



Study on the Influencing Factors of Farmers' Purchase Behavior of Organic Fertilizers Based on Logistic Model

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Authors' contributions

This work was carried out in collaboration between both authors. The author LL designed the research, carried on the statistical analysis, compiled the research plan and wrote the first draft. The author SYM was responsible for the study analysis. Both authors read and approved the final manuscript.

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ABSTRACT

The widespread use of chemical fertilizers has played an important role in China's agricultural development, but with the increasing input of chemical fertilizers, it has caused serious impact on the ecological environment, leading to agricultural non-point source pollution, food safety and many other problems. In order to promote the sustainable development of agriculture, China has issued a series of policies to popularize organic fertilizer in agriculture, which can not only improve the quality of agricultural products, promote agricultural production and increase income, but also make resource utilization of urban and rural organic wastes and protect the environment. Farmers are the main force of agricultural production and also the main body of rural environmental protection. It is of great significance to study farmers' ecological behavior. Through a survey of 407 farmers in the surrounding areas of Chengdu, Sichuan Province in 2019, and the logistic model constructed based on the survey data, this article analyzed the factors influencing farmers' behavior in purchasing organic fertilizer. The results show that 12 indexes such as farmers' gender, education level, and the number of family farmers are the main factors influencing farmers' purchase of organic fertilizer. At the end, the article puts forward relevant policy recommendations to guide farmers to purchase and apply organic fertilizer.

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1. INTRODUCTION

China is an ancient agricultural country, organic fertilizer occupies an extremely important position in Chinese traditional agricultural production. The history and reality of traditional agriculture relying on the application of organic fertilizer to obtain high yield and high quality agricultural products have provided rich experience for the development of agriculture in the world, but the history involving commercial organic fertilizer is only ten years [1]. In recent years, the universal use of chemical fertilizer has played an important role in increasing agricultural production and income, and the contribution rate to world crop production increase has reached over 50% [2]. However, with the increasing of chemical fertilizer input, the phenomenon of using more chemical fertilizer than organic fertilizer has appeared, and the increase rate of chemical fertilizer is gradually reduced. In addition, the excessive use of chemical fertilizer has serious effects on soil, water resources, atmosphere and ecological environment, which leads to many problems such as non-point source pollution and food safety in agriculture in China. The rational use of organic fertilizer can not only improve the quality and increase production of agricultural products, but also cause no affect the agricultural products and the surrounding environment, and can resourcefully use livestock and poultry manure, straw, domestic silt and other urban and rural organic wastes as a substitute for chemical fertilizer and support the sustainable development of agriculture [3]. In recent years, with the policy of "Reduction of Fertilizer and Pesticide" and "Organic Fertilizer Substitution ", it is urgent to promote the development of organic fertilizer industry in face of the problems of large amount of chemical fertilizer application and serious agricultural non-point source pollution [4]. As the final consumer of organic fertilizer products and services, farmers' purchase behavior fundamentally determines the production and consumption of organic fertilizer industry chain, and has a vital impact on the development of organic fertilizer industry. It is of great significance to clarify the influencing factors of organic fertilizer purchase behavior for the promotion and use of organic fertilizer.

This paper takes farmers' purchase behavior of organic fertilizer as the research object. Through questionnaire survey, logistic model is used from

five aspects: farmers' personal characteristics, family business characteristics, farmers' cognition of organic fertilizer, purchase decision variables and external factors to analyze the influencing factors and behavior mechanism of farmers' organic fertilizer purchase behavior in and around the Chengdu Plain - the main grain producing area of Sichuan Province. And then put forward reasonable suggestions for the promotion of organic fertilizer and policy improvement. The contribution of this study is that, at present, the domestic research on the purchase behavior of organic fertilizer by farmers in Sichuan region is still in a blank state. Starts from the micro subject of the farmers, through the field research, this paper makes a more detailed understanding of the farmers' family planting situation, fertilizer application and other aspects. The theoretical analytical framework for the behavior of farmers purchasing organic fertilizer is constructed, and the factors influencing farmers' purchase of organic fertilizer are comprehensively analyzed using a measurement model approach, which is a useful addition to the empirical analysis of organic fertilizer promotion in China.

The remainder of the study is organized as follows: section two presents a review of the literature, section three analyzes the factors influencing farmers' behavior in purchasing organic fertilizer, section four presents the data sources and basic characteristics of the sample, section five conducts an empirical analysis and discusses the results, and section six draws conclusions and limitations of the study.

