Farming Behavior Analysis of Agricultural Pollution Prevention and Control

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Abstract: Based on 500 samples data of rural farmer households by questionnaire survey and interview, the study empirically analyzes farming behavior mechanism for agriculture related pollution prevention and control, using logistic model of farmer production and living conditions. The study indicates that farmers' education time, policy awareness, technological training experiences, agricultural land use, planting structure, risk attitudes and other social and economic factors are importantly affecting farmers' behaviors. All these involve decreasing agricultural chemical inputs and adopting environment-friendly technologies. It could be helpful to policy-making of appropriate agriculture related environmental economic policies.

1 Introduction

Currently, the agricultural fertilizer, pesticide and film used by farmers have been one of the most serious pollution sources, for water and soil system [1-3]. How to reduce the damage to the environment caused by excessive application of agricultural materials under the premise of ensuring the increase of agricultural production, has become an urgent practical problem [1, 3]. Therefore, practical measures need to be taken for farmers rationally applying agricultural materials and reduce the amount of agricultural materials used. But how to guide the farmers' application behavior effectively? It need be clarified which factors determine the behavior of farmers, and how these factors affect their related behaviors, so the government can formulate relevant policies to control the increasingly prominent agricultural pollution problems. Farmer models have been widely used in many countries to analyze the different responses of farmers' behaviors under the changes of social, economic, market, policy and other factors. The scope of application has been widened from micro level to macro level [4, 5]. The effect of government environmental policy and the realization of agricultural pollution control targets depends to a large extent on farmers' willingness to accept agricultural pollution control policies. In recent years, China has begun to pay attention to the microscopic research on the factors affecting the application of agricultural resources at the farmer level, and studies using farmer models to analyze the production and living behaviors of farmers has also gradually increased, but the systematic investigation and comprehensive research on the socio-economic factors affecting the intensity of agricultural investment and environmental protection from the perspective of farmers are still lacking. In general, the research on agricultural non-point source pollution control policies is still in the exploration stage [6]. Based on the survey data of farmer households, this paper focus on the excessive application of agricultural resources in agricultural production and empirically study the farmers' willingness to reduce the application of agricultural materials, the willingness to adopt environmentally friendly agriculture and its influence factors through statistical analysis. Then this study look for social, economic and policy

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influencing factors affecting the reduction of agricultural resources and their interrelationships, so as to provide decision-making basis for formulating and adjusting policies related to agricultural environmental pollution and ensuring the implementation of policies.

2 Methodology

2.1 Data

The research involves 10 towns and villages in Beijing, Tianjin and Hebei religions. The research takes peasant household as the basic survey unit and obtained a total of 500 samples. Four investigation teams were sent from 10 towns and villages. All the team members were doctoral and master students from Chinese Academy of Sciences, Chinese Academy of Social Sciences, China Agricultural University and Minzu University of China. The investigation team selected 8 villages in each town and each team used the same sampling procedure for the area they surveyed. The farmer survey questionnaire covers a wide range of topics, including: basic characteristics of farmers, characteristics of farmer's cultivated land, crops grown by farmers, aquaculture status of farmers, various inputs purchased, and assets of farmers, farmers' environmental awareness and the variety, quantity, source and organic content of fertilizer purchased by farmers. We mainly investigated the production and consumption conditions of crops in 2017.

2.2 Econometrics

Logistic model is mainly used for regression analysis where the dependent variable is classified variable, and the probability ratio of the classified dependent variable is converted into classified variable by Logistic model. The selection model originated from Fechner's study on animal conditioned binary reflex [7, 8]. In this study, a binary selection model was established to analyze the influencing factors of farmers' willingness to reduce the use of agricultural materials and adopt environmentally friendly agricultural technologies. It is assumed that Xi is the main factor affecting the willingness of farmers to reduce the amount of agricultural resources applied, and P represents the probability of occurrence of an event. The general form of the Logistic model is as follows:

$$\log it(P) = \ln\left(\frac{P}{1-P}\right) \tag{1}$$

$$\ln\left(\frac{P}{1-P}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_m X_m + \varepsilon_i \tag{2}$$

$$-\infty < \ln\left(\frac{P}{1-P}\right) \le \infty \ , \ -\infty < X_i \le \infty \tag{3}$$

$$\log it(P) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_m X_m \tag{4}$$

So: $$\frac{P}{1-P} = \exp(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_m X_m) \tag{5}$$

By sorting out the above equation, we can get:

$$P = \frac{\exp(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_m X_m)}{1 + \exp(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_m X_m)} \tag{6}$$

$$P = \frac{1}{1 + \exp[-(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_m X_m)]} \tag{7}$$

Among them, Xj represents the various factors affecting the reduction of agricultural resources, including social and economic environment factors, characteristics of farmers and other factors. β_j is the average amount of change of logit P when Xj increases or decreases one unit while the other independent variables remain constant. The dependent variable obeys the binomial distribution, so the least squares method cannot be used. The study can estimate the parameters of the model using

the maximum likelihood estimation method.

