Study on Farmers' Cognition and Willingness to Plant Trees during Collective Forest Right Reform Based on Data from Plain Areas of Henan Province

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Abstract On the basis of the survey data from plain areas of Henan Province, farmers' cognition and willingness to plant trees in collective forest right reform are studied. According to statistical analysis and regression equation of binary logistic regress analysis, it is generally believed that different participants have various attitudes to the reform, with regard to if planting trees or more, reform variables have a distinct effect, as well as income variable and loaning or lending variable. At last, some advices are put forward, that is, the government should strengthen collective forest right reform, accelerate matching reform and increase policy and financial support to forestry farmers.

Key words Collective forest right system, Plain areas, Performance, Farmer

Collective forest right reform is being implemented in China now, and it is not only a significant practice of further liberating and developing rural productivity and establishing forestry development mechanism full of vigor and vitality, but also a system to ensure sustainable use of forest resources. The CPC Central Committee and the State Council issued the Decision on *Accelerating the Development of Forestry* in 2003, and the overall deployment of collective forest right reform is shown in the decision. The pilot work was carried out firstly in Fujian, Jiangxi, Liaoning and Zhejiang provinces, and lots of valuable experience was obtained. Moreover, In the Central Document No. 1 issued in 2006, 2007 and 2008 as well as the *Eleventh Five-Year Plan for National Economic and Social Development of the People's Republic of China*, collective forest right system reform is regarded as the important content and measure of deepening rural reform. In 2009, the central forestry work conference emphasized the importance of deepening forest right reform again. The cognition and willingness of forest farmers who are the main subject to implement the reform are key to the success of forest right system reform.

According to previous studies, farmers' cognition has two kinds, that is, one refers to farmers' cognition and acceptance attitude towards new technology, varieties and things[1-4], the other one is the degree of the approval to a new standards, organization, policy or system[5-9]. There are many studies about farmers' willingness, and these studies can be grouped into four kinds. The first group is mainly about farmers' willingness to accept a new technique or mode of production[10-17]. The second one is about farmers' degree of the approval to a policy or system[18-20]. The third one is about the farmers' willingness to take part in a new organization or service[21-25]. The fourth one is about farmer' willingness and attitude towards farmland adjustment or transfer[26-28]. Meanwhile, some scholars have discussed farmers' cognition and willingness about forestry policy and forest right reform[29-33]. For instance, Yin *et al.*[29] have studied the performance of China's forest right system reform in the 1980s, and the results show that farmers' production reaction to forest right system reform varies with regions, which mainly results from the instability of policy environment. Li Ya *et al.*[31] have analyzed the collective forest right reform of Jiangxi Province from aspects of forestland management, forestland transfer and public welfare forest subsidy will. It is concluded that it is necessary to enhance forestry management level and subsidy standard of public welfare forest, standardize forestland transfer and improve management system of cutting quota after the collective forest right system reform. The scholars above have illuminated the influencing factors of farmers' productive investment from different angles and obtained some useful conclusions. However, there are some deficiencies in these studies. That is, current studies are mainly about the collective forest area in the south, but there are few studies about collective forest right reform of the forest area in a plain, and there are a shortage of comprehensive reports on the quantitative analysis of farmers' cognition and willingness to implement forest right reform. Moreover, current methods should be improved, that is, there are too many descriptive analyses in empirical studies.

1 Analysis of farmers' cognition to forest right system reform

To study the performance of collective forest right reform in plain areas, it is necessary to analyze the cognition of farmers taking part in collective forest right reform. At the end of 2008, we conducted a questionnaire survey in three districts (Yuanhui, Zhaoling and Yancheng) and two counties (Linying and Wuyang) in plain areas of Henan Province, and the basic situation of the re-

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gions are shown in Table 1. In the survey, forestry personnel, village cadres, large forestry farmers with more than 6 666.7 m^2 of forest, common forestry farmers with less than 6 666.7 m^2 of forest, farmers without forest. Here, we mainly analyze forestry farmers' cognition to the equity and stability of collective forest right reform. Using the stratified sampling method, we issued 100 questionnaires in total and collected 85 questionnaires. Data were processed by spss13.0.

