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Farmers' Behaviors on Agricultural Technology Inputs and the Influencing Factors of Their Behaviors——Based on the Investigation of 276 Rural Households in Deyang City, Sichuan Province

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Abstract On the basis of expounding farmers' behaviors on agricultural technology inputs studied by the foreign scholars; relying on the investigation data of 276 rural households in Deyang City, Sichuan Province and by using the Logistic Regression model, the farmers' behaviors on agricultural technology inputs and the influencing factors on their behaviors are analyzed. The results show the main factors that influence farmers' behaviors on agricultural inputs are whether they have the assistance of agricultural technology personnel; the choices of plantation; non-agricultural income; area of land management; the expectation on land ownership, whether it has township enterprises and the proportion of the non-agricultural labor forces and some other factors. The influencing degree of these factors descends from strong to weak. On the strength of the study results, the countermeasures on increasing local farmers' inputs on agricultural technology are put forward from the aspects of stabilizing rural land property, establishing scientific land transfer mechanism and intensifying the governmental functions of agro-technical station.

Key words Agricultural technology input, behaviors, Logistic Model, Influencing factors, China

1 Literature Review

At the end of the 1979s, China implemented the household contract responsibility system in its rural area. It has been proven that the system played a great role in pushing forward the development of agricultural production and rural economic development and farmers' activity has been greatly improved. But since 1984, the growth tempo of agriculture has become slow obviously. LIN Yi-fu (2008) thought that the main reason of the decrease of agricultural growth tempo is that the potential interests caused by the stimulation of reform has died out. Besides, he pointed out that the further increase of agriculture relies on the input of general elements of agricultural development, for example, the input in terms of goods, materials and capital and technological change^[1]. Therefore, the study on the farmers' input on agricultural investment is of great significance. Meanwhile, driven by the rapid adjustment of economic policies and different industrial interests, the investment of farmers in land shows the short-term and unprofessional features and the volume of investment decreases gradually, which have bad effect on the development of rural economy^[2]. Therefore, how to direct farmers to increase technology input on farmland to increase the long-term interest of land is of great significance.

T. W. Schultz pointed out that there are three problems in the process of studying farmers' behaviors on applying technology, which are the rural households' acceptance tempo of new agricultural production elements, rural households' desire on new things and rural households' study and use of new things^[3]. Thereafter, the study on rural households' behaviors on applying technology basically follows the thought of T. W. Schultz. Taking the empirical research and the quantitative

analysis as the major ways, scholars analyzed the factors that affect the rural households' acceptance on new technology from the perspective of innovation spirit, natural resources, equality of getting resource and the adaptability of technology and so on. Rogers thought that the users' acceptance of new technology was affected by varied technology information, risks and market need. While, Rawlin put forward the imperfect factors of innovation theory. The factors cover inconsistency of population groups in mental trait, the capability of obtaining resources and information and some other aspects; opportunities and profits; inaccuracy of information. Based on this, the strategic theory of target group was put forward.

The domestic scholars also have studied the behaviors of rural households from different perspectives. ZHANG Haiyang, SONG Hong-yuan *et al* found that the increase of farmers' non-agricultural income may have good effect on mechanization level; rural households' investment to organic fertilizer has close relations with the development of animal husbandry; the government and organizations have certain effect on rural households' investment, but the major influencing factors are the traditional and non-traditional employment of cultivation; the effects of the prices of food and production and the proportion of input and output should not be over estimated^[4]. After analyzing the willingness of rural households on investing agricultural technology, ZHANG Bing, ZHOU Bin *et al* found that the educational level of head of a household, the proportion taken by the non-agricultural labors, the proportion of agricultural income to the family gross income, the ratio of agricultural technology input invested by people around and the accessibility of telephone at the village level are also the important influencing factors^[5].

In recent years, rural households' investment to agricultural technology has attracted the attention of scholars, but the current researches mainly focus on rural households' willing-

ness on input and few of them has studied rural households' behaviors on technology input from the micro-level perspective. Taking the Deyang City of Sichuan Province as an example, the paper studied rural households' behaviors on technology input and the influencing factors of their behaviors, as well as the actual situation of the regional rural households' behaviors on technology input that suit the local situation, so as to provide theory reference for the policy-makers.

