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## Identifying and Understanding factors influencing farmers' intentions on different forest management models in Sanming, Fujian

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### ABSTRACT

In attempts to foster sustainable forest management practices, farmers' intention on choosing different forest management models has become widely recognized as a core issue in forest management. This paper analyzed factors influencing farmers' intention on choosing individual household forest management, and joint forest management. Based on data collected through a household survey of 842 farmers in Sanming, Fujian Province using principal component analysis and multinomial logit model. Principal component analysis resulted in a three-factor the level of forest management, policy system and cutting index which accounted for 72.21% of the total variance. The results of multinomial logit model indicated educational level, the dispersion degree of forestland, the proportion of forestry income accounted to family income, the level of forest management, the number of household labor force and policy system were found to be the main factors influencing choosing the forest management model. Therefore, the government should fully respect farmers' intention on forest management model and guide them to choose the suitable management model in local conditions. Strengthen support to joint forest management to promote the development of forestry should also be take into consideration.

### KEYWORDS

Farmers; Individual household forest management; Joint forest management.



## INTRODUCTION

Since 2003, a new round of forest tenure reforms has been sweeping across rural China. The nature of the reforms is devolving these source use rights to individual or small groups of household and improving the policy environment for private forestry practices. At the same time, a number of new forest management models spring out, such as individual forest management, partnership management, joint shareholding management and so on, which maximally increased the initiative of farmers in engaging in forest management. No matter how the models differ in ownership, management, they are all in pursuit of economic or utility maximization. First-time forest owners took the forefront as forestry managers, whose activities directly impact on the development of sustainable forestry management. Their behavior on market and policy is reasonable like a “company” investor, weighing all the pros and cons to pursue benefit maximization<sup>[3]</sup>. However, why do the farmers have different decision-making on management models even in the same region and what are the factors that impact on their choosing behavior?

A number of researches devoted to the different models of forestry management<sup>[8]</sup> summarized the different forest management models through the survey in Fujian and then classified them into six types. Individual household management was taken as the most popular, followed by joint forest management among all the models. Furthermore, Huang<sup>[2]</sup> analyzed the operation form and mechanism of the models based on the transaction cost theory and property. For the attitude towards them, individual household management is prior to joint forest management due to it can maximize farmer's intention on afforestation and reduce intervention of government in forest management to demonstrate the equity for farmers. In contrast to individual household management, joint forest management was recommended since it can realize the scale effect and decrease cost in case of the negative characters of forest such as long cycle of forest growth and high risk. In recent years, understanding the intentions of mainly forest manager to a special forestry activity is significant for local government to devise development strategy. Several scholars contributed to investment of afforestation forest cooperative organization, forestland circulation and ecologic compensation<sup>[2]</sup>. Simultaneously, household self-characteristics, family characteristics, forest characteristics and other factors were proved to have different influence on farmers' intention. The approach of binary logit regression incorporated SSCP paradigm to analyze the indicators affecting on farmers' intention to the two management models. Gao<sup>[4]</sup> pointed that only if the management model is appropriate to forest resource and current institution, the benefit maximization and the sustainability of management can be realized. However, within the limited factors and approaches, this study drawn upon previous studies identified the factors and principal component analysis and multinomial logit model to understand farmers' intentions to choose a forest management model. Additionally, the study will help policymakers and other forest investors to gain insight into effective topics and strategies for improving the whole forest management level.

## MEASURES AND METHODS

### Study area

Sanming city is located in the middle of Fujian province with 2.29 million ha and the forest coverage has recently increased up to 76.8% as the most green city in China. In addition, it is one of the few cities whose stocking volume is more than 100 million m<sup>3</sup> and has the highest forested area per capita in Fujian province. The collective forest management in Sanming has experienced deeper changes over time which began in collective forest tenure reform in 1988. After conducting a series of practices on collective forest management, it formed a multiple forest management model shown in TABLE 1, individual household management and joint forest management are the main forest management models in Sanming now.

The ownership of the forestland is owned by collective in both of the management models. The decision-making power of forestland-use right and wood-management right belong to household individual totally in individual household management, which is maximum household's power. While,

the forestland-use right and wood-management right belong to all the shareholders in joint forest management.

