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Analysis on the Factors Affecting Farmers' Willingness to Participate in Forestry Carbon Sequestration—Taking Feng qing and Zhen kang County As an Example

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Analysis on the Factors Affecting Farmers' Willingness to Participate in Forestry Carbon Sequestration——Taking Feng qing and Zhen kang County As an Example

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Abstract. In order to reveal the factors affecting farmer's willingness to participate in forestry carbon sequestration, this paper took Feng qing and Zhen kang County in Yunnan as examples, 106 and 100 random samples were selected in the project areas and non-project areas, the investigation result showed that the farmers' participating willingness were not very high. Continuous survey data of household and regression model of binary logistic were used to analyze the factors which can affect the farmer's participating willingness of forestry carbon sequestration. The analysis results revealed that: education, household income, farmers' environmental awareness, future economic expectation of forestry carbon sequestration had significant effects on the farmer's desire. The reasons why farmers do not want to participate in forestry carbon sequestration were further analyzed. Finally corresponding countermeasures were put forward to encourage the farmers to participate in forestry carbon sequestration.

1. Introduction

With the serious impact of climate change on the sustainable development of economy and society, forestry carbon sequestration has become a new and hot topic. Because forestry carbon sequestration involves thousands of households, the farmers' participating willingness has a direct impact on whether forestry carbon sequestrations can be carried out smoothly. The investigation of the existing literature indicates the study on the participation in forestry carbon sequestration of farmers mainly from the aspects of family characteristics, cost and income, carbon sequestration market and carbon sequestration policy. The research on farmers' willingness to participate in forestry carbon sequestrations is few. At present, the domestic forestry carbon sequestration project is implemented as pilot of cooperation between government departments and NGOs, and farmers are not the main body of the implementation. In order to know the farmers' participating willingness and stimulate more farmers to participate in carbon sequestration projects, this paper uses development model of the industrialization to analyze the farmers' behaviors and maximize the benefits of farmers with the help of market-oriented trading platform.

2. Sample point profile and data sources

The authors based on the "China Carbon Trading Market Construction Framework and Operation Mechanism" project and cooperation with Yunnan Green Environment Development Foundation. A field survey was conducted on Feng qing and Zhen kang County, the jurisdictions of the two nature



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reserves in the southwestern border of Yunnan Province. The sample area is as follows:

2.1 Feng qing County Overview

Feng qing County is located in the southwestern part of Yunnan Province. It is connected to Wei Shan County and Nan jian County in the east. It is the “hometown of the Yunnan red tea” and the “hometown of Chinese walnuts”. The county's forestry land area is 19,6065.3 hectares, accounting for 58.96% of the total land area of the county, including: 14,0007.9 hectares of forest land, 4,6881.6 hectares of shrub land, 126 hectares of unforested land, 763 hectares of no-forest land, and suitable forest area 8286.8 hectares, the forest coverage rate is 48.33%. The county built a provincial nature reserve of Lin cang, lan cang relying on abundant forest resources.

2.2 Zhen kang County Overview

Zhen kang County is located in the southwest border of Yunnan Province, south of Geng ma County, east of Yong de County, bordering west on friendly neighbors as Myanmar Guo gan County, north on Long ling County of Bao shan area across the river. The county has a total woodland area of 1107.9 square kilometers, accounting for 43.72% of the total land area of the county, the forest coverage rate is 34%, Zhen kang County based on abundant forestry resources, established the provincial nature reserve of the nan peng River .

2.3 Data sources

In the field research of Feng qing and Zhen kang County, the authors selected 106 households of 10 villages in 4 Townships, including forestry carbon sequestration project implementation area and non-implementation area, the specific survey sample area is shown in the table below:

Tab 1. Sample Area

Survey Areas	Sample County	Township	Villages	The Number of Questionnaire	
Project areas	Feng qing	Guo Dazhai	Tuan shan	11	
			Gan ma	10	
			Ka si	10	
		Xue shan	Wang Jiazhai	10	
			Li ma	11	
		Meng you	Xin tian	12	
			A Lihou	12	
			Gen ji	10	
		Zhen kang	Meng peng	Xiang Jiaoshui	9
				Cha gou	11
Subtotal			106		
non-project areas	Feng qing	Guo Dazhai	Guo Dazhai	13	
			Song lin	12	
			Xin min	13	
		Xue shan	Xin hua	11	
			Li da	13	
		Meng you	Li ping	12	
			Meng peng	14	
			Ya kou	12	
		Zhen kang	Meng peng		100
					206
Subtotal			100		
Total			206		

The total number of this questionnaire is 206, there are 202 effective questionnaires, the effective rate of the questionnaire is 98%, the data provided by the effective questionnaires is the basis of author's follow-up analysis.