2. THEORETICAL BASIS

Farmers are the basic economic organization units in rural areas and limited rational economic people. Rural household behavior refers to the various choices made by rural households in rural economic activities and life in order to maximize their own and family utility or profit. As a representative of the school of rational peasants, the American economist Theodore Schultz follows the Western economics "economic man" point of view, that the small farmer has the same "rational" with other microeconomic subjects, the small farmer will moderate the use of resources, make a rational analysis on market changes and conduct agricultural activities with the goal of maximizing profits [5]. This view is also accepted by most

economists. However, the rural households behavior in a commodity economy is certainly different from that of subsistence households, generally speaking, any rural household is in pursuit of its own "utility maximization", while the behavior of rural households is influenced by natural, social, economic, cultural and many other factors. Therefore, different farmers' decision-making behaviors are all generated under certain environmental conditions and have some existential rationality. According to Posselt and Gersnter [6], farmer purchase is a kind of lock-in purchase behavior, i.e., a long-term purchase of a brand of products or multiple visits to a store without in-depth information collection, which is characterized by habitual or repetitive behavior, rapid and low-intervention purchase. Abdoulay et al. [7] used the Tobit model to analyze the fertilizer application behavior of farmers in Niger, Africa, and showed that the price of fertilizer had a negative effect on their fertilizer application behavior, while farmers' knowledge of fertilizer and total household income had a positive effect, and the effect of cultivated area was not significant. Jiang Bo [8] conducted a study on the potential influences on the acquisition of agricultural machinery, farmers in Anhui, Jiangsu, Xinjiang, and Shanxi provinces were selected as research subjects and their willingness to purchase agricultural machinery was analyzed quantitatively, the results showed that factors such as farm household income level, land management scale, number of family laborers, and macro policies had a significant impact on their willingness to purchase agricultural machinery. Li Weinan [9] used the logit model to empirically analyze the purchase behavior of farm machinery by farmers in the hilly areas of the middle and lower reaches of the Yangtze River, and concluded that education level, income level, Family-run acreage, and subsidy policy are the main influencing factors. Based on the research data of 863 farmers in 5 provinces, Jiang Lina and Zhao Xia [10] used the Bivariate Probit model to conduct a comparative study of the main factors affecting farmers' willingness to purchase green pesticides and their actual purchase behavior, and found that the awareness of the government's ban on pesticides, knowledge of green, pollution-free and organic products, and gender had a significant impact on farmers' willingness to purchase green pesticides and their behavior. Qu Kaixin [11] found that the influencing factors of whether farmers buy organic fertilizer in the Northeast Black Soil Zone of China were the age of family decision makers,

the degree of satisfaction with service, the understanding of organic fertilizer, the distance between cultivated land and home, and the quality of land, etc. At present, in terms of the comprehensive activities of the optimal allocation of production factors of farmers, although a large number of scholars have conducted research on the purchase behavior of production factors of farmers, but most of them focus on agricultural machinery, pesticides, fertilizers, seeds and other agricultural capital and agricultural insurance. Few studies have focused on farmers' purchase and application behaviour of commercial organic fertilizers. Yang Yongbing et al. (2012), Yu Zhihui (2012), Gong Meng et al. (2013) [12-14] and other scholars have developed certain research results through certain surveys and studies, which suggest that arable land area, education level, gender, fertilizer application experience, household income, and perception of fertilizer, social network, and price and quality of fertilizer have an impact on farmers' purchase and application behavior.

3. ANALYSIS OF FACTORS INFLUENCING THE BEHAVIOR OF FARMERS IN PURCHASING ORGANIC FERTILIZERS

In this paper, we take the basic theory of farmers' behavior of the school of rational peasants for the study of farmers' behavior in purchasing organic fertilizer, and draw on the research results of domestic and foreign scholars on related aspects, to classify the factors influencing Chinese farmers' purchase of organic fertilizer into five major categories: farmers' personal characteristics, family business characteristics, farmers' cognitive characteristics of organic fertilizer, decision variables for purchasing organic fertilizer, and external factors.

3.1 Personal Characteristics of the Farmer

As the main body of agricultural production, the personal characteristics of the head of household will affect the purchase and application of organic fertilizer. Based on the study of Nunez, Chen Li Ding et al. and Fu Xinhong and Zhu Liqun et al. [15-18], the paper argues that age, gender, education level and time spent on farming by household decision makers are the main factors that describe the personal characteristics of farmers. There are physiological and psychological differences among farmers of

different ages, which leads to different views on organic fertilizer. In general, the older the farmer, the more conservative his or her thinking, and the lower his or her physical strength, the less willing he or she is to buy organic fertilizer. Gender differences also affect farming decisions, with men being more adventurous and willing to try new things. The level of education of the farming household will have an impact on the behavior of the farming household too, the higher the level of education, the broader the vision of agricultural production, the better the ability to collect market information, accept and understand knowledge. At the same time, with the increase in farming time of the head of the household, fertilizer application experience is richer, more sensitive to the negative impact of increasing the application of chemical fertilizers, which may improve the willingness of farmers to apply organic fertilizers; however, if there is inertia thinking of farmers to strive for "short-term benefits", that may increase the amount of chemical fertilizer application to achieve the purpose of increasing production. Therefore, this paper assumes that age is negatively related to organic fertilizer purchase, positively related to gender and education level, while the correlation of time spent on farming by household decision makers cannot be determined.