**TABLE 1 : The manage area of different forest management model in Sanming**

Category	2005yr		2009yr		2013yr	
	million ha	%	million ha	%	million ha	%
individual household management	0.58	55.56	0.45	38.92	0.54	44.22
joint forest management	0.18	17.05	0.42	36.37	0.44	36.33
Others	0.29	27.39	0.28	24.71	0.23	19.45

Individual household management means single family as management unit, arranged their forest product activities and manage it all by household themselves. Generally, it can maximize the property rights incentive effect to farmers. Farmers can reduce the uncertainty risk of future forest management through owning the physical asset rights and economic rights of forest. Meanwhile, they will tend to engage in forest management when they thought they can get a greater earing in forest future, otherwise not.

Joint forest management, taking advantages of “joint” the resource, such as labor, capital, technology and forestland to manage under the cooperative principle. The household can take their forestland, wood or labor to participate in management, working together and distribution according to work or stock. As we known, interests-sharing, risk-sharing, self-financing, independent manage accounting can make participators obtain more benefits. Compare to the individual household management, it can maximum aggregate social capital, broadening the channels of forestry investment, decentralized management risk, and promote the rational flow of factors of production of the combination and improve the efficiency of the resource configuration.

**Methods**

The data obtained from the survey were analyzed using three approaches, apart from the frequency analysis. First, by means of Principal Component Analysis (PCA)<sup>[5]</sup>, taking into consideration the non-linear relationships, most commonly found in sociological researches. The rationale behind this process was to decrease the overall number of original variables and to combine both values and objectives to see if any combinations arise. Based on the components scores for each original variable and combinations between the scores for values and objectives, the components were named accordingly.

At the next step, a Multinomial Logit (MNL) model, widely applied in the social sciences literature<sup>[1,6,7]</sup> was employed in order to examine the indicators and the willingness to choose management to the groups of farmers, detected after the employment of the PCA. In other words, this step of the empirical analysis seeks to find differences in intentions which potentially stem from the differences in the groups of farmers. The basic Multinomial Logit model is specified as follows:

$$\left\{ \begin{aligned} \text{logit}(F_1) &= \ln\left(\frac{F_1}{F_2}\right) = B_1 + \sum_{n=1}^n \alpha_n x_n + \varepsilon_1 \\ \text{logit}(F_2) &= \ln\left(\frac{F_1}{F_3}\right) = B_2 + \sum_{n=1}^n \beta_n x_n + \varepsilon_2 \\ \text{logit}(F_3) &= \ln\left(\frac{F_2}{F_3}\right) = B_3 + \sum_{n=1}^n \theta_n x_n + \varepsilon_3 \end{aligned} \right.$$

Where,  $F_i$  is the probability for farmers choosing  $i$  model,  $X$  is the factors impacting on farmers’ intention to forest management;  $\alpha, \beta, \theta$  is coefficient;  $n$  is the number of factors,  $\varepsilon$  is random

disturbance term. According to the rational character of farmers, they will choose one is appropriate for their own capacity. Furthermore, the equation of farmers' intention to different models =  $F(\text{Household Self-Characteristics, Family Characteristics, Forest Characteristics, the others}) + \varepsilon$ .  $F_1$  is the probability for farmers choosing individual household management,  $F_2$  is the probability for farmers choosing joint forest management,  $F_3$  is the probability for farmers choosing either, and  $F_1 + F_2 + F_3 = 1$ .

### Date collection

Date was collected randomly from 902 heads of farm households in the 9 collective forest tenure reform towns, 38 villages in February, July 2013 and January 2014 through formal and informal survey techniques. It was attempted to interview the respondents in isolation to secure their sincerity in their responses. Especially, Jiangle and Youxi town where the government guided farmers to participate joint forest management by providing seedlings and technology, farmers got much benefit from it and take more interest in partnership management and joint share management. While, more than 80% farmers in the rest towns hold the intention on choosing individuals household management. Hence, government plays a significant role in farmers' behavior on choosing forest management model. This study econometric analysis of the selected independent variable descriptive statistical results showed in TABLE 2.

**TABLE 2 : Variable definitions included in the regression equation model**

Household Self-Characteristics	Gender	X1	1 if male, otherwise 0
	Age	X2	Quantitative
	Educational level	X3	1=illiteracy 2=primary school 3=middle school 4=high school 5=university
	Healthy	X4	1=very healthy 2=normal 3=轻度疾病 4=heavy illness
	Leader	X5	1 if yes, 0 otherwise
Family Characteristics	Household size	X6	Quantitative
	The number of family labor force	X7	Quantitative
	Annual income per capita (yuan/household*yr)	X8	Quantitative
	The percentage of forest contributing to income	X9	Quantitative
Forest Resource Characteristics	Forestry area (mu)	X10	Quantitative
	The number of forest	X11	Quantitative
	The quality of forest	X12	1=bad 2=normal 3=good
	The distance from household's house to the forest	X13	1=below 0.5 km 2=0.5km to 1km 3=1km to 5km 4=5km to 10km 5=above 10km
Forest Management Characteristics	Enough capital	X14	1 if yes, 0 otherwise
	Enough labor force	X15	1 if yes, 0 otherwise
	Enough technology and knowledge	X16	1 if yes, 0 otherwise
	Enough information	X17	1 if yes, 0 otherwise
Policy Characteristics	Easy to obtain cutting index	X18	1 if yes, 0 otherwise
	Forest productive enthusiasm	X19	1=low 2=normal 3=high