3. Analysis of farmers ' participating willingness and influencing factors

3.1. Analysis on the willingness of farmers to participate in forestry carbon sequestrations

3.1.1. Participating willingness in Project Area.

Farmers' willingness to participate in forestry carbon sequestrations projects is that: the proportion of the willingness in project area is 50%, the unwillingness proportion is 41.51%, and 8.49% did not respond to the investigation. The survey results show that people are willing to participate in the forestry carbon sequestration project, but the willingness is not strong.

3.1.2. Participating willingness in non-project areas.

In the non-project area, the proportion of willingness to participate in the forestry carbon sequestration project was half; 43% per cent of the interviewees expressed an unwillingness to participate; and 7% per cent did not respond to interviewers. The data show that people are willing to participate in the forestry carbon sequestration project, but the willingness to participate is not strong.

3.2. Construction of Regression model of binary logistic

Farmers' willingness to participate in forestry carbon sequestrations projects is affected by a series of factors. According to the common sense of experience and relevant literature, it is concluded the personal characteristics, family characteristics, economic environment and mentality of farmers. Combined with the specific indicators and data in the questionnaire, this paper sets 10 variables, so that 0 = unwilling, 1 = willing, Y as the Dependent variable, x as the independent variable, the construction of Regression model of binary logistic equation:

$$\ln[p/(1-p)] = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_{10} X_{10} + \mu$$

Among them, p is the probability of Y=0, 1-p is the probability of Y=1, X_1, X_2, \dots, X_{10} is the variable in the regression equation, $\beta_0, \beta_1, \beta_2, \dots, \beta_{10}$ is the parameter to be evaluated, μ is the perturbation item. Synthesize field survey data for analysis, variables and their specific explanations are as follows:

Tab 2. Variables and explanation

Variables	Index	Expected impact direction	Average	Standard deviation
Y= willingness	0= unwilling, 1= willing		0.55	0.50
X ₁ = age/year		+/-	45.66	11.57
X ₂ = degree of education	0= illiteracy, 1= primary school, 2= junior high school, 3= senior high school and above	+	1.38	0.73
X ₃ = Labor income in proportion of household annual income		+	0.11	0.10
X ₄ = Number of family workers/person		+	4.31	0.99

X ₅ = Household per capita income/yuan		+	4600.11	1446.48
X ₆ = forestry income proportion of household income		-	0.40	0.14
X ₇ = per capita arable land		+	1.50	0.81
X ₈ = Woodland Area		+	12.98	5.52
X ₉ = Farmers ' environmental awareness	0= not strong, 1 = strong	+	0.51	0.50
X ₁₀ = future economic expectations of carbon sequestration in forestry	0= bad, 1= general, 2= good	+	0.68	0.69

3.3. Analysis results and explanation

The paper uses Spss 17.0 to perform binary logistic regression analysis on the variables of 206 households, Y presents the dependent variable. X₁, X₂, ..., X₁₀ are used as independent variables. The analysis results are shown in Table 3, Table 4, Table 5 and Table 6.