3.2 Family Business Characteristics

Individual farmers in the process of choosing whether to apply organic fertilizer will be fully considered in the family business risk, expected returns and other factors, under different conditions of risk expectations, the willingness and tendency of farmers to apply organic fertilizer is different. According to the research of Liu Mei, Cai Rong, Shi Changliang, Zhang Chi, Zheng Bin [19-23] and other related documents, the paper holds that the number of family farmers, family income, the main source of family income, the area of cultivated land, the quality of cultivated land and the situation of field roads are the main factors to describe the characteristics of household management. In general, the greater the number of labourers engaged in farming in a household, the more likely it is that the head of the household will choose a fertilizer application program which will result in greater long-term gains for the household; however, in the short term, as the household size increases, the household's daily expenditure increases, and if the household wants to increase its income as soon as possible, it may increase its production and income through the use of chemical

fertilizers rather than investing more money in the use of organic fertilizers. Since the application of organic fertilizers may cause a decline in food production in an earlier stage and consequently in farmers' incomes, only an increase in household incomes will enable farmers to have sufficient financial resources to withstand the risks associated with the application of organic fertilizers. With the expansion of employment channels, farmers have been provided with more and more off-farm job opportunities, the increase in off-farm income makes it difficult for farmers to increase their enthusiasm for agricultural inputs and do not pay attention to the maintenance of land productivity; while farmers whose main income is agriculture are more likely to use organic fertilizers in order to maintain soil fertility and ensure product quality. As the most important factor of production in farming, the more land a farmer owns means that he or she is likely to start a scale operation. The scale operation can increase productivity, reduce production costs and facilitate the use of organic fertilizers by farmers. The different in quality of arable land determines whether farmers will apply organic fertilizer to protect the soil to maintain the sustainability of agricultural production. At the same time, if the roads in the field are suitable for the transport of organic fertilizer, there will be higher likelihood that farmers will buy and apply organic fertilizer. Therefore, this paper assumes that household income, household's main source of income, cultivated area, and field road condition are positively related to organic fertilizer purchase, while the correlation between the number of household farmers and the quality of cultivated land cannot be determined.

3.3 Characteristics of Farmers' Cognition of Organic Fertilizers

Theoretically speaking, with a higher level of education, the farmers will have a higher cognitive level of chemical fertilizers and organic fertilizers, a more profound understanding of organic fertilizers can not only improve the quality level of agricultural products, but also to achieve the purpose of increasing production. Based on the study of Liu Mei, Li Liangke, Zuo Zheyu, Wang Jingjing, and Yu Weizhen et al. [24-28], the paper considers the cognition of green, pollution-free or organic agricultural product, knowledge of organic fertilizers, and the convenience of applying organic fertilizers are the main factors describing the characteristics of farmers' perceptions of organic fertilizers.

Generally speaking, with the increasing demand for green products, farmers will apply organic fertilizer to improve the taste of agricultural products, thus increasing sales and sales prices. And as farmers learn more about the quality, quantity, dosage, application and nutrient content of organic fertilizer products, the possibility of them purchasing organic fertilizer will increase. In the meantime, if the more convenient it is to apply organic fertilizer, the higher the likelihood that farmers will purchase organic fertilizer. Therefore, this paper assumes that the cognition of green, non-polluting or organic agricultural products, comprehensive degree of organic fertilizers, and convenience of application of organic fertilizers are positively related to organic fertilizer purchase.

3.4 Decision Variables for Purchasing Organic Fertilizer

Farmers mainly consider the price and effect of organic fertilizer when buying organic fertilizer. Based on the study of Dong Xitao [29] and other related documents, the paper holds that farmers' perception of the price of organic fertilizer and farmers' satisfaction with the effect of organic fertilizer can be used as decision variables for farmers to buy organic fertilizer. Demand theory in traditional economics holds that when other factors affecting the demand for a commodity are held constant, price and demand are inversely proportional, farmers will make rational decisions in pursuit of profit, and the likelihood of buying organic fertilizer is high only if they believe that the price of organic fertilizer is reasonable. Similarly, only if farmers are satisfied with the application of organic fertilizer to improve soil fertility, increase the quality of production, increase income and other effects, then the likelihood of buying organic fertilizer will increase. Therefore, this paper assumes that farmers' perception of the price of organic fertilizer and farmers' satisfaction with the effectiveness of organic fertilizer are positively related to organic fertilizer purchase.