3 Results

Firstly, all the assumed variables were included in the model for simulation measurement, and then the variables were selected step by step. The final estimation results were shown in the table 1, respectively giving the model regression results. Sig. represents the significance level of Wald tests of different variables. Exp (B) is Odds Ratio, which is the occurrence probability of the dependent variable under certain conditions. It can be used to measure the probability of the change of one unit of explanatory variable to the original occurrence.

From the logistic model estimation results, the model's likelihood ratio test value is 158, indicating the model is reliable. The Hosmer-Lemeshow statistic is 5.394 and the freedom degree is 9, indicating the model fits well and the predicted correct rate is over 85%.

Table 1. Logistic model estimation results of farmers' willingness to reduce

Index	B	S.E.	Wald	E(B)
Farmer's family members	-0.202	0.246	2.575	0.737
Farmer's age	-0.022	0.216	0.576	0.843
Farmer's education period	0.223	0.195	8.421	1.225
National policy recognition	-1.126	0.628	5.006	0.378
Acceptance of agricultural technology guidance	0.894	0.507	2.802	2.369
Farmers' subjective consciousness	2.008	1.089	0.973	2.799
Agricultural land area	-0.132	0.137	0.592	0.899
Real estate	0.049	0.137	1.227	1.121
Planting structure	1.078	0.826	4.613	2.934

4 Conclusions

Based on the sample data of 500 peasant households collected from the Beijing-Tianjin-Hebei regions, this study applies the logistic model to empirically analyze the effect of household characteristics, education status, government technology promotion status, peasant autonomy, family assets, cultivated land and other factors on peasant households' willingness to reduce agricultural pollution.

The Logistic model empirical test results showed that the number of years of education, degree of policy awareness, technical training of farmers, agricultural land area of farmers, planting structure are important factors affecting the willingness of farmers to reduce the amount of agricultural resources [9]. The higher the level of education, the more willing to reduce the use of agricultural supplies on crops. The willingness of farmers to reduce the amount of agricultural resources is also related to the family planting structure, and the attitude of farmers towards risk is also an important factor affecting their willingness. The policy implications are as follows: Agricultural technology education is an important aspect to rationally guide farmers' agricultural application. Grassroots agricultural technology promotion stations and township governments play an important guiding role in the use of agricultural production materials and production technology.

Therefore, relevant policies should be introduced to strengthen the human resources construction of grassroots agricultural extension stations to ensure the technical guidance required by farmers. We should carry on agricultural environmental protection propaganda and skill training to the farmer through various ways, improving their agricultural environmental protection consciousness, agricultural production knowledge and agricultural skill level. In addition, we should build the effective agricultural technology extension service network based on the construction of agricultural technology promotion system, and comprehensively improve the agricultural science and technology level of farmers. Formula fertilization technology based on soil testing (referred to as formula fertilization technology) is an environmentally friendly technology promoted by the United Nations, which helps to alleviate agricultural non-point source pollution caused by excessive fertilizer application. The scientists test the nutrient composition according to the soil sampling, and then specifically produce the formula fertilizer rich in nitrogen, phosphorus, potassium and trace elements, and the farmer purchases and applies the specified formula fertilization according to the recommendation. Since 2005, the Chinese Ministry of Agriculture has organized and implemented a subsidy fund project of formula fertilization, focusing on the promotion of formula fertilization technology based on the soil testing for food crops. However, due to the lack of agricultural subsidy funds and the imperfect soil nutrient detection system, the implementation scope is less than 30% of the cultivated land area, and the degree of adoption by farmers is not satisfactory. Therefore, it is necessary to further strengthen the agricultural science and technology promotion policy, improve the education level of farmers, accelerate the promotion of formula fertilization technology, and fertilize crops in a scientific and reasonable way.

Due to the imperfect social security system, farmers tend to cautiously avoiding various risks, especially low-income farmers who mainly focus on food production [10]. The income from agricultural production is the basic source of income for their family life. Therefore, they will depend on the input of fertilizers, pesticides and other agricultural materials to obtain the enough food and money needed for their family, thus causing excessive fertilization and pesticide application. In the future, we should strengthen the propaganda of policies related to new rural construction, actively improve the rural social security system, and reduce the risks of farmers' living and production, so as to guide farmers to rationally apply fertilizer and apply drugs. Relevant governments should increase the budget for transfer payments in the fiscal sector, grant various forms of subsidies to low-income families in rural areas, and actively encourage low-income farmers to develop non-food crops and non-agricultural production to increase income and actively adjust the agricultural production structure. Besides, governments should encourage them to operate in a variety of ways, and pay more attention to strengthen the training of farmers' skills.

The characteristics of household population and cultivated land have different effects on the reduction of agricultural resources application. On the one hand, we must reform unreasonable policies and regulations, promote the steady flow of rural population to urban and non-agricultural industries, ease the pressure on rural population, and promote the standardized, orderly and rational transfer of rural labor factors. On the other hand, it is necessary to implement a flexible land policy and realize the rational, legal, effective circulation and concentration of land elements.

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