Tab 3. Model Summary

Step	-2 Log likelihood value	Cox & Snell R ²	Nagelkerke R ²
1	62.012	0.650	0.869

Tab 4. Variables in the equation

	β	S.E	Wals	df	Sig.	Exp (β)
Age	0.010	0.031	0.096	1	0.756	1.010
Degree of education	1.584	0.605	6.843	1	0.009**	4.874
Labor income percentage of household income	4.834	4.008	1.454	1	0.228	125.681
Household labor force	0.354	0.359	0.968	1	0.325	1.424
Household per capita annual income	0.003	0.001	27.366	1	0.000**	1.003
Forestry income percentage of household income	1.306	3.036	0.185	1	0.667	3.690
Per capita cultivated area	0.171	0.466	0.134	1	0.714	1.186
Forest area	0.074	0.076	0.959	1	0.328	1.077
Farmers' environmental awareness	2.000	0.808	6.132	1	0.013**	7.392
Future economic expectations of Carbon sequestration in forestry	2.461	0.738	11.129	1	0.001**	11.717
Constant	-19.945	4.383	20.710	1	0.000	0.000

Note : *indicates significant at the 5% level, **indicates significant at the 1% level.

It can be seen from Table 3 that the Cox & Snell R² statistic and the Nagelkerke R² statistic are equal to 0.650 and 0.869 respectively, which means that the model explains the variation of the

interpreted variable by more than 80%, indicating that the goodness of fit of the model is better. Table 4 lists the parameters to be estimated β of the regression equation, the labeling error S.E, the Wald statistic Wals, the degree of freedom df, the significance Sig (P value), and the occurrence ratio Exp (β).

3.4. Analysis of influencing factors

As can be seen from Table 4, among the 10 variables, the Sig (P value) of the coefficients of 4 variables is less than 0.05, which are X_2 (degree of education), X_5 (yearly income per capita), and X_9 (environmental awareness of farmers), X_{10} (for the future economic expectations of carbon sequestration forest), indicating that these four variables have a significant impact on farmers' willingness to participate in forestry carbon sequestrations. The Sig (P value) of the coefficients of the other six variables are all greater than 0.05, so they are considered to have no significant effect on the willingness of farmers to participate. The specific explanations for the extent to which the variables affect the farmers' willingness to participate in forestry carbon sequestrations are as follows.

3.4.1. Analysis of significant indicators.

(1) Education level. The degree of education has a significant impact on farmers' willingness to participate in forestry carbon sequestrations. Generally speaking, the higher the level of human culture, the stronger the willingness to accept new things. The author believes that the higher the education level of the farmers, the better they can understand the nature and significance of the carbon sequestration forest, and the stronger the enthusiasm for participating in the forest carbon sequestration, the more obvious participating willingness, and the analysis results confirm this.

(2) Annual per capita income of the family. The per capita annual income of the family has a significant impact on the willingness to participate in forestry carbon sequestrations. The higher annual income of a family, the farmers desire the better living standard. After meeting the basic material needs, they will pursue spiritual life. The implementation of forestry carbon sequestrations can maintain water and soil, purify the air, and beautify the environment. Therefore, farmers with high annual per capita income are more willing to participate in forestry carbon sequestrations.

(3) Farmers' environmental awareness. Farmers' environmental awareness has a significant impact on the willingness to participate in forestry carbon sequestrations. Among farmers who are willing to participate in forestry carbon sequestrations, most farmers have mentioned protecting the environment when asked "why willing". (listed in Table 5). Due to the serious ecological damage in the case, most farmers are willing to protect trees to prevent soil erosion, landslides and other disasters.

Tab 5. Environment awareness of farmers

expectation	Willingness /household	Percentage /%	Unwillingness /household	Percentage /%
Good or general	82	43.16	26	13.68
bad	21	11.05	61	32.11

(4) Future economic expectations for carbon sequestrations. The future economic expectations of carbon sequestration forests have a significant impact on the willingness to participate in forestry carbon sequestrations. Most of the farmers who think that the future economic situation of carbon sequestration forests is not bad are highly motivated to participate in forestry carbon sequestrations (Shown in Table 6). In the survey, many farmers said that participation in forestry carbon sequestrations not only does not require their own input costs, but also can obtain greater benefits from them, so they are willing to participate.

Tab 6. Future income of forestry carbon sequestration

Awareness	Willingness /household	Percentage /%	Unwillingness /household	Percentage /%
Strong	63	33.16	24	12.63
Not strong	41	21.58	62	32.63

3.4.2. Analysis of insignificant indicators.

(1) The age of the head of the household. The age of the head of household has no significant impact on the willingness to participate in forestry carbon sequestrations. In general, the younger a person is, the easier it is to understand and accept new things. However, according to the survey results, the age of the head of household is not related to whether or not they are willing to participate in forestry carbon sequestrations. This paper believes that the reason may be that the head of the farmer being surveyed is relatively old, his thoughts have become more rational, and he has formed a more stable attitude towards things.