3.5 External Factors

Farmers' fertilizer purchase and application behavior can be influenced by a combination of personal, economic, social, and psychological factors. Based on the research of Feder, Yan Lu, Tao Qunshan, Tao Junsheng, Yang Yurong, Li Kongqing, He Lijuan [30-36] and other related documents, the paper holds that the degree of influence of the surrounding environment on

fertilizer application behavior, whether or not to join a rural cooperative, whether or not to know the national policy related to organic fertilizer, the satisfaction of organic fertilizer supplier services, and whether or not to receive technical guidance during the application of organic fertilizer could be the main external factors that influenced farmers' purchase of organic fertilizer. Most farmers are path dependent on the purchase and use of fertilizer, and if the information about farmers comes from surrounding farmers, then this neighborhood effect will lead farmers to change their fertilizer application habits. Rural cooperatives, as an important part of the agricultural science and technology extension system, plays an important role in the promotion of organic fertilizers. Rural cooperatives provide their members with market and scientific and technical information on organic fertilizers through SMS and the Internet, or hire experts to guide them and conduct training courses, all of which can help to increase farmers' willingness to apply organic fertilizers. With the increase in government policy support, the higher the level of subsidies on organic fertilizer, farmers are more inclined to be willing to apply organic fertilizer. If organic fertilizer suppliers strengthen technical support and guidance on the application of organic fertilizer and improve farmers' application satisfaction, this may stimulate farmers' willingness to buy organic fertilizer. At the same time, technical guidance on fertilizer application can help farmers understand the necessity of proper selection of fertilizer and scientific planting, thus promoting the purchase of organic fertilizer by farmers. Therefore, this paper hypothesizes that the degree of influence of the surrounding environment on fertilizer application behavior, membership in a rural cooperative, knowledge of national organic fertilizer-related policies, satisfaction with organic fertilizer supplier services, and receipt of technical guidance during organic fertilizer application are positively related to organic fertilizer purchase.

4. DATA SOURCES AND BASIC CHARACTERISTICS OF SAMPLES

4.1 Data Sources

The data used in this paper comes from a sample survey of farmers in three cities of Chengdu, Deyang, and Mianyang in the main grain-producing region of Chengdu Plain, Sichuan Province, from May to December 2019 by the research team. The survey was conducted face-to-face between investigators and farmers, and when judging the validity of the questionnaire, incomplete

questionnaires and obviously unreasonable answers were regarded as invalid questionnaires, and 330 of the 407 questionnaires obtained were valid, with an effective questionnaire of 81.1%.

4.2 Basic Characteristics of the Sample

The majority of farm households in the sample area were male, with the age concentrated in the 25-65 age group, accounting for 84% of the total; those engaged in agricultural production in the countryside were mainly middle-aged and elderly farmers; the level of education was relatively low, concentrated in educational levels below junior high school, accounting for 70.6% of the total; the duration of farming was generally long, with those who had been farming for more than 20 years accounting for 59.1% of the total. The number of farming families working in agriculture was concentrated between three and five people, accounting for 47.3%; as some of those surveyed were earning income from professional farm management through rural land circulation and individual families also had non-agricultural income, the proportion of families with an annual income of more than 40,000 was the highest. The number of farming households who have 0.67-1 hm² of arable land is the highest of 48.5%; land quality is generally above the medium level, and the construction of field roads is generally in good condition. The farmers have a general understanding of green, pollution-free, organic agricultural products and organic fertilizers, and most of them think that organic fertilizers are unreasonably priced, inconvenient to apply, and unsatisfactory in application. They expressed their willingness to buy more organic fertilizers if the government could give more policy subsidies for the use of organic fertilizers and receive guidance on fertilization techniques.

5. EMPIRICAL ANALYSIS

5.1 Research Methods

Whether farmers choose to buy organic fertilizer is a binary variable, the dependent variable has only two outcomes, namely, unwillingness and willingness, therefore, this paper uses the logitstic model to measure and analyze the factors influencing farmers' organic fertilizer purchase behavior.

The basic form of the binomial logistic model is as follows:

$$\ln\left(\frac{P}{1-P}\right) = \alpha + \sum_{k=1}^n \beta_k x_k + u$$

Where, P is the probability of buying organic fertilizer, α is the regression intercept, μ is the random disturbance term, X_k is the kth influencing factor, and β_k is the regression coefficient of the kth influencing factor.

5.2 Variable Selection and Description Assignment

Based on the construction of theoretical model , " whether farmers are willing to buy organic fertilizer "is regarded as dependent variable, and" influencing factors that may affect farmers' purchase behavior "as independent variables, including farmers' personal characteristics, family business characteristics, farmers' perception of organic fertilizer, purchase decision variables, external factors, five aspects of 20 factors, specific variables and the expected direction as shown in Table 1.