2 The empirical analysis on the rural households' behaviors on agricultural technology input

2.1 Data source and sample description The data of this research comes from the investigation on 276 rural households from Deyang City of Sichuan Province in August, 2010, and the interviews with the personnel from the agricultural bureau in the study area. The investigation involves the basic situation of the villages, the characteristics of rural households, economic status of rural households and the rural households' willingness and behaviors on inputting land. When determining the investigation subject, the paper not only verified the economic and agricultural developmental status of each region, but also comprehensively considered the location factors, which included the villages located in the interjection area of urban and rural areas with favorable transportation situation, as well as the villages located in mediocre area and remote area. In the end, fourteen villages in four county (city and district) include Jingyang District, Luojiang County, Mianzhu City and Shifang City. The investigation chose more than 20 rural households at random from each village. 300 questionnaires were distributed and 276 valid questionnaires were retrieved.

Deyang City is located in the northwestern of Chengdu Plain of Sichuan Basin. In the city, the landscapes include " maintain, hill and dam " are complete, it is an important comprehensive production base of grain, oil, meat, silkworm *etc.* in Sichuan Province. At the end of 2009, the sown acreage in Deyang City has achieved 185 978 hm², and the paddy fields took 121 816 hm², the dry land shared 64 162 hm², and the effective irrigation area was 11 810 hm², and the major plantation was rice, rapeseed plant, wheat, corn, *etc.* . As a result of the decrease of per capital agricultural acreage, the mechanization degree in the investigation area is low and the agriculture is mainly the traditional plantation. The technology input in the area mainly includes improved seeds, cultivation technology, sprout cultivation and the application technology of fertilizer and pesticides. The main labors in the investigation area are old-aged people and women, the young people especially the young and strong men all work out. The rural households rely on the promotion of agro-technical station to get the information of agricultural technology, followed by the instruction of trial ground and demonstration community. However, rural households have different satisfactory degree toward the agricultural technology promotion personnel. Among all the sample rural households, only 25% of them have accepted the on-the-field direction of agricultural technology promotion personnel; five farmers have joined the cooperatives; 41% of them have ap-

plied the new species and plantation technology in 2009 (Fig. 1); farmers express that they need agricultural technology instruction in the process of cultivation.

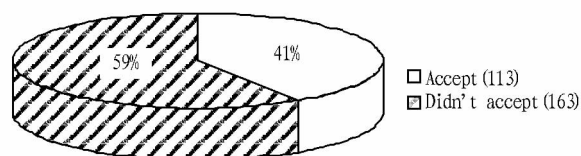


Fig. 1 Whether the rural households accept new agricultural technology

When asking the rural households whether the new technology can increase the output, it is found that the experience of rural households has great impact on the expectation. In the sample rural households, 26% of them think that the impact of new technology should not be over estimated. The climate, pests and other reasons are the major factors that affect the yield; 18% of them do not believe in the application of new technology, for they have bought fake pesticide or encountered immature technology that lead to a reduction in production (Fig. 2).

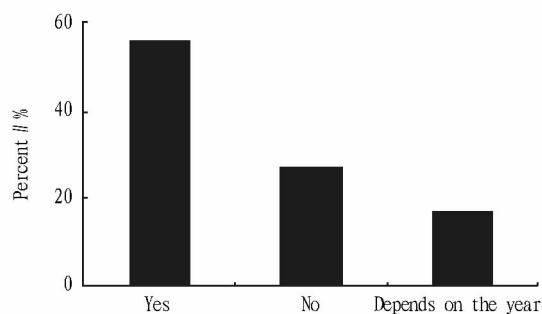


Fig. 2 Whether the application of new technology can increase production

Through investigation, it is found that the main reason that the new technology can not be applied is that there is no enough direction; the following reason is that the rural households think that other villagers have not applied the new technology; some other rural households think that new technology may lead to reduction in production (Fig. 3). Not all the rural households who applied the new technology think that the output will increase; some of them are promoted or motivated by the promotion of agro-technical station or people around them to apply new technology. The rural households who have used the new technology, but the production reduced do not have confidence in new technology. However, most of the rural households who have not applied new technology have high expectation on it. But the lack of instruction or many other reasons hinder their actions in using new technology.