Table 1 Basic situation of the regions studied

Region	Total population 10^4 people	Forestland area 10^4 hm^2	Annual GNP 10^8 yuan	Output value of forestry 10^8 yuan	Farmers' annual income per capita yuan	Main contracting methods of forestland
Linying	73.00	1.10	10.19	4.40	4 136	Contracting trees and land simultaneously, road section auction
Wuyang	63.00	2.20	4.67	4.90	2 200	Household contract, big household contract
Yuanhui	31.00	0.65	0.33	0.22	3 955	Contracting trees and land simultaneously, public auction
Zhaoling	49.70	0.45	5.52	2.31	4 359	Road section auction
Yancheng	48.70	1.12	6.48	1.69	4 544	Contracting trees and land simultaneously, auctioning on a forest website

Note: Data are from the collection of basic situation of forestry in the regions studied.

Table 2 Fairness of contracting model of forest right reform

Interviewee	Statistical value	Fairness of contracting model		Total
		Yes	No	
Forestry personnel	Number	15	1	16
	Number proportion//%	93.8	6.3	100.0
	Fairness proportion//%	19.7	11.1	18.8
	Total proportion//%	17.6	1.2	18.8
Village cadres	Number	12	0	12
	Number proportion//%	100.0	0	100.0
	Fairness proportion//%	15.8	0	14.1
	Total proportion//%	14.1	0	14.1
Farmers without forest	Number	15	3	18
	Number proportion//%	83.3	16.7	100.0
	Fairness proportion//%	19.7	33.3	21.2
	Total proportion//%	17.6	3.5	21.2
Common forestry farmers	Number	23	4	27
	Number proportion//%	85.2	14.8	100.0
	Fairness proportion//%	30.3	44.4	31.8
	Total proportion//%	27.1	4.7	31.8
Large forestry farmers	Number	11	1	12
	Number proportion//%	91.7	8.3	100.0
	Fairness proportion//%	14.5	11.1	14.1
	Total proportion//%	12.9	1.2	14.1
Total	Number	76	9	85
	Number proportion//%	89.4	10.6	100.0
	Fairness proportion//%	100.0	100.0	100.0
	Total proportion//%	89.4	10.6	100.0

Table 3 Effectiveness of contracting model of forest right reform

Interviewee	Statistical value	Fairness of contracting model		Total
		Yes	No	
Forestry personnel	Number	16	0	16
	Number proportion//%	100.0	0	100.0
	Fairness proportion//%	22.2	0	18.8
	Total proportion//%	18.8	0	18.8
Village cadres	Number	11	1	12
	Number proportion//%	91.7	8.3	100.0
	Fairness proportion//%	15.3	7.1	14.1
	Total proportion//%	12.9	1.2	14.1
Farmers without forest	Number	14	4	18
	Number proportion//%	77.8	22.2	100.0
	Fairness proportion//%	19.4	30.8	21.2
	Total proportion//%	16.5	4.7	21.2
Common forestry farmers	Number	20	7	27
	Number proportion//%	74.1	25.9	100.0
	Fairness proportion//%	27.8	53.8	31.8
	Total proportion//%	23.5	8.2	31.8
Large forestry farmers	Number	11	1	12
	Number proportion//%	91.7	8.3	100.0
	Fairness proportion//%	15.3	7.7	14.1
	Total proportion//%	12.9	1.2	14.1
Total	Number	72	13	85
	Number proportion//%	84.7	15.3	100.0
	Fairness proportion//%	100.0	100.0	100.0
	Total proportion//%	84.7	15.3	100.0

As shown in Table 2, the number of people thinking that forest right reform is fair accounts for 89.4% of total number, while 10.6% of people suggest that it is unfair. From Table 3, we can find that 84.7% of people think forest right reform is effective, while the others hold an opposite view. In a word, most people suggest that forest right reform is fair and effective, and different cognitive subjects have various views on forest right reform. That is, forestry personnel and village cadres, as executants of forest right reform, highly approve the reform. Most large forestry farmers have a good interpersonal background and a strong desire for planting forest, so they show a positive and optimistic attitude to distribution fairness and policy effect. Farmers without forest feel a impulse to plant forest and regret that they are unable to plant forest, so they are indifferent to the reform and suggest that the distribution policy and its effect need to be improved. Compared with the large forestry farmers, common forestry farmers are in a weaker position and doubt about the consistency, fairness and effectiveness of forest right system reform policy, so they hold a cautiously optimistic attitude to forest right system reform. Based on the analyses above, we could obtain some useful conclusion of farmers' cognition to forest right reform, but these conclusions are mainly about farmers' overall and general understanding to forest right reform. Moreover, the analyses above are too general, and the interviewee may skimp the questions, so the conclusions can not reflect real wishes of the individual precisely, and farmers' cognition to the reform needs to be further embodied.

