Factor Analysis on Subsidy Preference of Private Forest Owners

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Abstract Forest farmers are the basic micro-subjects in southern collectively owned forest, and their willingness towards forest management directly influences forestry development. Thus, to provide subsidies to forest farmers is an important means to encourage the farmers' enthusiasm to manage the forest and promote the healthy and sustainable development of private forest. In order to reduce the supply-demand contradictions and improve the implementation effects of the subsidies system, the design of the system should be based on the real needs of forest farmers. On this basis, a questionnaire survey was designed in this paper to study the preferences of forest farmers to different types of subsidies in the southern collectively owned forest and the influencing factors were analysed by the Logistic Model to search for the reasonable design of the system. It was concluded that the forest farmers with different backgrounds show different preference to the subsidies, which, to a certain extent, reflects the development bottlenecks of forestry, and lays a foundation for the design of subsidies system.

Key words Private forest, Design of subsidy system, Forest farmers, Preference

One important means to realize the leapfrog development of forestry in China during the new century is to encourage the free development of private forest. As a new-round forest reform launches, the private forest in China welcomes a great opportunity of development and is showing its strong vitality in many regions. Though a rapid development, the rapid forest also exposes some critical problems, such as the incomplete property right, unreasonable tax, difficult financing, imperfect social service system, *etc.*, which have strictly restricted the further development of private forest.

In order to promote the development of private forest, many countries with advanced forestry industry generally provide subsidies to the private forest[1-2] (the subsidies to private forest in this study refer to the generalized subsides provided by the government, including the direct governmental subsidies to private forest, the funds on road building, free training, subsidies to loan interest, *etc.*[1]). Since the private forest in China experiences a short period of development, the subsidy system to private forest hasn't yet been established. Thus, how to build a subsidy system to the private forest in China by learning from the experiences of other countries is not only a new research project of forestry development in the new century, but also an important project of new socialist countryside construction and urban-rural integration in China.

In order to promote the great development of agriculture, a long-term mechanism for agricultural subsidies is being formed. Forestry belongs to the large-scale agriculture, and it should be covered by the agricultural subsidies system. But due to its particularity, the subsidies to forestry should be based on the preference of forest farmers, otherwise the subsidy system would lose its validity[3]. In order to reduce the contradictions between supply and demand, and improve the implementation effect of the subsidies system, the design of subsidy system to private forest should take into account the real needs of forest owners. On this basis, a questionnaire was designed in this paper to investigate the preference of forest farmers to the subsidy system so as to guarantee the reasonable design of the system.

1 Data source

Southern collective forest is one of the wood production bases in China, covering ten provinces of Fujian, Guangdong, Hainan, Hunan, Hubei, Jiangxi, Guizhou, Zhejiang, Guangxi and Anhui[4]. In early 1980s, 80% of the collective forest was contracted by each household, and forest farmers become the basic and important subject of collective forest management in South China[5]. Therefore, although the southern collective forestry has experienced several reforms of property right, the private forest is still a popular model of forest property right after a new-round forestry reform in 2003[6-7]. According to the different management entities and models, the private forest in southern collective forest area is mainly managed in the models of individual operation, household operation, enterprise operation and cooperative operation[8-10].

In order to make clear the preference of private forest owners to forestry subsidies, the seminar carried out an investigation on the private forest owners in nine provinces except Guizhou in August, 2008, and the obtained data is reliable. With the forest owners in southern collective forest area as the research subject, the study selected the forest owners in some typical collective forest areas and characteristic forest counties, covering about 35

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counties and cities. The samples were randomly selected, and the studies were carried out in various forms, including questionnaires, field survey and face-to-face interviews, *etc*.. The questionnaire study were conducted on 1 413 forest farmers in the above-mentioned nine provinces, 93.7% of which, about 1 324 were valid.