5.3 Results and Analysis

In this paper, the cross-sectional data obtained from 330 questionnaires were analyzed by logistic model using SPSS17.0. The reliability test resulted in a Cronbach's Alpha coefficient of 0.821, indicating that the questionnaire has a high reliability and a more accurate design. Excluding the questionnaire entries that select categorical adjustment variables such as age and gender. The validity test only select potential variables and shows that the KMO value is 0.849, and the corresponding value of the spherical test is close to 0, which indicates that the data validity effect is satisfactory. The rate of total variance explained is greater than 70%. So the extracted principal components/factors have good explanatory power to the original variables. According to the estimated results of the model, the factors influencing farmers' purchase behavior of organic fertilizer are shown in Table 2. From the model results in the above table, it can be seen that the 12 variables of gender, education level, number of family farmers, total household income, cultivated land quality, understanding of organic fertilizer, convenience of applying organic fertilizer, rationality of organic fertilizer prices, knowledge of national organic fertilizer-related policies, service satisfaction of organic fertilizer suppliers, and whether or not they have received technical guidance in the process of applying organic fertilizer will have a statistically significant impact on whether or not

Table 1. Specific variables and expected directions

Category	Explanatory variables	symbol	Assignment and variable definition	Expected direction
	Dependent variable			
	Purchase of organic fertilizer	Y	0=Not purchased; 1=Purchased	
	Independent variable			
Individual characteristics of farmers	Age(years old)	X ₁	1=under 25; 2=25-45; 3=45-65; 4=over 65	-
	Gender	X ₂	1=female, 2=male	+
	Education level (years)	X ₃	1=primary and below, 2=middle school, 3=high school, 4=College or above	+
	Farming time	X ₄	1=less than 5; 2=6-10; 3=11-15; 4=16-20; 5=more than 21	+/-
	Number of family farmers	X ₅	1=less than 3; 2=4-6; 3=7-10; 4=11-20; 5=more than 21	+/-
	Total household income (RMB)	X ₆	1=less than 8000; 2=8000-20,000; 3=20,000 to 30,000; 4=30,000 to 40,000; 5=more than 40,000	+
	Main sources of household income	X ₇	1=Non-agricultural production, 2=agricultural production	+
	Agricultural acreage	X ₈	1=less than 0.67 hm ² ; 2=0.67 hm ² -3.33 hm ² ; 3=3.33 hm ² -6.67 hm ² ; 4=6.67 hm ² -13.3 hm ² ; 5=more than 13.3 hm ²	+
Family business characteristics	Cultivated land quality	X ₉	1=poor, 2=medium, 3=good	+/-
	Convenient access from home to the field	X ₁₀	1=strongly disagree, 2=disagree, 3=unsure, 4=agree, 5=strongly agree	+
	Cognitive level of green, pollution-free or organic agricultural products	X ₁₁	1=very little, 2=little, 3=some, 4=much, 5=very much	+
Farmers' cognition of organic fertilizer	Understanding of organic Fertilizer	X ₁₂	1=very little, 2=little, 3=some, 4=much, 5=very much	+
	Convenience of organic fertilizer application	X ₁₃	1=strongly disagree, 2=disagree, 3=unsure, 4=agree, 5=strongly agree	+
Purchase decision variables	Rationality of organic fertilizer prices	X ₁₄	1=strongly disagree, 2=disagree, 3=unsure, 4=agree, 5=strongly agree	+

External factor	Satisfaction level with the effectiveness of organic fertilizer	X ₁₅	1=strongly disagree, 2=disagree, 3=unsure, 4=agree, 5=strongly agree	+
	Influence of environment on fertilization behavior	X ₁₆	1=strongly disagree, 2=disagree, 3=unsure, 4=agree, 5=strongly agree	+
	Whether participate in rural cooperatives	X ₁₇	1=no, 2=yes	+
	Knowledge of national organic fertilizer-related policies	X ₁₈	1=very little, 2=little, 3=some, 4=much, 5=very much	+
	Service satisfaction of organic fertilizer suppliers	X ₁₉	1=very dissatisfied, 2=fairly dissatisfied, 3=satisfied, 4=fairly satisfied, 5=very satisfied.	+
	Whether received technical guidance on the application of organic fertilizers	X ₂₀	1=no, 2=yes	+

Table 2. Logistic Model Estimation results of Influencing Factors of Organic Fertilizer Purchase by Farmers