2 Analysis of farmers' willingness to implement forest right reform

A system can affect forest growth through influencing factors of

production (forestry farmers and related subjects, forestland and forest resources, funds, technology, systems and so forth) and their collocation mode. Therefore, to increase the quantity and benefit of forest resources, we should consider non-institutional environment (individual characteristics, family characteristics, regional environment features and so on) and their own characteristics besides institutional factors.

2.1 Proposing of a hypothesis and data sources

2.1.1 Proposing of a hypothesis. At the end of 2007, the plain areas of Henan Province began to carry out forest right reform and planed to finish the reform within three years. The implementation process of the reform is different in various regions, villages and towns. Besides issuing a forest right certificate, an important content of the new forest right system reform is giving the right of disposal more freedom and reforming harvesting system of commercial forest, so the issue of a forest right certificate and satisfaction degree of harvesting system are as variables of forest right reform. In this study, we lay heavy stress on the effects of forest right system reform on farmers' forest planting, so we put forward a hypothesis, that is, with the implementation of the new forest right system reform, farmers without forest willingness be inclined to plant trees, and forestry farmers' willingness to plant more trees.

2.1.2 Data sources. Relying on the subject "Research on forest right system reform and innovative of plain areas in Henan Province" proposed by Forestry Department of Henan Province, a survey was conducted in 23 villages of two counties and three districts of Luohe at the end of 2008. 500 questionnaires were issued through random sampling, and 346 questionnaires were collected. In 2009, a supplementary survey was carried out.

2.2 Model specification, variable definition and description

2.2.1 Model specification. In this study, we choose logit model to verify the hypothesis above. When the dependent variable $y = 0$, farmers are unwilling to plant trees or more trees; as $y = 1$, farmers want to plant trees or more trees. Following the classic assumption, Z is as the linear function of variables influencing farmers' choice about planting (more) trees:

$$Z = a + \Sigma\beta_i x_i + U$$

where U is the random variable obeying extreme value distribution; x_i is influencing factor i; β and a are parameters to be estimated. Based on the assumption, it is suggested that the observation values have a linear relationship with farmers' tendency to plant trees, so it is suitable to use the linear regression to express them in the model.

According to Logistic function, logit model can be obtained, namely $P_i = E(y = 1/x_i) = 1/[1 + \exp(-x_i\beta)] = \exp(x_i\beta)/[1 + \exp(x_i\beta)]$, where $P_i/(1 - P_i) = \exp(x_i\beta)$, and $P_i/(1 - P_i)$ is odds ratio, namely $L = \ln(P_i/(1 - P_i)) = x_i\beta$, where L is called logit, so a positive model is named logit model. As p varies from 0 to 1, log unit L changes from $-\infty$ to $+\infty$. That is, the probability is 0 - 1, but it can not restrict logit. If logit is positive, the chance of regressand = 1 will increase when regressor value rises; if logit is negative, the chance of regressand = 1 will decrease when regressor value increases. According to the definition of the independent variable in Table 4, the model can be formed as follows: $\ln(P_i/(1 - P_i)) = \beta_0 + \beta_i HOV + \beta KPIEV + \beta LPROV + \beta MMAV$.

2.2.2 Variable choice and description. The influencing factors of planting trees involve a subject (forestry farmers), an object (forest) and external environment (village-level characteristics, forestry management system features and other stakeholders like characteristics of agricultural land). Age and education level of a household head, population of a family and social network representing basic situation of a family, per capita arable land area, breeding scale and per capita net income standing for production, management, income and expenditure of a family, if issuing forest right certificates and satisfying harvesting system reflecting the reform, and development degree of infrastructures, satisfaction degree of forestry technical services and if loaning or lending standing for the market and the environment are chosen as independent variables. The definitions and expected changing directions of these independent variables are shown in Table 4.

2.2.3 Statistical description of the independent variables. As shown in Table 5, the youngest head of a household is 26 years old, while the oldest head is 78 years old, and their average age is 49.6. The minimum population of a family is 2, while the maximum reaches 9, and the average is 4.56. The minimum and maximum values of per capita arable land area are 133.4 and 2 000 m^2 respectively, with an average of 973.33 m^2. The minimum and maximum value of per capita net income are 700 and 15 000 yuan respectively, with an average of 6 600 yuan.