2 Factors influencing the subsidies preferences of private forest owners

According to the investigation data, the forest owners with different backgrounds showed different preferences to the subsidies. In order to analyse the factors influencing their preference, fifteen indexes or independent variables were determined in Table 1 based on the literature data, expert experience and field investigation. Among the fifteen indexes, the indexes of total income and forest area were continuous variables, while others were non-continuous variables. Those dependent variables were binary data which was applicable to the multiple regression analysis by Logistic model. Every index can be divided into several dichotomous variables based on the analysis of Logistic model.

3 Establishment of a Logistic model for the influence factors of subsidies preference

In order to analyse the subsidies preferences of forest owners by the Logistic model, some dependent variables should be set up. According to the practical investigation, the eight forms of subsidies that the private forest owners prefer include direct subsidies, free or discounted good tree species, free or favorable technical guidance, free or favorable market information, state funds to build road, free training, subsidized loans and tax concessions[11-13], thus eight dependent variables should be set up, and the corresponding Logistic models were established, which could be seen from (1) to (8).

$$\mathrm{logit}(p_1) = a + \sum_{i=1}^{i=111}(b_i x_i) \quad (1)$$

p_1 refers to the probability of preferring direct subsidies.

$$\mathrm{logit}(p_2) = a + \sum_{i=1}^{i=111}(b_i x_i) \quad (2)$$

p_2 refers to the probability of preferring free or discounted good tree species.

$$\mathrm{logit}(p_3) = a + \sum_{i=1}^{i=111}(b_i x_i) \quad (3)$$

p_3 refers to the probability of preferring free or favorable technical guidance.

$$\mathrm{logit}(p_4) = a + \sum_{i=1}^{i=111}(b_i x_i) \quad (4)$$

p_4 refers to the probability of preferring free or favorable market information.

$$\mathrm{logit}(p_5) = a + \sum_{i=1}^{i=111}(b_i x_i) \quad (5)$$

p_5 refers to the probability of preferring state funds to build road.

$$\mathrm{logit}(p_6) = a + \sum_{i=1}^{i=111}(b_i x_i) \quad (6)$$

p_6 refers to the probability of preferring free training.

Table 1 Factors influencing the subsidies preferences of private forest owners

Factors	Variables
Educational degree	x_1: Primary school or below(Y=1,N=0)
	x_2:Middle school(Y=1,N=0)
	x_3:High school or above(Y=1,N=0)
Number of family labors	x_4:None (Y=1,N=0)
	x_5:One (Y=1,N=0)
	…
	x_{13}:Nine (Y=1,N=0)
Main source of household income	x_{14}:Farming (Y=1,N=0)
	x_{15}:Vegetable planting (Y=1,N=0)
	x_{16}:Forest (Y=1,N=0)
	x_{17}:Working out (Y=1,N=0)
	x_{18}:Others (Y=1,N=0)
Annual household income	x_{19}:Continuous variable (unit: ¥)
Scale of forest	x_{20}:Total forest area (unit: hm^2), continuous variable
Years of forest planting	x_{21}:0 (Y=1,N=0)
	x_{22}:1 (Y=1,N=0)
	…
	x_{69}:48 (Y=1,N=0)
Mode of management	x_{70}:Mountains allotted to private use (Y=1,N=0)
	x_{71}:Contracted management (Y=1,N=0)
	x_{72}:Leasing management (Y=1,N=0)
	x_{73}:Stock cooperative management (Y=1,N=0)
	x_{74}:Rural unified management (Y=1,N=0)
	x_{75}:Others (Y=1,N=0)
Reasons for forest management	x_{76}:Making money (Y=1,N=0)
	x_{77}:Unwilling to give up forest (Y=1,N=0)
	x_{78}:No other choices (Y=1,N=0)
	x_{79}:Guaranteeing a livelihood security (Y=1,N=0)
Difficulties of forest management	x_{80}:Shortage of labors (Y=1,N=0)
	x_{81}:Inconvenient traffic (Y=1,N=0)
	x_{82}:Financial constraints (Y=1,N=0)
	x_{83}:Policies (Y=1,N=0)
	x_{84}:Market (Y=1,N=0)
	x_{85}:Others (Y=1,N=0)
Main financial sources	x_{86}:Family income (Y=1,N=0)
	x_{87}: Government grants (Y=1,N=0)
	x_{88}:Bank loan (Y=1,N=0)
	x_{89}:Private lending (Y=1,N=0)
	x_{90}:Others (Y=1,N=0)
Category of forest	x_{91}:Economic forest (Y=1,N=0)
	x_{92}:Timber forest (Y=1,N=0)
	x_{93}:Ecological forest (Y=1,N=0)
	x_{94}:Others (Y=1,N=0)
Expectations	x_{95}:Promising (Y=1,N=0)
	x_{96}:Non-promising (Y=1,N=0)
	x_{97}:Others (Y=1,N=0)
Existing subsidies in local areas	x_{98}:Cash (Y=1,N=0)
	x_{99}:Free or discounted good tree species (Y=1,N=0)
	x_{100}:Free or favorable technical support (Y=1,N=0)
	x_{101}:Free or favorable market information (Y=1,N=0)
	x_{102}:State fund to build road (Y=1,N=0)
	x_{103}:Free training(Y=1,N=0)
	x_{104}:Subsidies to loan interest(subsidized loans)(Y=1,N=0)
	x_{105}:Protective price(Y=1,N=0)
	x_{106}:Others (Y=1,N=0)
Disputes of forest ownership	x_{107}:With disputes (Y=1,N=0)
Property of forest ownership disputes	x_{108}:Serious (Y=1,N=0)
	x_{109}:Average (Y=1,N=0)
	x_{100}:less(Y=1,N=0)
	x_{111}:few (Y=1,N=0)