## RESULT AND DISCUSSION

### The descriptive of indicators

In total, the average of family income in joint forest management is much high than that of individual household management, while, the forest income contribution is contrasted. And the mean value and standard error of each indicators showed in TABLE 3.

TABLE 3 : descriptive statistics of influence indicators

Indicators	Individual household management		Joint forest management	
	Mean	Standard error	Mean	Standard error
X1	0.9	0.013	0.95	0.018
X2	49.43	0.432	50.15	0.865
X3	2.75	0.041	2.9	0.079
X4	1.22	0.023	1.24	0.043
X5	0.26	0.019	0.34	0.04
X6	5.01	0.078	5.07	0.142
X7	1.8	0.046	2.13	0.129
X8	18578.79	22848.79	20247.61	2499.666
X9	0.14	0.01	0.07	0.015
X10	61.9	5.774	60.189	10.5979
X11	2.92	0.061	2.77	0.108
X12	2.53	0.029	2.54	0.049
X13	2.48	0.044	2.68	0.084
X14	0.77	0.019	0.67	0.039
X15	0.78	0.019	0.65	0.04
X16	0.7	0.02	0.62	0.041
X17	0.61	0.022	0.52	0.042
X18	0.83	0.017	0.74	0.037
X19	2.75	0.022	2.74	0.043

### The result of PCA

Considered many factors are potential affected farmers' intentions different managements. Firstly, PCA was involved six indicators, such as X14, X15, X16, X17, X18 and X19. From the KMO - Barlett inspection showed that the value 0.621 is lower than the criteria 0.7, which suggested that the variable degree of overlap between information might not be particularly high, but it still necessary to do PCA. While Barlett spherical inspection showed Sig<0.01, strong correlation between variables, and also explained the PCA was necessary to independent variable dimension reduction.

Then, variance contribution rate of each indicator and the cumulative contribution rate, demonstrated the top three factors contribution was 72.21%. Moreover, X14, X15 and X16 were classified as factor 1, X17 and X19 informed in factor 2 and X18 took as factor 3 by given the rotation is the factor loading matrix. Based on the founding, factor 1 was named as the forestry production situation, the factor 2 called forestry policy as well. By doing so, the new three factors were incorporated into household self-characteristics, family characteristics, forestry resources characteristics and policy characteristics to process regression analysis.

### The result of MNL

According to the results of MNL founding, the chi-square statistic  $X^2$  (chi-square) = 72.871, the sig. = 0.000 < 0.05, which showed least one independent variable can effectively explained and forecasted the result of the sample in the dependent variable as well the model fitting was good. Based on the standard as no willingness intent to forest manage households, X3, X7, X9, X11, Factor 1 and Factor 3 had different significant influence on farmers' intention to individual household management, while X11, Factor 2 and Factor 3 passed the test of significance to farmers' intention to joint forest management. In views of the joint forest management, X1, X9 and Factor 2 had different significant effect on farmers choosing individual household management, the results showed in TABLE 4.

TABLE 4 : The results of MNL

	Individual household management/No willingness		Joint forest management/No willingness		Individual household management/Joint forest management	
	B1	Exp(B1)	B2	Exp(B2)	B3	Exp(B2)
Intercept	2.78		1.232		1.5483	
Male	1.544	3.327	0.223	1.723	1.321*	2.43
Female	0 <sup>b</sup>	.	0 <sup>b</sup>	.	0 <sup>b</sup>	.
X2	-0.013	1.057	0.023	1.043	-0.036	0.865
X3	-0.195*	0.524	-0.329	0.547	0.134	1.078
X4	0.297	1.423	0.533	1.562	-0.236	0.810
Leader	-0.346	1.761	-0.623	0.874	0.277	1.431
NonLea	0 <sup>b</sup>	.	0 <sup>b</sup>	.	0 <sup>b</sup>	.
X6	-0.026	0.343	0.032	1.045	-0.058	0.038
X7	0.263*	1.353	0.029	1.013	0.234	1.231
X8	0	1	0	1	0	1
X9	2.417**	7.353	0.523	1.872	1.894**	4.037
X10	0.023	1.043	0.023	0.968	0	0.324
X11	-0.214***	0.643	-0.235**	0.492	0.021	1.075
X12	-0.281	0.596	-0.346	0.314	0.065	1.032
X13	-0.662	0.358	-0.23	0.343	-0.432	0.562
Factor 1	0.461***	1.037	0.238	1.252	0.223*	1.653
Factor 2	0.089	1.188	0.232*	1.345	-0.143	0.883
Factor 3	-0.338**	0.714	-0.581**	0.581	0.243	1.228

