



A Study of the Characteristics of Rural Household Affecting the Behavior of Applying Pesticides

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Submission: April 07, 2016; **Published:** August 05, 2016

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Abstract

Small-scale farmers constitute the main Chinese agricultural production. Based on the investigation and relevant data from 500 small-scale farmers in Jiangsu and Zhejiang Province, this paper analyzes their behavioral characteristics of experience from family, friends and neighbors, education background and cultivation areas have a positive effect on the frequency of applying pesticides, while gender has a negative one. Therefore, farmers should keep on learning to master advanced technology and concept and promote the awareness of safety production. Besides, they also need to improve self-quality, regularize their acts of production and ensure the safe quality of agricultural products from the beginning.

Keywords: Small-scale farmers; Pesticides application; Behavior characteristics; Empirical study

Introduction

Small-scale farmers are the basic unit of the production of agricultural products. The scholar like Ying Xia [1] is the earliest to study farmers. Yunhua Zhang gathers the investigation data of farmers from different places and empirically analyzes the behavior of applying pesticides which influence the quality of agricultural products. Yaogang Zhang argues that production behavior of farmers is the most crucial human factor to the quality of agricultural products. Gilardi Letal declares that farmers play a decisive role in the quality of agricultural products. According to Jianxin Zhao and Zhonggen Zhang [2], farmers are the main subject of the production of agricultural products and it's vital to control the quality of agricultural products at the very beginning.

Li Hao concludes that the key link to manage the quality of agricultural products is farmers' production behaviors. Juan Qiao and Lei Cao studies that farmers' production behaviors are the direct factor to final quality level of products. Xiao feng Zhang illustrates that the main body of Chinese agricultural production is farmers which is also the constitution foundation of micro-economy in rural areas. The key factor of influencing the quality of agricultural products is farmers' supplement behaviors.

Therefore, it's a basic, crucial and significant issue to probe into farmers' behavioral characteristics of applying pesticides and to explore the countermeasures to the problem of agricultural product quality at the very beginning from the perspective of farmers.

Questionnaire Survey

Principles of questionnaire design

Simplicity principle- All the questions in the questionnaire are designed to be simple.

Convenience principle- All the questions in the questionnaire are easy for farmers to answer without too much time of thinking.

Application principle- All the questions in the questionnaire are acceptable and easily understood.

Sample selection

Selection of survey places: Firstly, they are both economically strong and big province. As the economically strong province, their conditions to develop agriculture are richly endowed by nature. Moreover, they have developed economy and residents have high demand for quality of life.

Survey pattern: The formal questionnaire is modified and determined on the basis of the preliminary research in Wuxi. Taking into consideration the differences of dialects, local college students who are heading to their hometown are invited to help conduct this survey. To make sure the authenticity and validity of the questionnaires, direct interview is adopted. Investigators ask questions and farmers answer them and fill in the questionnaires on the spot. The number of questionnaires randomly distributed in Nantong, Fengxian and Wuxi in Jiangsu province was 320 while that of Anji in Zhejiang province was 180. Five hundred farmers related to tea, vegetables, rice and apples were selected

[3]. The interviewees may not be heads of household, but they must be the ones that apply pesticides. The number of final valid questionnaires was 473.

Construction of Model

Establishment of empirical model

Multiple regression analysis has already been widely applied to the social sciences research. The behaviors, attitudes and preferences to be studied are qualitative. To explore the factors influencing these decisions or actions, Logistic regression is applied to multiple regression analysis of non-continuous variable. The establishment of empirical model:

The prototype of Logistic function is:

$$P = \frac{L}{1 + \exp[-(a + bt)]} \dots\dots\dots(1)$$

In pattern(1), $\exp[bt] = e^{bt}$, t means time, P means the number of population in t, L is the maximum limiting value, a and b both mean relevant parameter. Based on the requirement of nonlinear probabilistic model, P is transformed into the probability $p=p(y=1)$, and the upper limit is changed into 1, with the value of set probability in the reasonable range (0, 1). The independent variable may be not the t, so t can be changed into any independent variable x whose range has no limitation. The logistic probability function can be reached:

$$P = \frac{1}{1 + \exp[-(a + bx)]} \dots\dots\dots(2)$$

(2) can be transformed into:

$$P = \frac{1}{1 + \exp[b(-a / b + x)]} \dots\dots\dots(3)$$

On this basis, the multiple analysis of logistic probability function can be done with more input independent variables. $\sum b_k x_k$ Means the multiple linear combination $a + b_1x_1 + b_2x_2 + b_3x_3 + \dots + b_kx_k$ b_0 means constant term a. If is constantly equal to 1, $z = \sum b_k x_k$, then logistic probability function can be:

$$P = \frac{1}{1 + \exp(-\sum b_k x_k)} = \frac{\exp(z)}{1 + \exp(z)} \dots\dots\dots(4)$$

The pattern 4 can be transformed with a series of :

$$p[1 + \exp(z)] = \exp(z) \dots\dots\dots(5)$$

$$p + p * \exp(z) = \exp(z) \dots\dots\dots(6)$$

$$p = (1 - p)\exp(z) \dots\dots\dots(7)$$

$$\frac{p}{1 - p} = \exp(z) = \exp(\sum b_k x_k) \dots\dots\dots(8)$$

Take the logarithm of (8) from two sides, then

$$\ln \frac{p}{1 - p} = z = \sum b_k x_k \dots\dots\dots(9)$$

Logistic regression common form (10) can be reached with logistically transforming (9):

$$\logit(p) = \sum b_k x_k \dots\dots\dots(10)$$

Because the behavior of applying pesticides is complicated and units of measurement and varieties cannot be integrated, the big gap between varieties and prices curtails only when the survey data of using pesticides is accurate. The dependent variable used in the paper refers to the frequency of actually utilizing pesticides [4]. To inspect the significance of each factor affecting the frequency, dichotomy Logistic regression model is adopted (Table 1). The Logistic regression equation is:

$$Wald = \left(\frac{B}{S.E.}\right)^2 = \left(\frac{\hat{\beta}_j}{\sqrt{D(\hat{\beta}_j)}}\right)^2 \dots\dots\dots(11)$$

Table 1: The chart of variables paraphrase.