$$\text{logit}(p_7) = a + \sum_{i=1}^{i=111}(b_i x_i) \quad (7)$$

p_7 refers to the probability of preferring subsidized loans.

$$\text{logit}(p_8) = a + \sum_{i=1}^{i=111}(b_i x_i) \quad (8)$$

p_8 refers to the probability of preferring tax concessions.

b_i in above models refers to the coefficient of corresponding independent variables.

According to the investigation data, the SPSS software was adopted to carry out the Logistic regression analysis by the method of forward stepwise regression. The best model was obtained after fourteen steps of regression, which could be referred to in Table 2.

Table 2 Steps of regression

Models	Variables		Model checking		
	Variables	Name	Chi-Square(a,b)	*df*	*Sig.*
Step 0		Intercept			
Step 1	x_{106}	Other models	98.781	16	0.000
Step 2	x_{84}	Market issues	80.358	8	0.000
Step 3	x_{101}	Market information	64.719	8	0.000
Step 4	x_{99}	Good tree species	53.094	8	0.000
Step 5	x_{102}	Building road	49.862	8	0.000
Step 6	x_{105}	Protective price	47.910	8	0.000
Step 7	x_{85}	Other problems	36.251	8	0.000
Step 8	x_{100}	Technical guidance	30.640	8	0.000
Step 9	x_{77}	Not willing to give up forest	30.904	8	0.000
Step 10	x_{91}	Timber forest	28.470	8	0.000
Step 11	x_{93}	Ecological forest	20.101	8	0.010
Step 12	x_{81}	Inconvenient traffic	20.096	8	0.010
Step 13	x_{14}	Farming	17.346	8	0.027
Step 14	x_{16}	Forest planting	18.689	8	0.017

As is shown in Table 2, x_{106} is the first independent variable to enter the model (whether there are other subsidies in local area), and its *Sig.* is 0.000, indicating that the variable has great influence on the farmers' preference; the next variable is x_{84} (whether the main difficulty of forest management is market issue) whose *Sig.* is also 0.000, indicating that the variable also has great influence on the farmers' preference; the variables in a time order are x_{101}, x_{99}, x_{102}, x_{105}, x_{85}, x_{100}, x_{77}, x_{91}, x_{93}, x_{81}, x_{14} and x_{16} (the meaning of each variable can be referred to Table 2).