Variable	B	S.E	Wald	df	Sig.	Exp (B)
Individual characteristics of farmers variables						
Age(X ₁)	-0.203	0.220	0.847	1	0.357	0.817
Gender(X ₂)	0.468	0.258	3.304	1	0.069*	1.597
Education level (X ₃)	0.702	0.148	22.428	1	0.000***	2.017
Farming time(X ₄)	-0.122	0.189	0.419	1	0.517	0.885
Family business characteristics variables						
Number of family farmers(X ₅)	0.590	0.272	4.711	1	0.030**	1.746
Total household income(X ₆)	0.557	0.097	32.944	1	0.000***	1.746
Main sources of household income(X ₇)	0.348	0.251	1.923	1	0.166	1.416
Agricultural acreage(X ₈)	-0.041	0.180	0.052	1	0.819	0.960
Cultivated land quality(X ₉)	0.424	0.178	5.672	1	0.017**	1.527
Convenient access from home to the field(X ₁₀)	0.079	0.101	0.610	1	0.435	1.082
Farmers' cognition of organic fertilizer variables						
Cognitive level of green, pollution-free or organic agricultural products(X ₁₁)	0.639	0.446	2.059	1	0.151	1.895
Understanding of organic Fertilizer(X ₁₂)	1.114	0.437	6.515	1	0.011**	3.407
Convenience of organic fertilizer application(X ₁₃)	4.519	0.696	42.196	1	0.000***	91.763
Purchase decision variables						
Rationality of organic fertilizer prices(X ₁₄)	0.724	0.288	6.301	1	0.012**	2.062
Satisfaction level with the effectiveness of organic fertilizer(X ₁₅)	0.335	0.228	2.169	1	0.141	1.398
External factor variables						
Influence of environment on fertilization behavior(X ₁₆)	0.229	0.145	2.488	1	0.115	1.257
Whether participate in rural cooperatives(X ₁₇)	0.259	0.154	2.832	1	0.092*	1.295
Knowledge of national organic fertilizer-related policies(X ₁₈)	1.633	0.619	6.996	1	0.008***	5.120
Service satisfaction of organic fertilizer suppliers(X ₁₉)	0.131	0.064	4.255	1	0.039**	1.140
Whether received technical guidance on the application of organic fertilizers(X ₂₀)	0.569	0.296	3.678	1	0.055*	1.766
Constant	-5.712	0.786	52.849	1	0.000	0.003

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

Source: calculated from research data

farmers buy organic fertilizer, which are explained as follows:

5.3.1 Characteristic analysis of individual farmer

Of the four variables regarding the personal characteristics of the farmer, gender (X₂) passed

the test with a positive coefficient at the 10% level. Men are more likely to buy organic fertilizer, which may be due to the fact that men are more unafraid of dirt and odor than women. Also, men's advantages in terms of physical fitness, etc. and their focus on the sustainability of the land make them more energetic and willing to engage in the act of

buying and applying organic fertilizer. Educational level (X_3) passes the test at the 1% level with a positive coefficient. It shows that the more educated the farmers are and the more new knowledge they accept, the higher their level of knowledge about chemical and organic fertilizers, thus they are more able to understand the uses, efficacy, advantages and deficiencies of chemical fertilizers, and the more motivated they are to develop land fertility with organic fertilizers. Age and time spent in farming did not pass the test of significance on whether farmers bought organic fertilizer, indicating that these two factors were not the main influences on whether farmers bought organic fertilizer or not.

5.3.2 Characteristic analysis of farm family businesses

The regression results showed that the coefficients of agricultural number (X_5), total household income (X_6) and cultivated land quality (X_9) is 5%, 1% and 5% respectively, and the coefficients were positive. In general, an acre of land with 200-300kg refined organic fertilizer will cost 200-400 yuan; and an acre of land with about 30-40kg chemical fertilizer will cost 80-100 yuan. Therefore, to achieve essentially the same fertilization effect, the volume and weight of organic fertilizers applied increases compared to chemical fertilizers, and the cost of transportation increases at the same time. The increase in the number of people working in farming households has provided labor security for the application of organic fertilizers and has relatively reduced labor costs. At the same time, with the higher household income of farmers, on the one hand, they have the ability to buy relatively high prices of organic fertilizer; on the other hand, due to the slow release of organic fertilizer efficiency, resulting in lower income of farmers in the early stages, while the increased income can provide them financial security thereby improving their ability to resist risks. The correlation between the quality of farmland and the purchase of organic fertilizer is positive, i.e., the better the quality of the land, the more importance farmers attach to conserving good quality soil, thus the more they apply organic fertilizer, therefore the higher their willingness to purchase. The household's main source of income, area of cultivated land, and the convenience of the road from home to the field did not pass the test of significance on whether or not the farmer purchased organic fertilizer behavior.

5.3.3 Characteristic analysis of farmers' cognition of organic fertilizers

It can be seen from the regression results that the coefficient of understanding degree (X_{12}) index of organic fertilizer is significant at the level of 5%, and the coefficient is positive. With the improved understanding of organic fertilizers, farmers more clearly understand that excessive application of chemical fertilizers not only does not bring the desired effect, but will affect the growth of crops; not only affect the quality of agricultural products, but also caused the acidification of the soil, soil hardening, reducing the harvest and increasing the agricultural non-point pollution. The application of organic fertilizer can not only improve the quality level of agricultural products, but also to achieve the purpose of increasing production, and will not affect the agricultural products and the surrounding environment. Thus improve the income in the long run. Therefore, the more farmers know about organic fertilizer, the more likely they are to buy it.