(2) Percentage of labor income in household income. Labor income percentage of household income has little effect on the willingness to participate in forestry carbon sequestrations. According to the analysis of 190 questionnaires (excluding 16 unanswered questionnaires), the labor income accounted for a relatively low proportion of household income, and most of the income of farmers still came from agricultural income. This paper believes that under this factor farmers who depend on agricultural income may seldom consider their dependence on agricultural income when making decisions about whether to participate in forestry carbon sequestrations.

(3) Number of family laborers. The number of household laborers has little effect on the willingness to participate in forestry carbon sequestrations. When setting variables, we believe that the more number of household laborers, the more willingness to invest in business activities, which shows that the direction of participation in forestry carbon sequestrations is positive. However, the results have not been confirmed. In our survey, it was found that the more households with more household labor, the more likely they are to go out to work because the income from working is much higher than the income from forestry activities, so the number of labor does not affect the willingness to participate in forestry carbon sequestrations.

(4) The proportion of forestry income to household income. The proportion of forestry income to household income is not significant for the willingness to participate in forestry carbon sequestrations. In general, the higher the proportion of forestry income to household income, the more interested farmers are in the management of forest land. However, in the 206 surveys of households in this paper, the vast majority of farmers have lower forestry incomes. This paper argues that low forestry incomes make farmers less interested in forest management, which leads farmers not to care whether their own forest land participates in forestry carbon sequestrations. Therefore, the proportion of forestry income to household income does not have a significant impact on the willingness to participate in forestry carbon sequestrations.

(5) Per capita cultivated area. The per capita arable land area has no significant impact on the willingness to participate in forestry carbon sequestrations. Generally speaking, the more per capita arable land, the more willing to participate in forestry carbon sequestrations. In fact, the results of the analysis have not been confirmed. In the survey, it was found that some farmers with a large area of cultivated land are willing to plant economic forests with high incomes rather than participate in forestry carbon sequestrations. Some farmers with small per capita arable land are willing to participate in forestry carbon sequestrations because they can invest the remaining labor to go out to work, so that they can get more benefits, so there is no significant impact on the per capita arable land area.

(6) Forest area. The impact of forest land area on the willingness to participate in forestry carbon sequestrations is not significant. In the field investigation, we found that in order to protect the environment, even the commercial forests cannot be cut and sold at random. The size of the forest area is not directly related to the income, so the forest area has no significant impact on the willingness to participate in forestry carbon sequestrations.

4. Analysis on the deep root of influencing farmers' participation in forestry carbon sequestration projects

4.1. The lack of a reasonable participation mechanism

In the implementation process of forestry carbon sequestration projects, the participation of farmers is different. Some projects have introduced the concept of community forestry participatory development in the implementation process, farmers have higher participation, but in most cases under the traditional implementation method, the participation of farmers is relatively low.

4.1.1. Farmers are in a passive acceptance state during the planning and design phase.

In the beginning phase of forestry carbon sequestration projects, the majority of farmers are difficult to participate in it, and only a few village cadres participate in related work. In the project design, it is mainly undertaken by the project implementer and the forestry department. The participation of the farmers is mainly to help the project designers to view the land and provide relevant information. Therefore, the participation of the community at this stage is mainly to provide information.

4.1.2. Low level participation of farmers in the specific implementation stage.

In terms of project propaganda, the majority of farmers only passively accept propaganda information. In the choice of project implementation mode, most places are unified planning by the forestry department and the project implementer, and most farmers are passively accepted. In terms of seedling selection, farmers cannot choose by their own will, and will be subject to the requirements of the project implementer. In terms of seedling supply, due to the consideration of seedling quality, most places are uniformly supplied by the forestry department. In terms of afforestation and forest management, in order to ensure the survival rate of seedlings, most places are finished by afforestation companies, and a few places are completed by farmers themselves. In terms of cashing out subsidies, most areas are under the unified arrangement of the forestry department, and farmers are passively receiving subsidies.