After the variables were determined, the SPSS software was adopted to obtain the final fitting of models, which could be seen in Table 3.

Table 3 Fit coefficient of the final model

	Chi-Square	*df*	*Sig.*
Final model	597.223	120	0.000

According to the fit coefficient of the final model, the final model can well explain the dependent variables. According to the investigation data, the statistics table of model parameters were obtained (some are omitted due to the space limitations), which were shown from (9) to (16).

$$\text{logit}(p_1) = 21.351 + 0.931x_{14} - 1.694x_{16} + 0.091x_{77} - 0.206x_{81} - 1.433x_{84} + 1.200x_{85} + 0.907x_{91} + 2.875x_{93} - 1.078x_{99} - 0.891x_{100} + 3.486x_{101} + 2.186x_{102} - 11.434x_{105} - 9.826x_{75} \quad (9)$$

$$\text{logit}(p_2) = 8.833 + 0.715x_{14} - 1.292x_{16} - 0.392x_{77} + 0.089x_{81} - 1.353x_{84} + 1.840x_{85} + 1.025x_{91} + 2.943x_{93} - 2.826x_{99} - 0.631x_{100} + 2.919x_{101} + 2.153x_{102} - 12.441x_{105} + 2.490x_{75} \quad (10)$$

$$\text{logit}(p_3) = 9.686 + 0.826x_{14} - 1.100x_{16} - 0.979x_{77} - 0.122x_{81} - 1.658x_{84} + 1.049x_{85} + 1.168x_{91} + 2.824x_{93} - 1.0585x_{99} - 2.159x_{100} + 2.290x_{101} + 2.268x_{102} - 11.148x_{105} + 1.687x_{75} \quad (11)$$

$$\text{logit}(p_4) = 8.964 + 1.084x_{14} + 1.653x_{16} + 0.436x_{77} + 0.333x_{81} - 2.169x_{84} + 0.850x_{85} + 0.715x_{91} + 1.802x_{93} - 1.019x_{99} - 0.695x_{100} + 0.883x_{101} + 2.039x_{102} - 11.562x_{105} + 1.976x_{75} \quad (12)$$

$$\text{logit}(p_5) = 9.583 + 0.205x_{14} - 1.511x_{16} - 0.630x_{77} - 1.017x_{81} - 1.401x_{84} + 1.714x_{85} + 0.133x_{91} + 4.062x_{93} - 1.240x_{99} - 0.183x_{100} + 2.566x_{101} + 0.516x_{102} - 12.205x_{105} + 2.052x_{75} \quad (13)$$

$$\text{logit}(p_6) = 7.688 + 0.236x_{14} - 0.971x_{16} - 0.447x_{77} + 0.667x_{81} - 2.831x_{84} + 1.563x_{85} + 1.406x_{91} + 2.995x_{93} - 1.177x_{99} - 0.963x_{100} + 2.793x_{101} + 0.216x_{102} - 11.141x_{105} + 2.038x_{75} \quad (14)$$

$$\text{logit}(p_7) = 6.945 + 1.236x_{14} - 1.584x_{16} - 0.104x_{77} - 0.219x_{81} - 0.753x_{84} + 0.974x_{85} + 0.166x_{91} + 3.314x_{93} - 1.021x_{99} - 1.824x_{100} + 2.037x_{101} + 3.057x_{102} - 12.073x_{105} + 2.850x_{75} \quad (15)$$

$$\text{logit}(p_8) = 9.055 + 1.897x_{14} - 2.436x_{16} + 0.148x_7 - 0.274x_{81} - 2.732x_{84} + 1.393x_{85} + 0.463x_{91} + 4.001x_{93} - 0.885x_{99} - 0.814x_{100} + 2.506x_{101} + 2.175x_{102} - 13.795x_{105} + 2.297x_{75} \quad (16)$$

4 Result and analysis

4.1 Factors influencing the private forest owners' preference to direct subsidies As is shown in model (9), the forest owners whose main income source is farming and who are not willing to give up the forest management and manage the timber forest generally show a preference to direct subsidies. Due to the long period of forest production, great management risks and the implementation of cutting quota system, the forest owners do not show high expectations towards the returns of forestry, and prefer the government to provide some direct subsidies such as cash subsidies.

