A Research on the Affecting Factors of Farmers’
Comprehensive Utilization of Straw in China

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Abstract. Based on the data from the field research of 1038 households from 17 cities in 7 provinces, the author analyzes the current situation of comprehensive utilization of straw and then uses ordered Probit Model to research the factors that affecting the farmers’ comprehensive utilization of straw. The survey attests that nowadays the degree of comprehensive utilization of straw is low, because 53.72% straw isn’t used in any forms. The farmers’ utilization of straw is apparently in direct proportion to the area they have planted, to the situation of whether farmers have ever engaged in livestock breeding, to the degree of farmers’ cognition of its harm, to the situation of whether they have received price subsidies. However, it is in inverse proportion to the share of non-agricultural earnings in farm families’ gross income, the ages and education background of heads of households. It can be inferred that the inadequate agricultural work force, the high opportunity cost of utilization, the small farming scale and the deficient governmental function can serve as the major reasons for the low degree of comprehensive utilization of straw.

1. Introduction
Straw, a kind of crop, is one of the main by-products of agricultural production. As one important food for herbivore, straw is also the principal raw material for industries like sheet metal and papermaking. Despite these, it plays a significant role in keeping soil fertility and boosting crop yields. Straw resources are rich in our country, for the amount of straw, wheat straw and maize stalk were estimated to around 194.02 million ton, 157.33 million ton and 226.18 million ton respectively in China in 2015, equivalent to around 288.76 million ton of standard coal; if all used in field retention, it could reduce around 16.1 million ton fertilizer input by adding 4.87 million ton of nitrogen (N), 1.65 million ton of phosphorus (P₂O₅) and 9.59 million ton of potassium (K₂O). It is thus clear that the comprehensive utilization of straw is of vital realistic significance, especially in raising resource utilization efficiency and achieving sustainable development in agriculture.

As household fuels and building materials, straw could be used to cut farmers’ living costs, and as organic fertilizer and poultry feed, it could reduce their planting and breeding costs, which would bring them considerable economic benefits. Some researches in late 20 century showed (Yang Linshu, 1993 [1]; Huang Guoqin, 1997 [2]) that the proportion of comprehensive straw utilization in our country is generally reached about 80%. According to the proportion of open-air straw burning, there were 5 areas divided by Cao Guoliang (2006) [3], and the percentage in the economically-advanced area, East China (take Jiangsu Province as an example) was around 35.9% from 2001 to 2003. Figures of National Satellite Remote Sensing Monitoring showed that from 2004 to 2015, over 3000 fire points of straw burning every year during the summer harvest were spotted, with their numbers and...
sizes growing in varying degrees. Open-air straw burning would not only lead to the loss of organic matter in straw and the decline in soil fertility, but also result in environmental pollution by producing much chemical compounds like CO₂, CO, benzene etc., whose smoke could cause social problems such as traffic congestion, frequent fire and so on.

Concerning the discussion on the influencing factors of the comprehensive straw utilization for peasant households in our country, experts offered explanations as follows. Firstly, the low degree of comprehensive straw utilization was caused by system failures. Li Zhenyu and Huang Shao’an (2002) [4] began from new institutional economics, and thought that government’s system of straw burning prohibition was high-cost and low efficient, which was a kind of system failure; Ma Ji and Qin Fu (2009) [5] adopted theories of Static Nash equilibrium game in their economic analysis of the phenomenon that peasants tend to burn straw, and held that using the mode of severe punishment could hardly reach the goal of prohibiting straw burning. Guo Lijing and Zhao Jin (2014) [6] gave explanations on whether peasant households would utilize straw comprehensively from informal systems. Jia Xiufei and Ye Hongwei (2016) [7], from the perspective of Public Policy Science and economics, pointed out the reason why the government failed to prohibit straw burning lied in their defects in environmental regulations. Secondly, technological bottleneck was the main reason restraining the utilization. Immaturity of technologies such as rotary tillers, straw smashing, straw returning, fertilizer composting and so on, forced peasants to burn straws (Chen Xinfeng, 2001 [8]; Zhu Qirong, 2008 [9]). Thirdly, cost constraints made burning straws a most rational choice for peasants. Mei Fuchun (2008) [10] believed under the hypothesis of rational man, that the fundamental reason peasants chose to burn straws directly was because of its low costs, and the high opportunity costs of choosing other processing methods. Wang Shujuan and Zhang Bing (2012) [11], Wu Xuelian and her team (2017) [12] stated that the lack of market conditions increased peasants’ costs to sell straws, because the convenience of selling straws was the key factor influencing their sales decisions. Fourthly, the characteristics of peasants had significant effect on their behaviors of straw treatment. After investigating in areas like Jiangsu, Anhui and Shandong, Qian Zhonghao and Cui Hongmei (2010) [13], Yan Tingwu and his team (2017) [14] saw that identities, educational backgrounds, awareness of the harm of straw burning, the ecological and welfare level of comprehensive utilization, earnings expectations and risk preferences etc. of householders were main factors that influence straw utilization.