2.2 Analyses on the influencing factors of rural households' behaviors on agricultural technology input

2.2.1 Selection of the dependent variable. The investigation faces the rural households, so in order to make sure the simple but accurate investigation, the specific questions in view of rural households' behaviors on agricultural technology input are designed: whether you have applied the new technology in the

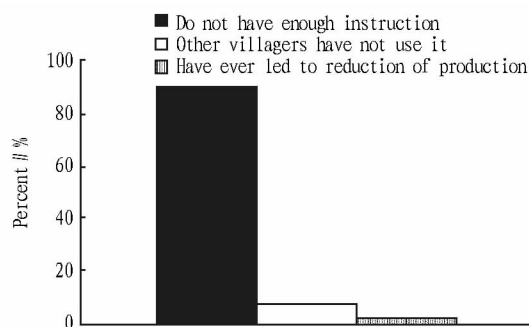


Fig.3 The reasons why the rural households apply new technology

process of cultivation in 2009: 0 is positive answer and 1 is negative answer.

2.2.2.2 Selection of independent variable. In view of the fundam-ent of the scientific research and by combining the features of the study area, the paper determines the influencing factors that affect rural households' behaviors on technology input into the following several aspects.

2.2.2.2.1 The characteristic of rural households. It mainly re-fers to the age and educational level of rural households. In theory, the rural households with young age and high educa-tional level are easy to accept new technology and emphasize the input on technology. However, it is possible that after they weighing the comparable income of agriculture, they will invest the resources to non-agricultural industry with higher interests, and then reduce the investment in land^[6]. The research selects the average age and average educational level of rural agricul-tural labors to weigh the impacts of the characteristics of rural households on their agricultural technology input.

2.2.2.2.2 The selection of cultivation approaches. Through the investigation on sample rural households, the cultivation ap-proaches of rural households have significant impact on rural households' behaviors on agricultural technology input. The production pattern of rural households will determine whether they will accept or follow new instruction. Therefore, the re-search supposes five types of cultivation approaches: cultiva-tion by experience; asking information from agro-technical sta-tion; through reading newspaper and watching TV; studying from eldership and other villagers; other ways.

2.2.2.2.3 The non-agricultural production features of rural house-holds. The impacts of non-agricultural employment on rural households' agricultural technology input are reflected on two as-pects. For one thing, the non-agricultural input stimulates the ag-ricultural input. The non-agricultural input can increase rural households' disposable income, and rural households can have more capital to input on agriculture; for another thing, the non-agricultural employment will cost agricultural time. What's worse, rural households may input more resources on non-agri-cultural income with higher interests and reduce the input on agriculture^[7-8]. The research selects the family non-agricultural income in the previous year and the proportion of non-agricul-tural employment in the previous year to reflect the impact of non-agricultural employment on rural households' agricultural

technology input.

2.2.2.2.4 The scale of land management. Generally speaking, the proper expansion of the area of land is conducive to leading to the scale effect and to the technology input. But the expan-sion may be restricted by capital and labors and the risks of im-puting will be increased^[9]. The research applies the overall ar-ea of land management of rural households to reflect the impact of land scale on technology input.

2.2.2.2.5 The features of sample households' villages and groups. The economic development status of villages and groups and the instruction of agro-technical stations to rural households have certain pertinence to rural households' tech-nology input. Villages and groups with rapid economic develop-ment, rural households have relatively higher disposable in-come and they are easier to accept new technology. The in-struction from the agro-technical stations becomes more fre-quent and more specific; the possibility of rural households' technology input will be larger. So the research uses two indi-cators, covering whether there are township enterprises and whether there is agro-technical staff to instruct, to reflect the impact of the features of villages and groups on rural households' technology input.

2.2.2.2.6 Rural households' expectation on land property. Al-though the study area has not experienced great or minor land consolidation in recent five years, but part of the land of some villages has been expropriated, which does not only affect rural households' input on land, but also affect neighboring rural households' expectation on land. If rural households' expecta-tion is possibly to be verified in the next cultivation period, then the long-term input and technology input on the land in this cul-tivation period will be reduced correspondingly^[10-11]. The research asks whether the rural households think the land family contract right will be taken back or not, the answer 1 means it will be taken back; 2 means it will not be taken back and 3 means uncertain and rural households have certain expectation on land property.