The coefficient of convenience index of organic fertilizer application (X_{13}) is significant at the level of 1%, and the coefficient is positive. Compared to chemical fertilizers, organic fertilizers is larger in size, more laborious and time-consuming to apply, and requires a certain fertilization techniques, so those who think the application of organic fertilizers is more convenient will not see the trouble of applying organic fertilizers as a disadvantage and will be more inclined to buy organic fertilizers. The convenience of the road from home to the field did not pass a significant test on whether the farmer purchased organic fertilizer behavior.

5.3.4 Purchase decision variable analysis

The regression results showed that the coefficient of rationality (X_{14}) index of organic fertilizer price was significant at the level of 5%, and the coefficient was positive. This means that the more reasonable the price of organic fertilizer is perceived by farmers to be, and the more acceptable it is to them, the more willing they are to apply it in their production. If other factors affecting demand remain constant, an increase in price will cause a decrease in demand for the commodity, then the higher the price of organic fertilizer, the lower the amount of organic fertilizer that farmers are willing and able to purchase. The price of chemical fertilizer as a substitute will lower than the price of the same amount of

organic fertilizer, and farmers will increase the application amount of chemical fertilizer. Farmers' willingness to apply organic fertilizer is likely to increase only if the price of organic fertilizer is lower than the price of chemical fertilizer. The degree of satisfaction of organic fertilizer effect did not pass the significant test on whether farmers bought organic fertilizer.

5.3.5 Analysis of external factors

From the regression results, the influence of external factors on farmers' fertilizer purchase and application behavior is still significant. The coefficient of joining rural cooperative (X_{17}) index is significant at the level of 10%, and the coefficient is positive. This indicates that farmers participating in rural cooperatives are more willing to apply organic fertilizer. Market-oriented cooperatives are able to establish more stable distribution channels that help members realize the value of their agricultural products, reflect the effects of organic fertilizer application directly in the value of the product, and increase members' incomes. This has increased members' degree of approval of organic fertilizers and their consciousness in applying them. At the same time, rural cooperatives can provide their members with quality-assured organic fertilizer and technical guidance on organic fertilizer, reducing the cost and risk of applying organic fertilizer to farmers. Therefore, farmers who have joined rural cooperatives are more willing to buy organic fertilizer. The coefficient of farmers' understanding of the national organic fertilizer policy (X_{18}) is significant at the level of 1%, and the coefficient is positive. On the one hand, the greater the support of government policy on the purchase and application of organic fertilizer and the higher the level of subsidies, the lower the relative cost of production for farmers; on the other hand, farmers' awareness of the policy and understanding of the process of getting subsidies makes it easier to receive subsidies. Therefore, the more farmers understand the policy, the stronger willingness they have to buy and apply organic fertilizer. The coefficient of farmers' satisfaction with the services of organic fertilizer suppliers (X_{19}) is significant at the level of 5%, and the coefficient is positive. If the organic fertilizer supplier can introduce the characteristics and the effect of organic fertilizer, and provide free transportation and technical guidance and other services, so that the farmers can get more value-added services in the purchase of organic fertilizer which not only improves the cost-effectiveness of the

commodity, but also enhances the confidence of farmers to apply organic fertilizer, thus enhancing their the willingness to purchase. The coefficient of farmers receiving technical guidance (X_{20}) index in the process of organic fertilizer application is significant at the level of 10%, and the coefficient is positive. If farmers accept the relevant technical guidance in the process of applying organic fertilizer, they will master more scientific and reasonable fertilization methods, including fertilization methods, fertilization time, fertilization structure, etc. At the same time, they can also fertilize more reasonably according to the crop conditions, to play the role of organic fertilizer of increasing yield and income, thus enhancing their willingness to buy and apply organic fertilizer. The degree of influence of the surrounding environment on fertilizer application behavior did not pass the significance test on whether farmers bought organic fertilizer.

6. CONCLUSION

Through the above analysis, the following conclusions were drawn: among the 20 factors influencing the purchase of organic fertilizer by farmers, 12 indicators are significant. They are the gender of the farmers, the level of education, the number of family farmers, the total income of the family, the quality of farmland, the level of knowledge of organic fertilizer, the convenience of applying organic fertilizer, the reasonableness of the price of organic fertilizer, the level of understanding of the national policy related to organic fertilizer, the level of satisfaction with the services of organic fertilizer suppliers and whether they received technical guidance in the process of applying organic fertilizer, all of which are positively correlated.