The influencing factors analyzed by our predecessors started from aspects like systems, technologies, costs and the characteristics of peasant households. Based on researches and studies of many experts, and the cost benefit for peasant households to treat straw, this paper is centered on 4 factors: peasant households’ non-agricultural employment level, the scale of agricultural production, the influence of government policies and the individual characteristics of peasants. In light of these, this paper was intended to help set up an analytical framework and then suggest theoretical hypotheses. By using survey data of questionnaires and Ordered Probit Model, the author empirically studied his hypotheses to reveal the influencing factors of comprehensive straw utilization, and then, provide policy advice on improving it.

2. Analytical Framework and Research Hypotheses

The logical thought of this paper is: whether peasant households would utilize straw comprehensively or not depends on the cost income of straw treatment. If their income is higher than their costs, they would turn to utilize it comprehensively; if not, they would abandon it directly or burn it on spot. Consequently, all factors that influence peasants' income and costs would finally impact on their behaviors of straw treatment.

First, farmers' labor costs would affect their treatment behaviors. Collection and treatment of straw usually take much labor forces, while the rising level of farmers' non-agricultural employment indicates that the opportunity cost of straw treatment is high, so their productive and living demand for straw would recess, which leads them to prefer the latter choice (on-spot straw burning). From their productive demand for straw, it is noted that the rise in pay costs of part-time farmers makes straw
returning, which takes much labor forces, a comparatively expensive choice. Peasant households are inclined to replace organic fertilizers with chemical fertilizers so that the fertilizer producing function of straw is weakened accordingly. From their living demand for straw, their traditional demand to use straws as household fuels decreases when their non-agricultural income and opportunity costs of collecting straw increases. Instead, they would go for liquefied gas or natural gas as fuels, so the usage of straw for fuel wood purpose would drop sharply.

Then, the scale of agricultural production affects peasant households' judgment in the benefits of utilizing straws, and their handling behaviors are influenced thereby. For small planting scale, the amount of straw as by-products is little. Compared with other non-agricultural income which is higher, the economic value of straw seems low, and is easily ignored, or even discarded by farmers. Small breeding scale, or no livestock (especially grass-feeding livestock) at all, would make the need of straw for feed purpose decline.

Next, government policy also affects peasant households' handling behaviors of straw. Government policy could be used as an external force to change farmers' handling costs and income through some relevant measures, and thus affect their behaviors. For instance, if the government provides them with direct subsidies for selling straw, it could raise the price in the market, and add their income; if the government provides technological support in terms of straw collection, it could lower the difficulty of collection and then reduce their handling costs; if the government provides effective publicity and guidance, it could change their ideas and make them abandon their wrong ways of treating straw.

Lastly, the individual characteristics of peasant households would affect their costs in straw treatment. Straw treatment usually needs much labor input, and elder people, restricted by their physical strength, may prefer open-air burning, which is easier in consideration of their health condition; well-educated householders, have more possibilities of getting non-agricultural job opportunities, so they are reluctant to take much time to treat straw because of higher chance costs. Besides, cadres in a village should take the lead, for they are the bridge to link the government and ordinary farmers, and are grassroots propagandists for government's prohibition of burning straw. Moreover, violating the prohibition policy would make them pay higher prices, because they should not only pay fines, but are possibly subject to administrative penalties. So, peasant families with village cadres are more likely to utilize straw comprehensively.

Based on the above analysis, we suggest the following research hypotheses that need confirmations:

Hypothesis 1: The higher the non-agricultural employment level is, and the higher non-agricultural income it takes in families' gross income, the lower the possibility there is for peasant households to utilize straw comprehensively.

