table 2. Among them, the average value of y is 0.2720, indicating that most farmers are not inclined to choose green pesticides; the average value of the variable x_1 is 2.7541, indicating that the middle-aged and aged population is the main body of rice planting in local area; the average value of variable x_2 is 0.7351, indicating that more farmers are male; the average value of variable x_3 is 1.8264, indicating that the education level of surveyed farmers is generally law, the majority of whom are primary or junior high school diploma; the average value of variable x_4 is 2.8975, indicating that most farmers have more than 15 years planting experience; the average value of variable x_5 is 0.3711, indicating that the cognition of green pesticides of farmers is not high; the average value of variable x_6 is 0.1323, indicating that the majority of farmers have not received the training of green pesticide technology; the average value of variable x_7 is 2.31, indicating that the annual per capita income of farmers is between 4001 and 5500 Yuan; the average value of variable x_8 is 12.21, indicating that the small-scale family farming is still the main rice-farming entity in these three regions; the average value of variable x_9 is 1.78, indicating that most peasants are in good control of pests and diseases in the past three years; the average of x_{10} is 1.45, indicating that most farmers have the expectation that the price of crop is going to increase in the future; the average value of variable x_{11} is 1.12, indicating that the risk of crop yield reduction is small for most farmers in recent three years; the average value of variable x_{12} is 4.4321, indicating that nearly half of the farmers selecting green pesticides have obtained the green pesticide subsidy; the average of x_{13} is 1.321, indicating that the recognition degree of farmers for government policies is not high.

Table 2. Descriptive statistical analysis of variables

Variables	Minimum	Maximum	Average value	Standard deviation
Green pesticide selection behavior (y)	0	1	0.2720	0.4551
age (x_1)	0	3	2.7541	0.7035
gender(x_2)	0	1	0.7351	0.2115
educational level (x_3)	0	3	1.8264	0.3541
planting experience (x_4)	0	3	2.8975	1.3521
cognition of green pesticides (x_5)	0	1	0.4711	0.4712
whether receiving training of green pesticide technology (x_6)	0	1	0.1323	0.3527
household income per capita in previous year (x_7)	0	3	2.31	0.7118
planting area of rice (x_8)	2.1	200	12.21	9.9472
control of diseases and pests in agricultural production (x_9)	0	2	1.78	0.2952
expected market price of agricultural products (x_{10})	0	2	1.45	0.2612
risk of crop yield reduction (x_{11})	0	3	1.12	0.3142
subsidies for promotion (x_{12})	0	10	4.4321	1.9834
government technical support (x_{13})	0	4	1.321	0.5341

3.2 Model selection

Based on the above analysis, this study attempts to establish a binary selection model to analyze the influencing factors of farmers' selection behavior of green pesticides.
Whether farmers select green pesticides= f (individual endowment, risk preference, policy support) + ε_i

In this study, the dependent variable y is a random variable with values of 1 and 0. The independent variable x_1, x_2, ..., x_i. The *Logi* model is:

$\mathrm{Logit(p)} = \mathrm{Ln}(1-\mathrm{p}) = \beta_0 + \beta_1 x_1 +, \ldots, +\beta_i x_i + \varepsilon_1$.

It can be obtained from the conversion of the above formula:

$\mathrm{P(y=1)} = \frac{\exp(\beta_0+\beta_1 x_1+,\ldots,+\beta_i x_i)}{1+\exp(\beta_0+\beta_1 x_1+,\ldots,+\beta_i x_i)}$.

3.3 Analysis and explanation of results

In this study, SPSS16.0 software was used to investigate the influencing factors of peasants' selection of green pesticides and the results are shown in Table 3. The Hosmer-Lemeshow statistic is 8.31, P> 0.05, which shows that the overall fitness of parameter estimation in this model is good. The overall regression results of the equation can be used to explain the influence of various factors on the peasant household's green pesticide selection behavior. The results are as follows:

Table 3. Farmers choose green pesticides influencing factors logit analysis

Item	Regression coefficient (B)	Standard deviation (S.E.)	Chi-square (Wald)	Significance (Sig)
age (x_1)	—0.734**	0.215	4.350	0.035
gender(x_2)	0.147	0.317	0.191	0.701
educational level (x_3)	0.864***	0.311	7.124	0.010
planting experience (x_4)	—0.675**	0.298	5.432	0.023
cognition of green pesticides (x_5)	0.771	0.613	0.718	0.453
whether receiving training of green pesticide technology (x_6)	0.893***	0.687	0.167	0.014
household income per capita in previous year (x_7)	—0.431**	0.279	4.474	0.024
planting area of rice (x_8)	0.196*	0.112	5.12	0.014
control of diseases and pests in agricultural production (x_9)	0.233**	0.537	3.347	0.037
expected market price of agricultural products (x_{10})	1.37**	0.423	0.824	0.041
risk of crop yield reduction (x_{11})	—0.483	0.325	6.732	0.247
subsidies for promotion (x_{12})	—0.117	0.319	2.187	0.155
government technical support (x_{13})	0.412**	0.449	0.432	0.013
constant	—0.161	1.315	0.000	0.712
—2 log likelihood		253.964		
Cox&snell R^2		0.181		
Nagelkerke R^2		0.332		
Hosmer and Lemeshow test		8.31		

Note: *, ** and *** represents the level of significance test passing 10%, 5% and 1% respectively.