Variable	Name of Variable	Variable Definition
X ₁	Government policy	1=relevant policy;0=no relevant policy
X ₂	Training accepted or not	1=yes;0=no
X ₃	Experience from family, friends and neighbors	1=acceptable; 0=not acceptable
X ₄	Gender	1=male; 0=female
X ₅	Age	1=below 50 years old; 0=above 50 years old
X ₆	Education background	1=below 9 years; 0=above 9 years
X ₇	Income of family	1=above 3ten thousand; 0=below 3 ten thousand
X ₈	Cultivation areas	1=above 5acre; 0=below 5acre

Calculation of model

S.E. is short for Std. Error, which means the standard deviation of regression coefficient estimated value. Wald is the statistical value of regression coefficient test.

$$\logit(p) = \ln \frac{p}{1 - p} = b_0 + b_1x_1 + b_2x_2 + \dots + b_kx_k \dots\dots\dots(12)$$

Sig is Wald test significance probability. With SPSS software, backward condition step wise regression is adopted to conduct logistic regression calculation.

Table 2: Variables in the Equation(1).

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1a	X ₁	.027	.230	.014	1	.907	1.027
	X ₂	.149	.274	.296	1	.586	1.161
	X ₃	-.424	.248	2.930	1	.087	.654
	X ₄	.483	.263	3.383	1	.066	1.621
	X ₅	-.051	.229	.049	1	.826	.951
	X ₆	-1.599	.629	6.466	1	.011	.202
	X ₇	-19.753	28421.020	.000	1	.999	.000
	X ₈	-.444	.276	2.574	1	.109	.642
	Constant	20.904	28421.020	.000	1	.999	1.199E9

From (Table 2) above, the variable “family income” is not obvious, so it was rejected. The remaining independent variables were regressed, the variable “government policy” was not obvious, so it was rejected. And then the variable “age” was rejected, the variable “training accepted or not” is also rejected. At last, the remaining independent variables are regressed, which shows the variable “experience from family, friends and neighbors, gender, age, education background, income of family, cultivation areas” is obvious (Table 3).

Table 3: Variables in the Equation(2)

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1 ^a	X ₃	-.433	.244	3.155	1	.076	.649
	X ₄	.478	.261	3.356	1	.067	1.612
	X ₆	-1.550	.620	6.253	1	.012	.212
	X ₈	-.454	.274	2.735	1	.098	.635
	Constant	1.354	.951	2.026	1	.155	3.874

Table 4: Variables in the Equation(2).

	Observed		Predicted		
			Yes		Percentage Correct
			1.00	2.00	
Step 1	Yes	1.00	275	0	100.0
		2.00	119	0	.0
	Overall Percentage				69.8
a. The cut value is .500					

Variable(s) entered on step 1: experience from family, friends and neighbors, gender, age, education background, income of family, cultivation areas (Table 4).

Result and Analysis

Through calculation, the logistic model of influencing factors of applying pesticides is:

$$\text{logit}(p) = 1.354 - 0.433X_3 + 0.478X_4 - 1.55X_6 - 0.454X_8 \dots\dots\dots(13)$$

From the model above, it is obvious that there are four factors affecting farmers’ choices of pesticides [5]. They are experience from family, friends and neighbors, gender, education background, and cultivation areas.

The more experience gained from family, friends and neighbors, the less frequency farmers apply pesticides. The frequency of farmers’ experience attained to apply pesticides reduces by 0.433 than those who do not get it. The higher the education level is, the less frequency farmers apply pesticides. The frequency that farmers who are well educated apply pesticides reduces by 1.55 than those who are not.

The bigger the cultivation areas are, the less frequency farmers apply pesticides. The frequency that farmers who have

bigger cultivation areas apply pesticides reduces by 0.454 than those who own smaller ones. Gender is a very important factor and perhaps in rural areas, men get much more education than women, so the frequency that men apply pesticides reduces by 0.478 than women.

Conclusions and Policy Implication

Based on the cases in Jiangsu and Zhejiang Province, the main conclusions and policy implication include:

The behavior of applying pesticides is related to farmers’ gender, schooling years and experience from family, friends and neighbors, which illustrates that the three factors have apparent impact on the behavior and they are the essential characteristics of it.

Therefore, improving all farmers’ education level is the fundamental countermeasure to thoroughly solve the hidden danger of the quality of agricultural products from the very beginning. In the future, the new rural construction process should increase the input of popularizing agricultural technology system [6].

The cultivation areas and family features also influence the behavior in different degrees. The frequency of applying pesticides has negative correlation with the cultivation areas. The policy implication is that in the rural deepening reform, on the basis of respecting farmers’ will the land circulation of moderate scale can reduce the blindness of the behavior of applying pesticides.

Acknowledgement

This paper was supported by the 2010 Humanities and Social Sciences Project of Education Ministry “ Farmers’ Using Behaviors of Pesticides, Research of the Plant Scale and Export Quality of Agricultural Products” (10YJC790240); 2011 Nantong University, Initial Funding of Social Science Ph.D. (03080294); 2011 Social Science Foundation Project of Nantong “The Research of the Structural Transformation of Export Products under the View of Low-carbon Economy in Nantong “ (2011CNT003); Jiangsu Provincial Department of Education.

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