Hypothesis 2: The larger the planting scale is, and the higher value the straw resource has, the higher the possibility it is for farmers' comprehensive straw utilization; if the farmer is engaged in livestock raising, then the possibility of using straw for feed purpose is higher, and the straw is less likely to be discarded or burned.

Hypothesis 3: Farmers' net income could be raised if the government play its function effectively in providing guidance, technological support and price subsidies, and the chance of comprehensive straw utilization is then higher.

Hypothesis 4: The older the householder is, and the higher his/her education level is, the higher his/her health and opportunity costs are, in other words, his/her possibility of comprehensive straw utilization is lower; the higher the cost is for families with village cadres to burn straw, the higher the possibility is for them to utilize it comprehensively.

3. Empirical Research

3.1. Selection of the Model and Variables

The empirical research of experts are mostly carried out under Binary Logit Model, which is to say, burning or utilizing are the dependent variables. However, the author holds that, according to different ways of utilizing straws, there are different types of utilizing efficiency and environmental impact. It is
found after practical investigation that, even for the same peasant, his/her handling behavior may not be single. So, the binary choice of burning or utilizing as dependent variables could not show the utilizing efficiency accurately. Therefore, this paper categorizes and sorts the comprehensive utilization degree in accordance with farmers' handling behaviors, expecting to explain their selection behaviors. On these grounds, we use Ordered Probit Model here, which has been widely used in dealing with discrete data these years. Its general form is \( Y_i = \beta X_i + \epsilon_i \), and \( Y_i \) is the dependent variable, \( X_i \) is the aggregate to explain variables, \( \beta \) is the parameter that is to be estimated, and \( \epsilon_i \) is the random variable.

3.1.1. Choice of Dependent Variables. When choosing and ranking the model, \( Y \), the observation data and the explained variable, is used to represent the result of ranking and categorizing, which is took as round numbers like 0, 1, 2, 3. The author sorts farmers' ways of straw treatment in assignments, according to the degree of comprehensive utilization. 4 points is given for farmers who choose high efficiency ways for resource recovery like selling, recycling, feeding; using straw as household fuels, which is a traditional extensive type, though cost saving, is low efficient and high-polluting, so 2 points is given for this; and 0 point is for the complete waste of resource like open-air burning, burying, discarding. Scores are counted respectively if farmers choose one handling way (single choice); if they choose various ways (multiple choice), the weighted average is needed to be count. There are 5 rankings based on these: higher (4), high (3), medium (2), low (1), and lower (0).

3.1.2. Choice of Independent Variables. On the basis of above analysis and hypotheses, the author selects 8 independent variables to reflect the non-agricultural employment level of farmers, the scale of agricultural production, the impact of government policy and the individual characteristics of farmers. These independent variables are: \( X_1 \), the percentage non-agricultural income takes in total family income, represents the non-agricultural employment level; \( X_2 \) and \( X_3 \), planting acreage and whether the farmer breeds livestock, represent the scale of agricultural production; \( X_4 \) and \( X_5 \), farmers’ cognitive degree and whether the government provides price subsidies, representing the impact of government policy; \( X_6 \), \( X_7 \) and \( X_8 \), the age of householders, the educational level of householders, and whether there are village cadres in peasant households, represent the individual characteristics of farmers.

3.2. Data Sources and Sample Descriptions

Data sources in this paper come from the on-site survey the author has participated from 17 cities in 7 provinces (Jingjiang, Pizhou, Nantong, Haimen, Yancheng and Xuzhou in Jiangsu Province; Anqing and Linbi in Anhui Province; Leaching and Dong’ e in Shandong Province; Zhengzhou and Xinxiang in Henan Province; Hangzhou and Ninghai in Zhejiang Province; Jilin and Dunhua in Jilin Province; Beihai in Guangxi Province ) together with the Agroforestry Economic Management majors in Nanjing Agricultural University. The sample areas above are the main agricultural zones of each provinces, and the sample households would be selected out by random sampling. We had sent out 1251 questionnaires, and then collected 1038 valid ones of high effective rate (83%) and high quality. Content of this investigation includes ways of straw treatment, farmers’ individual characteristics (age, gender, educational level and whether are village cadres), agricultural production structure (planting acreage, livestock breeding), family income structure (income of planting, livestock breeding and non-agricultural employment), knowledge of comprehensive straw utilization and willingness of straw treatment etc.