According to the results of field survey and statistical analysis, the peasants' selection behavior of green pesticides is affected by three factors: individual endowment of farmers, risk preference and government policy support. In the individual endowment of farmers, the educational level and whether receiving training of green pesticide technology and the planting area have a significant positive impact on farmers' selection behavior; however, age, planting experience and household income have a significant negative impact on farmers' selection behavior of green pesticides; gender and cognition of green pesticides have no significant impact on the selection of green pesticides. In terms of farmers' risk preference, the control of pests and diseases in agricultural production and the expected market price of agricultural products have a positive and significant impact on farmers' selection behavior; the risk of crop yield reduction does not have a significant impact on farmers' selection behavior of green pesticides. In terms of policy support, government technical support has a significant impact on farmers' selection of green pesticides while subsidies for green pesticides have no significant impact on farmers' selection of green pesticides.

Specifically, the educational level has a significant positive impact on farmers' selection of green pesticides and the main reason is that the higher the educational level of farmers, the more emphasis on the learning of

new knowledge, the more likely to recognize the damage of chemical pesticides and the more inclined to use green pesticides. Farmers who have received the training of green pesticide technology are more willing to use green pesticides. The survey shows that "unable to use" is the main constraint for farmers to select green pesticides. The training experience of green pesticide technology can improve farmers' technical skills and enhance farmers' selection behavior. The planting area has a significant impact on the peasant household's selection behavior. The survey finds that large-scale pheasants of rice are more likely to be promoted by the local agricultural departments and they are more likely to obtain green pesticide-related information and technical support for usage. Moreover, large-scale rice pheasants pay more attention to the benefits of agricultural production than small-scale pheasants and they are more willing to accept and use new technologies. Age planting experience and family income have a significant negative impact on the farmers' selection of green pesticides mainly because the local peasants are mainly middle-aged and aged men with rich planting experience and relatively rigid habit of pesticide use. Gender and cognition of green pesticides have no significant impact on farmers' selection behavior. Farmers in the survey area had a lower cognition of green pesticides, so there is no obvious difference between the selection of male and female. In general, a high cognition degree of green pesticides may help to increase farmers' purchasing willingness. However, compared with cognition, the usage barrier of new technologies has a direct impact on farmers' selection behavior.

In terms of farmers' risk preference, the control of pests and diseases in agricultural production and the expected market price of agricultural products have a significant positive impact on farmers' selection of green pesticides. High controllability of pests and diseases in agricultural production and the good market price expectation of agricultural products indicate that the planting risk of peasants is not severe and the motivation for risk aversion is not strong. In general, farmers prefer risks and are more inclined to select new technologies.

In terms of policy support, government technical support has a significant positive impact on farmers' selection of green pesticides, and subsidies for green pesticides have no significant impact on farmers' selection of green pesticides, which shows that farmers pay more attention to the use of technology, and once the usage technology is mastered, the risk of adopting new technology will be greatly reduced and thus they are more inclined to use new technology. The actual survey finds that in terms of subsidies for green pesticides, farmers are more concerned about the actual using effect of pesticides when buying pesticides, and pay less attention to subsidies of green policies. The main reason is that the green benefits of government subsidies are small, and farmers are more concerned about the benefits generated from the actual effectiveness of pesticides, which shows that the consideration of farm for technology is greater than subsidies.

4. Conclusions and suggestions

Based on the above analysis, the conclusions of this study are as follows: 1) the age, educational level, planting area and the effect of green pesticide training in individual endowments have a significant impact on farmers' selection of green pesticides; 2) the risk preference of peasants helps to enhance farmers' selection behavior of green pesticides; 3) direct technical support has a significant impact on farmers' selection of green pesticides. Based on the above analysis, the policy suggestions are as follows:

(A) Pay attention to the difference of individual endowment among farmers and improve the pertinence of technology promotion. The technology promotion in the early stage should focus on farmers with a high degree of education and large-scale pheasants, which can reduce the difficulty of promotion and establish a good demonstration role among farmers. In the later period, emphasis should be placed on farmers with low educational level and small-scale pheasants. With the demonstration effect of farmers with a high degree of education and large-scale pheasants, their concerns for risks can be eliminated, and more farmers can become beneficiaries of green pesticide technology.

(B) Emphasize farmers' psychology of risk aversion and improve the expected return of farmers for the selection of green pesticides. On the macro level, the diversification and sharing mechanism of agricultural risks should be established and improved to improve farmers' ability to cope with risks; specifically, regarding the selection of green pesticides, the related supporting policies on green pesticide promotion should be established, such as setting up green pesticide insurance products to reduce the concerns of farmers and enhance the risk preference level of farmers' selection of green pesticides.

(C) Increase technical support. Only by mastering the using technology of green pesticides, farmers will select green pesticides. The multi-channel and multi-form of technical training should be carried out to enable more farmers to master the using technology of green pesticides. Firstly, importance should be attached to the primary role of grassroots agricultural technology sector in technical training and we should give full play to the technological radiation advantages of grassroots agricultural technicians, providing more direct technical training to more farmers. Secondly, with the help of market forces, we should give full play to the role of sales

in agricultural department in the promotion of new technology. With the help of green pesticide market sales system, the technical promotion can be carried out. We can select excellent agricultural sales staff, providing them with free technical training and influence more farmers; finally, we should give full play to the role of various social organizations in rural areas, such as farmer professional cooperatives and village committees, and extend the promotion path of green pesticide technology through various social organizations.

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