2.3 The selection and analysis of model

2.3.1 The selection of model and the explanation of varia-bles. Logistic regression model is one of the effective tools used to study the qualitative variables and their relations with the influencing factors. The induced variables in the model only have two choices, 1 and 0 are used to show whether the event has happened or not. In order to test the influencing factors of rural households' technology input behaviors and further clearly define their influencing degree and significance, the research establishes the binary choice model of the influencing factors of technology input to analyze 276 sample rural households.

The connotation and values of the variables involved in the analysis can be seem on Table 1.

2.3.2 The results and explanation of estimated results of the model. The research applies SPSS statistical software to esti-mate the model and the gradual screening strategy is analyzed. Taking the explanatory variable to equation or supposing the significance level of equation is 0.1, and then the variables en-tered the equation are shown on Table 2 according to the se-quence of the equation.

Table 1 The variable definition in model analysis

Variables	Explanation of variables	The value and equation of variables	The types of variables
<i>Inpt</i>	Induced variables; whether input new technology or not	Yes, <i>Inpt</i> = 0; No, <i>Inpt</i> = 1	Dummy variable
<i>Age</i>	Age	The average age of agricultural labors in a family	Continuous variable
<i>Edu</i>	Educational level	The average educational degree of agricultural labors in a family	Continuous variable
<i>Selc</i>	The selection of cultivation approach	According to the formal experience, <i>Selc</i> = 1; studying from the eldership and other villagers, <i>Selc</i> = 2; asking information from agro-technical station, <i>Selc</i> = 3; through reading newspapers and watching TV <i>Selc</i> = 4; others, <i>Selc</i> = 5	Dummy variable
<i>Incm</i>	Non-agricultural income	The non-agricultural income of rural households in the previous year	Continuous variable
<i>Labr</i>	The proportion of labors employed in non-agricultural industry	The proportion of labors employed in non-agricultural industry	Continuous variable
<i>Lad</i>	The area of land management	The scale of land management of rural family	Continuous variable
<i>Entr</i>	Whether there are township enterprises in the villages or groups	Yes, <i>Entr</i> = 0; No, <i>Entr</i> = 1	Dummy variable
<i>Dirc</i>	Whether there are agro-technical personnel to direct on the spot	Yes, <i>Dirc</i> = 0; No, <i>Dirc</i> = 1	Dummy variable
<i>Expc</i>	The expectation on land property	The current contracted land will be taken back, <i>Expc</i> = 1; the land will not be taken back, <i>Expc</i> = 2; Uncertain, <i>Expc</i> = 3	Dummy variable

Table 2 The estimated results of model parameters

Variables	<i>B</i>	<i>S. E.</i>	<i>Wald</i>	<i>Sig.</i>
Constant term (<i>Con</i>)	-6.699 76	1.408 194	22.635 7	0.000 0
Whether there is direction from agro-technical personnel (<i>Dirc</i>)	3.374 688	0.510 771	43.653 03	0.000 0
The selection of cultivation approaches (<i>Selc</i>)	-0.504 81	0.164 301	9.440 104	0.002 1
Non-agricultural income (<i>Incm</i>)	-1.9E -05	8.65E -06	5.004 364	0.025 3
The area of land management (<i>Lad</i>)	4.408 067	1.728 863	6.500 927	0.010 8
The expectation on land property (<i>Expc</i>)	0.773 557	0.290 798	7.076 226	0.007 8
Whether there are township enterprises (<i>Entr</i>)	0.773 618	0.388 543	3.964 376	0.046 5
The proportion of labors employed in non-agricultural industry (<i>Labr</i>)	-1.925 69	1.168 158	2.717 502	0.099 3

Through the test on the model, the variables that have great impact on the rural households' new technology input are listed as follows according to their influences: whether there is agro-technical personnel to direct (*Dirc*), the selection of cultivation approaches (*Selc*), non-agricultural income (*Incm*), the area of land management (*Lad*), the expectation on land property (*Expc*), whether there are township enterprises (*Entr*), the proportion taken by labors employed in non-agricultural industry (*Labr*). Due to the insignificance in statistical, age (*Age*) and educational degree (*Edu*) can not enter the model.