3.2.1. Comprehensive Straw Utilization Degree and Cognitive Status of Peasant Households. According to the survey, the comprehensive straw utilization degree of 1038 interviewed households is 10.31%, 3.85%, 24.76%, 21.29% and 39.79% respectively ranging from high to low. Farmers who choose ways with higher degree of comprehensive utilization like selling, recycling and feeding take
up 5.45%, 6.79% and 3.15%; who choose traditional utilization ways (for household fuel purpose) take up 30.89%; who choose open-air burning, burying directly and discarding take up 24.27%, 21.36% and 8.89% correspondently. Overall, degree of comprehensive straw utilization in our country is relatively low, which is only 46.28%, and the rest 53.72% of straw resource is left unused in any form.

Besides, for the question *What do you think is the most reasonable way to treat straw*, farmers who choose selling, recycling, feeding and household fuel using consist of 8.71%, 23.61%, 3.72% and 13.61%; who choose open-air burning, burying, discarding or unclear take up 14.24%, 19.29%, 0.35% and 16.47%. There is 50.35% of peasant households who know mistakenly or vaguely about what comprehensive straw utilization is.

### 3.2.2. Individual Characteristics of Peasant Households
It is found that the average age of these households is 51.59, with the oldest 82 and the youngest 20. They are mostly over 45 (73.79%), showing that middle-aged and elderly people are in the majority of taking up agricultural production. In terms of educational level, the average years of education are 8.13, with the most 20 years and the least 0 years. Among them, people of junior middle school level are in the majority, consisting of 45.55%. In addition, there are 157 village cadres in the peasant households that have been surveyed, which take up 15.13%.

### 3.2.3. Agricultural Production Structure and Income Composition of Peasant Households
First, from the perspective of agricultural production structure, the average planting acreage of surveyed farmers is 0.60 hm², biggest of which is 16.67 hm² and smallest, 0.02 hm². Farmers whose planting acreage is below 0.30 hm² consist of 52.5%, showing that their total agricultural land is small. Besides, only 77 farmers (7.42%) work on breeding ruminants (sheep and cattle), and their scale of breeding is generally small. Second, from the perspective of income composition, farmers' average income for planting is 15288 yuan, with the highest 450000 yuan and lowest 0 yuan; the average income for livestock breeding is 2046 yuan, with the highest 170000 yuan and lowest 0 yuan; the average non-agricultural income is 26626 yuan, with highest 500000 yuan and lowest 0 yuan. Furthermore, there are 611 peasant households whose non-agricultural income takes up over 50% in their total family income (making up 58.86% in total samples), and 432 ones whose non-agricultural income takes up over 75% (making up 41.62% in total samples). This means farmers have high degree of non-agricultural employment, and their non-agricultural income takes up a large proportion in their total family income.

### 3.3. Results of Estimation
These 1038 valid questionnaires are regressed using Ordered Probit by the statistical software Eviews8.0. It is found according to its result that the LR value is 93.0133 and the Prob (LR statistic) value is 0, so the reasonable fitting is obtained. The relationship between non-agricultural income in total family income(X₁), age of householders(X₆), educational degree(X₇) and the degree of comprehensive straw utilization is distinctly negative, satisfying our prediction; the relationship between planting acreage(X₂), livestock breeding(X₃) and their comprehensive utilization is remarkably positive, satisfying our prediction; the relationship between cognitive degree of open-air straw burning(X₄), government price subsidies(X₅) and comprehensive utilization is markedly positive, satisfying our prediction; though not notable, the relationship between whether the householder is a village cadre(X₈) and comprehensive utilization is negative, opposing to our prediction (Table 1).
Table 1 Results of Econometric Model Estimation

| Variable                                | Coefficient | Std. Error | z-Statistic | Prob.  |
|-----------------------------------------|-------------|------------|-------------|--------|
| Percentage of Non-agricultural Income in Total Family Income(X1) | -0.1974**   | 0.0977     | -2.0204     | 0.0433 |
| Planting Acreage(X2)                  | 0.2116***   | 0.0479     | 4.4168      | 0      |
| Livestock Breeding(X3)                | 0.5262***   | 0.1337     | 3.9361      | 0.0001 |
| Awareness of the Harm of Open-air Straw Burning(X4) | 0.2043**    | 0.0947     | 2.1569      | 0.0310 |
| Government Price Subsidies(X5)        | 0.4053***   | 0.0843     | 4.8069      | 0      |
| Age(X6)                                | -0.0062*    | 0.0034     | -1.8357     | 0.0664 |
| Educational Level(X7)                 | -0.0423***  | 0.0124     | -3.4169     | 0.0006 |
| Village Cadres in Families(X8)        | -0.0709     | 0.0990     | -0.7158     | 0.4741 |

Notes: *, ** and *** represent 10%, 5% and 1% for the significance level.