2.3 Model test and result interpretation

2.3.1 Model test. Different variables constitute various models to analyze farmers' willingness, and the regression results and model checking are shown in Table 6. In this study, Chi-square test and goodness of fit test of each model were carried out. Chi-square test (Step, Block and Model) shows that the models are significant, and they are still significant after increasing variables. Moreover, Chi-square values are larger after increasing variables. Goodness of fit test of the models reveals that -2 Log likelihood is smaller, while Cox & Snell R Square and Nagelkerke R Square are larger; HOSMER and LEMESHOW test are not significant. According to the test results, model 1 is better and more meaningful to the quantitative analysis, so variables of model 1 were mainly analyzed as follows. As shown in Table 6, the variables reflecting the reform have significant effects on the dependent variable ($\alpha = 0.05$), and their correlation is positive. For the variable of issuing forest right certificates, the ratio of planting trees to unwilling to plant trees is $e^{1.892}$, that is, the probability of planting trees is 6.232 6 times as higher as that of unwilling to plant trees. For the variable of satisfying harvesting system, the ratio of planting trees to unwilling to plant trees is $e^{1.238}$, that is, the probability of planting trees is 3.448 7 times as higher as that of unwilling to plant trees. All variables reflecting basic situation of a family have no significant effects on the dependent variable, showing that

these factors are unimportant to planting trees. It is also probably because that there is no obvious difference in family characteristics among various households as the modern society has become increasingly open. Among the variables reflecting production, management, income and expenditure of a family, per capita net income has significant effects on farmers' willingness to plant trees, and they have positive correlation, showing that farmers are prone to plant trees with the increase of their income. Moreover, one of main ways to increase farmers' income is to plant trees after forest right reform. Per capita arable land area and breeding scale have no significant effects on the dependent variable, revealing that farmers' production and operation conditions are unimportant to plant trees. The possible reason is that planting trees or managing forest has more independence compared with planting crops and breeding. In addition, farmers with or without forest before have the same willingness to planting trees. Among the variables reflecting the market and service, development degree of infrastructures and satisfaction degree of forestry technical services have no significant effects on the dependent variable. On the one hand, these external environmental conditions are unimportant to farmers' choice of planting trees; on the other hand, these external services and basic conditions are the same in the sample regions. Loaning or lending variable has significant effects on the dependent variable, showing that planting trees needs more funds, and farmers with enough circulating funds may plant trees or more trees.

Table 4 Definitions of the independent variables about farmers' willingness

Independent variable	Symbol	Unit	Value explanation	Expected changing direction
Basic situation of a family	HOV			
Age of a household head	AGE	Year		+/−
Education level of a household head	EDU		1 = Primary school and below; 2 = Junior high school; 3 = High school and above	+
Population of a family	NUMNUM	People		+/−
Social network	SOCINET		1 = Very good; 2 = Better; 3 = General; 4 = Worse; 5 = Very bad	+
Production, management, income and expenditure of a family	PIEV			
If planting forest	IFFOREST		1 = Yes; 0 = No	+/−
Per capita arable land area	MEANAREA	Mu (666.7 m^2)		−
Breeding scale	BREED		1 = Without; 2 = Small; 3 = General; 4 = Bigger; 5 = Big	+/−
Per capita net income	MEANINCO	10^4 yuan		+
Reform variables	PROV			
If issuing forest right certificates	IFREFORM		1 = Yes; 0 = No	+
If satisfying harvesting system	IFSATIFC		1 = Yes; 0 = No	+
Market and environmental variables	MAV			
Development degree of infrastructures,	INFRASTR		1 = Very good; 2 = Better; 3 = General; 4 = Worse; 5 = Very bad	+
Satisfaction degree of forestry technical services	IFSERVE		1 = Very good; 2 = Better; 3 = General; 4 = Worse; 5 = Very bad	+
If loaning or lending	IFBLOAN		1 = Yes; 0 = No	+

Table 5 Statistical description of the independent variables about farmers' willingness