Furthermore, X2, X4 and X5 had no influence on farmers' intention, nevertheless, X3 effect on farmers' intention at 5% significant level and the coefficient was negative in the domain of household self-characteristics. The founding suggested the households whose educational level are higher, more tend to choose joint forest management.

The founding from family characteristics indicating that X6 had no connection to farmers' intention, however, X7, X9 impacted on farmers' intention positively at 10% or 5% significant level. The more labor force and higher forest income proportion, the more possibility of farmers' choosing individual household management.

X10, X12 had no effect on farmers' choosing intention. But X11 had 10% and 5% significant impact on farmers' intention to joint forest management and individual households respectively and negatively. Compare to individual household management, the amount of households' forestland were more, they want to engage in joint forest manage more.

The components of forest management, included capital, technology, labor and information, were proved have positively influence in farmers' intention at 1% and 10% significant level. In contrast to joint forest management, the better of the forest management condition, the more households would like to management by themselves to obtain the maximum benefit.

Factor 3 had negative impact on farmers' intention to choose individual household management and joint forest management both through 5% test of significant. Simultaneously, factor 2 have positive 10% significant influence in farmers' choosing joint forest management comparing to not engaging forest management. It also said that the enthusiasm to forest management was higher and obtaining information was more efficient, farmers tend to participate in joint forest management.

## CONCLUSION

Knowing family forest owner's intentions is critical to furthering the development of forest throughout the Southern of China. The study indicated farmers mostly want to engage in individual

household management. For the factors influencing farmers' intention, the educational level, the number of family labor force, forest income contributing, forestland decentralized, forestry production situation and policy factors all have different significances on the intention of farmers towards different management.

Furthermore, farmers who are high education, owned much dispersal forestland and getting cutting index more difficult, would like to engage in joint forest management. In contrast, the more family labor force, the high forest income contribution, the better forest management level, farmers will choose manage forest by themselves. In our investigation, the amount of joint forest manage is still small since the low development of management, lack of publicity and knowledge. Even worse, this makes some farmers' behavior deviated from their intention. Hence, the decision-makers should further develop and innovative such as joint forest management and other collective management models by holding the key role of individual forest management. Guide farmers choose appropriate forest management model under local context was should also take into consideration by government.

### REFERENCES

- [1] H.Farid, A.D.Silong, S.K.Sarkar; Application of Logit Model in innovation adoption: a study on Biotechnology Academic Researchers in Malaysia. *Am.Eurasian J.Agric.Enviro.Sci.*, **9(3)**, 282-287 (2010).
- [2] Huang heliang et. al; Analysis of influence factors of farmer participation in forestry cooperative economic organization, **9**, 55-58 (2008).
- [3] S.L.Popkin; The rational peasant: The political economy of rural society in Vietnam[M]. University of California Press, (1979).
- [4] Gao lan, Zhangziqiang; Analysis on the Foresters' Behavior Choices and Impact of Constraints about the Sustainable Operated Pattern. *Forestry economics*, **2**, 50-55 (2012).
- [5] J.F.Hair, B.Black, B.Babin, R.E.Anderson, R.L.Tatham; *Multivariate data analysis: a global perspective*. Pearson Education Inc, New Jersey, USA, 800 (2010).
- [6] L.A.Neilson, P.Paxton; Social capital and political consumerism: a multilevel analysis. *Soc.Probl.*, **57(1)**, 5-24 (2010).
- [7] R.Jongeneel, N.Polman, L.Slangen; Changing rural landscapes: demand and supply of public services in The Netherlands. In: F.Brouwer, C.M.van der Heide, (Eds.); *Multifunctional Rural Land Management: Economics and Policies*. Earthscan, London, (2009).
- [8] Xu jingtao et al.; Collective Forest Tenure Reform in China: Analysis of Pattern and Performance Based Data. *Theory and practice of forestry technical and economic China*, (2008).