4. Conclusion and Suggestions for policies

4.1. Major Conclusion
Data of our field investigation in 1038 households from 7 provinces showed that farmers in our country have low degree of comprehensive straw utilization, and there are 53.72% of straw resource left unused in any form. The results of our empirical analysis to comprehensive straw utilization, with the help of Ordered Probit Model, reflected that:

1) The relationship between non-agricultural income in total family income and the degree of comprehensive straw utilization is distinctly negative, so farmers who receive higher non-agricultural income are more reluctant to utilize straw comprehensively. The fundamental reason is that non-agricultural job opportunities would lead to labor shortage and wage rises in rural area, causing higher opportunity costs for farmers, so their net profits are low or even negative.

2) The relationship between farmers' planting acreage, livestock breeding and their comprehensive utilization is remarkably positive, so farmers who have larger planting or breeding scale are more likely to utilize straw comprehensively. Because larger planting acreage means more straw resource and higher economic value, so the potential value and expected earnings of straw are higher, and farmers are more willing to utilize it comprehensively; farmers who work on breeding ruminants need straw for feed, so are more willing to collect and utilize it.

3) The relationship between farmers' cognitive degree of open-air straw burning, government price subsidies and comprehensive straw utilization is markedly positive. Government measures like publicity and subsidies contribute to farmers' comprehensive utilizations. On the contrary, if lack of government publicity, farmers may not realize the damage of open-air straw burning, and their misconception could bring about incorrect handling ways of straw; if lack of government price subsidies, farmers' expected earnings may be decreased because of low market price, resulting their unwillingness to collect and utilize it.

4) The relationship between householders' age, their educational level, and the degree of comprehensive straw utilization is distinctly negative, showing that farmers who are of older age and higher educational level are less inclined to utilize straw comprehensively. Farmers who receive more education mostly participate in non-agricultural employment, and are disinclined to devote much time to treating straw. Furthermore, labor ability loss of left-behind elderly limits comprehensive straw utilization.

4.2. Suggestions for policies
a) By means of price subsidies, the government could raise the purchasing price of straw, and thus guide peasants to collect and sell it. The large gap between straw earnings and non-agricultural income make peasants unwilling to treat straw comprehensively. For this reason, the government could
converge peasants' opportunity cost for abandoning straw (profits of selling straw) with the one for utilizing it (non-agricultural income) by adopting the mentioned measure, so as to improve their willingness of collecting and selling straw. Also, the government could begin with subsidizing enterprises that need straw, for example, the government could offer power plants tax cuts to replace coal with straw, and then generate their demands for it. Meanwhile, the government could provide these kind of enterprises with price subsidies when collecting straw, then, encourage and supervise them to acquire straw on site, so that peasants' price demand is satisfied and the market supply of straw is stimulated.

b) The government could encourage land circulation to expand agricultural production scale and increase profit of straw. Limited by small scale of agricultural production, one of the problems existed commonly now is the poor and scattered production of straw, so, scale economy is hardly reached during the process of straw treatment. Under the situation of growing non-agricultural employment, the government should encourage reasonable land circulation after the mass transfer of rural labor forces, for the purpose of adding planting acreage of individual farmers. By this means, farmers could treasure the economic value of straw while enjoying the privilege of scale economy of treating straw to reduce their utilizing costs.

c) By publicizing, training and subsidizing peasants, the government could raise their environmental awareness and their cognitive level, so as to reduce their treating costs and guide them to utilize straw comprehensively in different ways. Firstly, the government should strengthen publicity and education via broadcasts, seminars etc., in order to spread among peasants the damage of open-air straw burning, the ways and potential economic value of comprehensive straw utilization, and thus raise their environmental consciousness and cognitive level. Secondly, with the aid of agricultural science and technology popularization, the government should take up responsibilities of testing, demonstrating, training and popularizing new technologies, and conduct farmers to select and master technologies that suit locally like straw returning, fertilizer composting, biogas producing and forage making. Thirdly, to share farmers' treating costs, the government should offer price subsidies when farmers buy machines for straw treatment to raise their net profit.