2.4 Analysis on the results of model

2.4.1 The impact of the characteristic of rural households. The age and educational level of rural households do not have significant impact on the new technology input, which is different from other scholars' research^[12]. Different investigation region may be accountable for it. In the research, most of the sample households are old-aged people and women, although they are different in age, but the same in educational level. Besides, the knowledge of young women on agricultural production mainly comes from their parents and they seldom accept new information. Consequently, the impacts of age and educational level on technology input are not the biggest.

2.4.2 The selection of rural households' cultivation approaches. Rural households' selection on cultivation approaches shows significance in the 1% level of statistical test, which indi-

cates that rural households' cultivation pattern has significant influence on new technology input. The rural households, who tend to produce according to the formal experience, often have cultivated for many years, and they know clearly each section of agricultural production and do not willing to find new technology and approaches actively, so they input less on technology. But the rural households, who often ask information from agro-technical personnel, are often the beneficiary of new technology or have high activity to agricultural production, so they are more likely to input new technology.

2.4.3 The non-agricultural features of rural households. Rural households' non-agricultural income in the previous year is significant in the 5% level of statistical test level, but the proportion of non-agricultural labors is significant in the 10% level of statistical test level. It indicates that the two all have significant impact on the new technology input of rural households. According to the analysis above, the non-agricultural employment has two sides of impacts on agricultural production input. According to the statistical results, the negative impact has obviously surpassed the positive impact. The big proportion of non-agricultural production in rural family makes the rural households do not want to input capital and labors to agriculture with relatively lower interest, thus the agriculture will be ignored and the technology on it will be reduced correspondingly.

2.4.4 The scale of land management. The variable of the

scale of family land management is significant at the 5% statistical test level. It indicates that the total area of land has significant positive impact on agricultural technology input. The input of agricultural technology input needs certain scale of land, and if the total area of land operated by rural households is too small and the scale effect can not be displayed, so the input on technology will be reduced.

2.4.5 The features of villages and groups of the sample rural households. Whether there is direction of agro-technical personnel is the indicator that enters the model first. The indicator has the greatest impact on rural households' input on new technology. The indicator whether there are township enterprises in the villages and groups is significant at the 5% statistical test level. It implies that the agro-technical station plays an important role in promoting new technology to rural households. Restricted by the educational degree and economic situation of rural households, the government is not only the main source for rural households receiving information, but also plays a major role in influencing the production of rural households. Generally speaking, rural households have high enthusiasm on technology input, but they depend on the promotion and direction of the government. Economy in the villages or groups, which have township enterprises, is relatively good. Sometimes, they have the special industries and can get the attention from the government. In these areas, the functions of the government are well displayed and the living condition of rural households is higher, therefore, rural households emphasize the input on agricultural technology.

2.4.6 Rural households' expectation on land property. The variable of the expectation of rural households on land property is significant at 1% statistical test level, which indicates that rural households' input on technology has displayed significant effect. Rural households will predict the interest of their input, so driven by the maximum interests, only when the expected income is larger than input, then rural households will input. The land consolidation or land expropriation in the villages and neighboring villages will decrease rural households' expectation on the stability of land property. The expectation has grave impact on the long term input, for the interest of long term input can be taken back after long time, so only when the land property is stable, rural households can conduct long term input.

3 Conclusions and countermeasures

Taking rural households in Deyang City of Sichuan Province as an example, the main factors that affect rural households' behaviors on agricultural technology input are analyzed. The study shows that the major factors that affect rural households' input on agricultural technology are as follows according to their effects from strong to weak: whether there is the direction from agro-technical personnel (*Dirc*), the selection of cultivation (*Selc*), non-agricultural income (*Incm*), the area of land management (*Lad*), expectation on land property (*Expc*), whether there are township enterprises (*Entr*), the proportion of non-agricultural labors (*Labr*) *et al.*

Based on the result of the study, the following counter-

measures can be put forward. In the first place, the property of rural land should be stabilized. For one thing, rural households' long term input on farmland should be encouraged; for another thing, rural households' responsibility on protecting and developing farmland should be intensified. In the second place, scientific land transfer system should be established to let non-agricultural rural labors to transfer their surplus land to agricultural labors to increase the management area of land and form economic effect. In the third place, the governmental functions of agro-technical stations should be strengthened to gradually realize the structural adjustment of agricultural industry.

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