4.2 Factors influencing the private forest owners' preference to the subsidies of good seed trees According to model (10), the farmers whose main income comes from farming prefer

the subsidies of good seed trees, and those farmers whose main income comes from forest planting show higher preference, because the former, in comparison with the latter, lack the practical skills of forest management, as well as the experience of choosing good seed trees. Their preference to subsidies of seed trees is actually to reduce the risks of forest management; The owners of timber forest and ecological forest and in the areas where the existing models of subsidies include market information, road building and others also prefer good seed trees, because the seed trees provided by the government have guaranteed quality; while the owners in the areas where the existing subsidies include good seed trees, technical guidance and protective price do not prefer the subsidies of good trees, because local technicans can completely solve the problem of seed trees and the owners in these areas prefer the subsidies of market information and state fund to build roads.

4.3 Factors influencing the private forest owners' preference to the subsidies of technical guidance According to model (11), the farmers whose main income comes from farming prefer the subsidies of technical guidance, while those farmers whose main income comes from forest planting do not, because the former, in comparison with the latter, lack the practical techniques of forest management, and show greater expectations towards technical guidance. The private forest owners whose main problems are inconvenient traffic and market issues do not prefer the subsidies of technical guidance, since most forest owners are rational, and they deems that the benefits of forest cannot be achieved under the conditions of inconvenient traffic and serious market problems even if with the best forest management skills. The forest farmers who lack the knowledge about the control of diseases and pests as well as the management of forest (belonging to "Others" in the questionnaires) also show great preference to technical guidance, so do the forest owners of timber forest and ecological forest and in the areas where the existing models of subsidies include market information and road building. All in all, it can be concluded that the private forest owners generally lack the skills of forest management, and are eager for the technical support from experts.

4.4 Factors influencing the private forest owners' preference to the subsidies of market information According to model (12), the forest owners whose income mainly comes from farming showed greater preference to the subsidies of market information than those professional forest owners, because the latter have much more market information, which on the one hand is accumulated during their management experiences, on the other hand is collected out of their own wills. The subsidies of market information are also welcomed by the forest owners who manage the forest simply because they don't want to give up the forest, the owners of timber forest and those owners who face the problems of inconvenient traffic and other issues. Thus, it can be concluded that the market information is one of the great demands of private forest owners.

4.5 Factors influencing the private forest owners' preference to the state funds to build roads According to model (13), the forest owners whose income mainly comes from farming showed greater preference to the subsidies of market information, so do the forest owners of timber forest and ecological forest and in the areas where the existing models of subsidies include market information and road building. Since the building of forest road shows some spillover effect, the private forest owners lack interest or enough money to build the forest roads. Thus the subsidies of state funds to build roads should be taken into account when designing the subsidies system.

4.6 Factors influencing the private forest owners' preference to free training According to model (14), the forest owners whose income mainly comes from farming showed greater preference to the subsidies of free training than those whose income doesn't mainly come from farming, while the forest owners whose income mainly comes from forest planting showed weaker preference to the subsidies of free training than those whose income doesn't mainly come from forest planting, because the forest owners whose income mainly comes from farming generally lack technical guidance, while those professional forest farmers have the urge to collective technical information and their demands for techniques are weaker than others. The subsidies of free training are also welcomed by the owners who face the problems of inconvenient traffic and other issues as well as the owners of timber and ecological forest. In fact, the private forest owners' preference to free training is basically the same as that to technical guidance, which reflects the forest owners' thirst for forest management techniques.