d) If the system of agricultural socialization service is perfected, the difficulties for farmers to utilize straw comprehensively would be lowered. Facing the phenomenon of agricultural labor aging and labor shortage, the government should encourage the extension of agricultural socialization service system from production to postproduction, with the bond of agricultural cooperative economic organization, agricultural leading enterprises and civil service organization in individual form. In this way, the government could raise farmers' organization degree by providing related services like technical support, mechanical lease, straw treating outsourcing and so on, to deal with their difficulties in collecting and utilizing straw, especially for elder farmers, so their willingness to comprehensive utilization could be promoted.

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References
[1] Yang Linshu, Wu Jinheng, Yan Cheng. Overviews on Straw Re-utilization [J]. Journal of Agricultural Environmental Science, 1993, (6): 271 - 273.
[2] Huang Guoqin. Straw Resources and Their Utilization and Development in Southern China [J]. Natural Resources, 1997, (5): 64 - 70.
[3] Cao Guoliang and his team. Estimating the Quantity of Crop Residues Burnt in Open Field in China [J]. Resources Science, 2006, (1): 9 - 13.
[4] Li Zhenyu, Huang Shao’an. Institutional Failure and Technological Innovation: An Economic Analysis of Farmers’ Burning of Straw [J]. China Rural Survey, 2002, (5): 11 - 16.
[5] Ma Ji, Qin Fu. Comparison of the Effect of Different Patterns of the Government Supervisory on Prohibiting Straw Burning: Based on the Static Game Model with the Analysis of the Relationship Between Farmers and the Government [J]. Journal of China Agricultural University, 2009, (4): 131 - 136.

[6] Guo Lijing, Zhao Jin. Informal Institutions and Farmers Pro-environmental Behavior: As An Example of the Farmers' Straw Processing Behavior [J]. China Population Resources and Environment, 2014, (11): 69 - 75.

[7] Jia Xiufei, Ye Hongwei. Selection of the Policy Tools for Straw Burning Pollution Control: According to the Analysis of Public Policy, Economics Dimension [J]. Journal of Arid Land Resources and Environment, 2016, (1): 36 - 41.

[8] Chen Xinfeng. An Economic Analysis on the Pollution of Straw Burning in Rural Areas and its Treatment in China and on the Industrial Substitution of Agricultural Production Factors in the Process of Agricultural Modernization [J]. Chinese Rural Economy, 2001, (2): 47 - 52.

[9] Zhu Qirong. Study on the Willingness of Farmers to Deal with Crop Straw in Suburban Areas: An Empirical Analysis Based on the Survey Data in Jinan [J]. Issues in Agricultural Economy, 2008, (5): 103 - 109.

[10] Mei Fuchun. Cost-benefit Analysis of Straw-burning Pollution: Take Xinyang in Henan Province as an Example [J]. Environmental Science and Management, 2008, (1): 30 - 37.

[11] Wang Shujuan, Zhang Bing. A Study on the Decision-making Behavior of Farmers Selling Straw: Based on the Data of Farmers in Jiangsu Province [J]. Issues in Agricultural Economy, 2012, (6): 90-96.

[12] Wu Xuelian, Zhang Junbiao, Feng Junhui. Farmers’ Willingness to Participate in the Market Circulation of Straw and its Influencing Factors [J]. Journal of Arid Land Resources and Environment, 2017, (2): 79 - 84.

[13] Qian Zhonghao, Cui Hongmei. Farmers’ Behavior of Straw Utilization: Theoretical and Empirical Analysis-Based on the Survey Data of Nantong, Jiangsu [J]. Journal of Agrotechnical Economics, 2010, (9): 4 - 9.

[14] Yan Tingwu, Zhang Tongzhao, He Ke, Zhang Junbiao. A Study on Farmers’ Decision-making Behavior of Crop Straw Returning: Based on the Survey in Seven Provinces [J]. Issues in Agricultural Economy, 2017, (4): 39 - 48.