Independent variable	Survey population	Minimum value	Maximum value	Average	Standard deviation
Age	346	26	78	49.62	9.739
Education level	346	1	3	2.16	0.926
Population of a family	346	2	9	4.56	1.373
Social network	346	1	5	2.79	1.192
If planting forest	346	0	1	0.63	0.560
Per capita arable land area	342	0.20	3.00	1.46	0.618
Breeding scale	344	1	5	1.96	1.683
Per capita net income	346	0.07	1.50	0.66	0.258
If issuing forest right certificates	345	0	1	0.42	0.469
If satisfying harvesting system	346	0	1	0.33	0.479
Development degree of infrastructures	346	1	3	2.32	0.597
If loaning or lending	346	0	1	0.27	0.490
Satisfaction degree of forestry technical services	346	1	5	2.81	0.931

Table 6 Regression analysis of logit model

Variable	Model 1		Model 2		Model 3		Model 4		Model 5	
	B	Sig.	B	Sig.	B	Sig.	B	Sig.	B	Sig.
AGE	0	0.978			-0.004	0.762				
EDU	0.090	0.512			0.108	0.413				
NUMNUM	0.014	0.878			0.007	0.936				
SOCIENT	0.196	0.103			0.125	0.252				
IFFOREST	-0.153	0.780	0.060	0.908			0.063	0.899		
MEANAREA	-0.212	0.376	-0.109	0.635			-0.147	0.520		
BREED	-0.020	0.872	-0.012	0.924			-0.009	0.942		
MEANINCO	1.384	0.009	1.339	0.010			1.310	0.012		
IFREFORM	1.892	0.016	0.797	0.028	0.909	0.002			0.770	0.004
IFSATIFC	1.238	0.000	1.206	0	1.148	0			1.130	0
INFRASTR	0.136	0.494	0.116	0.560	0.098	0.613			0.089	0.645
IFSERVE	0.045	0.748	0.050	0.716	0	0.997			0.173	0.468
IFBLOAN	0.143	0.045	0.163	0.036	0.188	0.042			0.124	0.050
Constant	1.260	0.312	1.074	0.148	0.768	0.495			0.447	0.434

3 Conclusions and suggestions

According to the analysis of farmers' cognition to forest right system reform, different participants have various cognition, and most participants believe forest right system reform can increase their income and it is fair, but a considerable quantities of participants doubt about the stability of the reform. In addition, the analysis of farmers' willingness to implement forest right system reform shows that the variables reflecting forest right system reform have significant effects on the dependent variable, as well as the variables per capita net income and if loaning or lending. That is, implementation of forest right reform, improvement of per capita net income, and enhancement of farmers' loaning and lending capacity can induce farmers to plant trees.

Based on the analyses above, some suggestions are put forward as follows. During implementation of forest right reform, according to the difference of various participants' cognition to forest right reform, the participants should be treated differently to reduce resistance to the reform as much as possible and obtain the best performance of the reform. Meanwhile, it is necessary to speed up matching reform, innovate forest-related financial system, and strengthen policy and financial support to forestry farmers to make farmers plant trees or more trees. Besides, harvesting system of commercial forest should be reformed to increase farmers' income anticipation from planting trees.

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ter diversion and water distribution are difficult to increase the total amount of water supply, but from Chinese agricultural water features that the key grain-producing areas are lack of water relatively and regional unharmonious problems are more obvious, it is more realistic and significant to realize the inter-regional water diversion for the resolution of agricultural water consumption. Only in this way can agricultural water environment be improved and the most efficient food production can be guaranteed in the key grain-producing areas.

(1) Trade of virtual water and water supply increasing[8].

Virtual water refers to the total water consumption during the production of goods and services. Because the virtual water can be adjusted by the trade mode between the countries or regions, we can import virtual water from the areas with high water level to balance the utilization deficit of regional water resources, and ease the pressure of regional water resources.

(2) Regional water diversion and coordination of water resources allocation.

Regional water resources diversion is a normal form and method for water resources allocation which is proved practicable by practice. For example, the water resources pressure in key grain-producing areas including Shandong, Jiangsu and Hebei is too large, according to this, water diversion from some other non-principle production areas such as Sichuan should be considered. During water diversion, we should persist in some principles including focusing on economic efficiency, ecological environment protection, global optimum and quasi-market operation, as well as do some dynamic adjustment based on the new unbalance of regional economic and social development[9].

Furthermore, regional water diversion does favor of flood control and drainage and improvement of ecological environment, and provides a better guarantee for agricultural production indirectly. The rational allocation of domestic water and agricultural water ratio should be paid special attention after water diversion, so as to make them develop in coordination.

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