4.7 Factors influencing the private forest owners' preference to the subsidized loans According to model (15), the forest owners whose main income source is farming prefer subsidized loans, because they are generally poor and favor the subsidized loans provided by the government. The forest owners who face the problems of inconvenient traffic and market issues show less preference to subsidized loans, while those who face other problems (such as shortage of money) prefer the subsidized loans, which reflects the real needs of forest owners, that is, they have the inclination to ask for governmental aids when facing the problems of inconvenient traffic and market issues, and choose subsidized loans only when they lack money.

The owners of timber and ecological forest also show great preference to the subsidized loans. Since timber and ecological forest requires a long period of investment and its benefits cannot be seen in a short period of time, the timber forest in Fujian is generally cut down after nearly twenty years, before which the farmers' income basically equals to zero. Therefore, the private forest owners show greater needs for money and greater preference to subsidized loans.

The private forest owners who are now enjoying the subsidies of market information and forest roads financed by the government and other forms of subsidies show greater preference to the subsidized loans. Their preference to government subsidies is closely related to how much information they get. When they can enjoy various government subsidies, they will compare them and choose

the best for themselves. Due to the particularity of forestry, money is the key factor and also preferred by most private forest owners.

4.8 Factors influencing the private forest owners' preference to tax concessions According to model (16), the owners of timber forest prefer the subsidies of tax concessions, so do the forest owners whose main income comes from farming and forest planting. The preferential tax can be directly transferred into the forest owners' income, and the forest owners will prefer the policies of tax concessions under any circumstances.

5 Conclusion

Based on the investigation data of nine provinces in South China, the study in this paper applied the Logistic model to analyse the factors influencing the private forest owners' preference. Due to their different backgrounds, the forest farmers showed greatly different preference to different subsidies. Thus, the farmers' real needs should be taken into account when designing the subsidy system, otherwise, the system would lose its rationality. In fact, the forest farmers' preference to different subsidies embodies the development bottlenecks of private forest, for example, the preference to techniques and market reflects the imperfect social service system; the preference to the building of forest road reflects the imperfect infrastructure of forestry; the preferences to subsidized loans reflects the difficult financing situation of forest farmers, and the preference to tax concessions reflects the high tax of forestry, *etc*. Those bottlenecks have strictly influenced the incentives of forest owners and should be solved immediately, otherwise, they will jeopardize the sustainable development of China forestry. Those problems, however, cannot be solved by the forest farmers themselves who are badly in need of governmental help. By adopting the measures of direct subsidies, tax reduction, providing seed trees and technical services, improving infrastructure construction, providing market information and credit support to reduce the production costs of farmers and the information costs caused by uncertain management[13], the government will greatly push the reform of forestry property right and improve its overall benefits. Thus it can be said that the subsidy system to private forest is a necessary choice for deepening the reform of forestry property right system[14-15].

6 Discussion

Whether China should develop its private forest should not be neglected. The proposal of developing non-public forest is actually to discuss the development problems of private forest[10]. In order to attract more private capital to private forest, on the one hand, the government should create a good external environment for the development of private forest, on the other hand, it should keep increasing the incomes of forest farmers. Thus, the design of subsidy system should focus on building a good external environment and improving the competitiveness of private forest, and only in this way can the system encourage the enthusiasm of farmers to nurture the private forest and improve its market competitiveness. The study of subsidy system for private forest in China is still at its initial stage of development, and how to construct suitable subsidy system based on the practical situation of China is a complex project covering various aspects, such as whether to provide subsidies, how to design the subsidies, how to decide the program and amount of cash subsidies, what makes reasonable subsidies[16], whether the ecological benefits of forest should be taken into consideration, *etc*. In this paper, the studies on the preference of private forest owners to subsidies only provide theoretical references for the development of private forest, and how to put them into action still needs further studies.

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