Based on the above conclusions, the following policy implications can be obtained:

6.1 Strengthening Policy Support

Economic factors are currently the main factors influencing the poor promotion of organic fertilizer, the government should based on the principle of increasing farmers' production and income and developing the green ecological agriculture, making guidelines and policies for the promotion and application of organic fertilizer. Through different levels of policy subsidies to increase financial support for the promotion and application of organic fertilizers. In order to mobilize the enthusiasm of farmers to use organic fertilizer, the government can provide

subsidies for organic fertilizer that are higher than chemical fertilizers, so as to reduce the cost and risk of using organic fertilizer and promote the rationalization of farmers' fertilizer constitution. For those with a large scale of production, like large growers, cooperatives and agricultural enterprises, if the amount of organic fertilizer they applied has reached a certain amount, the government can increase subsidies to encourage the reasonable use of organic fertilizer, and give full play to its demonstration effect. At the same time, the government should strengthen supervision and made the subsidies public in order to enhance farmers' awareness of the policy and ensure that the subsidy policy is specifically implemented for each household and each acre of land.

6.2 Establish a Reasonable Land Transfer Mechanism

With the increase in part-time farming, much agricultural land is being left unused, resulting in a waste of land resources. Even though some farmers have transferred their land to other farmers, due to the short period of transfer, the new farmers will only apply large amounts of chemical fertilizers to increase production and income in order to gain short-term benefits, instead of maintaining soil fertility through organic fertilizers. Therefore, the government should establish a reasonable land transfer mechanism to appropriately increase the number of years of land transfer, thus prompting farmers to focus on the sustainable development of land. Farmers should be encouraged to actively adopt large-scale management, so as to achieve the government's scientific management of the agricultural production and form a unified and intensive production mode of organic fertilizer from the purchase to the application, which can effectively reduce the cost of organic fertilizer application, improve the economic efficiency of agricultural products, and reduce the cost of government regulation.

6.3 Improve the Agricultural Technology Promoting System

Whether the farmers have mastered scientific organic fertilizer application technology has an important impact on whether they use organic fertilizer in the agricultural production process. While agricultural promotion work is an important link for the promotion of technologies for sustainable agricultural development (including organic fertilizer application technology) and the

provision of technical guidance, especially the guide role of basic agricultural extension stations have in guiding farmers' reasonable fertilizer application and other sustainable agricultural technology issues. Technicians promote new scientific fertilization techniques such as balanced fertilization and soil testing fertilization according to the pattern of requirement of fertilizer, soil nutrient conditions and fertilizer effects, so as to increase fertilization efficiency and improve the quality of agricultural products. Therefore, the government should improve the agricultural technology promotion system, actively explore innovative models for the agricultural technology promotion management system, increase subsidies to agricultural extension stations, provide technical guidance needed for production and operation for the majority of farmers and guide farmers to reasonably apply commercial organic fertilizers.

6.4 Strengthen the Market Management of Organic Fertilizer

The high price of organic fertilizers compared to chemical fertilizers is one of the most important factors influencing farmers to buy organic fertilizers. Therefore, as a substitute for organic fertilizer, chemical fertilizers' prices will have a direct impact on farmers' demand for organic fertilizer. Government can adopt different price policy on different fertilizer type to control the demand for chemical fertilizer and encourage fertilizer enterprises to produce more organic fertilizer at the same time, so as to strengthen organic fertilizer market supply and stabilize the market price of organic fertilizer. On the other hand, the quality of organic fertilizer products should be strictly controlled. The Government should, in accordance with the development of organic fertilizer production technology, revise organic fertilizer standards, improve product testing and supervision mechanisms to prevent the market from being disrupted by poor-quality organic fertilizer, the sampling of unqualified organic fertilizer products should be dealt with by law and traced back to their origins, the organic fertilizer enterprises should be rectified, and the enterprises of counterfeit and shoddy organic fertilizer products should be resolutely banned.

6.5 Strengthen the Publicity of Knowledge and Policies Related to Organic Fertilizers

Government departments should make full use of television, village radio, bulletin boards and

village training to promote commercial organic fertilizers and related policies. On the one hand, strengthening rural environmental education, vigorously publicizing the importance of developing ecological agriculture, guiding farmers to establish a strong awareness of environmental protection, increasing the initiative and enthusiasm of farmers to participate in environmental protection work in rural areas, and reducing the environmental damage caused by farmer in agricultural production. On the other hand, organizing experts to go to the countryside to carry out on-site training and technical guidance, publicizing the benefits of organic fertilizer on agricultural production, guiding farmers to use organic fertilizer scientifically, making them fully aware of the important role of the rational use of organic fertilizer in maintaining and improving soil fertility, improving the quality of agricultural products, increasing production and income, and protecting the ecological environment.

The weakness of this study is that, considering the difficulty of quantification, the possible influential factors such as channel factors and promotional factors were not involved in the study of farmers' intention to purchase organic fertilizer in Sichuan. At the same time, due to the diversity and complexity of the factors influencing farmers' purchase and application of organic fertilizer and the lack of materials, the number of samples taken in the field study, the time of sampling and other factors may affect the representativeness of the research data, thus affecting the results of the study.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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