4.1.3. Farmers cannot participate in the carbon transaction service.

In the case of carbon transactions service, farmers cannot participate in it. It is entirely implemented by NGOs or project implementer in the market. Farmers are unable to know the specific transaction information, and the specific allocation of transaction amounts cannot be intervened. Farmers are completely at this stage. It is passive acceptance.

4.2. Lower forestry carbon sequestration income cannot attract farmers to participate

As a resource enjoyed by farmers, forest land can bring income to farmers' families to a certain extent. Nowadays, farmers are becoming more and more rational. They hope to maximize the benefits of forest land use. This is an important reason why farmers are willing to participate in forestry carbon sequestrations. The direct income earned by farmers participating in the forestry carbon sequestration project is a subsidy of 200 yuan per mu, which granted by the Yunnan provincial government and TNC, and the potential income is the timber income after 30 years. For farmers who do not participate in forestry carbon sequestration projects under the same circumstances, they only have a subsidy of 400 yuan, but these farmers can plant economic crops with better benefits.

4.3. Forestry carbon sequestration risk ambassadors generate evasive behavior

According to the sample area survey, 15.2% of the farmers in the project area believe that the risk of participating in forestry carbon sequestrations is large, and 21.5% of the farmers in the non-project areas believe that the risk of participating in forestry carbon sequestrations is high. The farmers are lack of confidence in the stability, sustainability and reliability of future returns, they are cautious about forestry carbon sequestrations. They have long formed a traditional way of behavior, have a strong dependence on the lands, and it is difficult to change in a short time. The land has social security and psychological comfort for them, so the forestry carbon sequestrations allow them to evade behavior.

5. Suggestions for effectively promoting farmers' participation in forestry carbon sequestrations

At present, the domestic forestry carbon sequestration project is carried out by government departments and NGOs. Farmers are only passively accepting participation, and only a small amount of subsidies can be obtained in the participation process. Participation in carbon sequestration projects has not been improved the living standard of the farmers. Therefore, corresponding policy recommendations should be made to attract more farmers to participate.

5.1. Building a forestry carbon sequestration mechanism to promote farmers' participation

5.1.1 Actively making use of conditions for farmers' participation in forestry carbon sequestrations.

First, since the forest tenure reform in 2006, farmers have the right to use forest lands property rights, which has stimulated the enthusiasm of farmers to develop forestry industry, and is conducive to improving the utilization and productivity of forest resources. At the same time, farmers have right to self-selection, it makes farmers participate in related forestry transactions.

Secondly, the vast rural areas have abundant labor resources and low prices, while forestry carbon sequestrations require a large amount of labor force to participate in afforestation and management , the enrichment of cheap labor enables farmers to gain an advantage in forestry carbon sequestration projects.

5.1.2. Establishing a forestry carbon sequestration evaluation agency to accurately assess farmers' assets.

The forestry carbon sequestration assessment needs a large of technical and professional knowledge. As China's forestry carbon sequestrations start lately, China does not have a perfect monitoring system and professional evaluation agencies. In order to promote the carbon trading, it is necessary to establish an expert team who understand the measurement methods, international rules and carbon quantity assessment at home and abroad, so as to accurately evaluate the assets of farmers and safeguard the economic interests of farmers.

5.1.3. Building a trading platform to provide conditions for farmers to participate in forestry carbon sequestrations.

At present, China's forestry carbon sequestration is mainly carried out by government departments and NGOs. Farmers are neither the main body of implementation nor the participation in the management and trading of the project. Therefore, it is necessary to build a new trading platform, and organize farmers by forestry cooperatives, and under the guidance of relevant technical departments, encourage farmers participate in the afforestation, management and monitoring of project. The most important thing is that the transaction amount will be distributed to the participating farmers in proportion to the investment.

5.1.4. Designing farmers' incentive system of participation in forestry carbon sequestration.

In order to encourage farmers to actively participate in forestry carbon sequestrations, the government should introduce corresponding preferential policies. First, establishing a medium- and long-term low-interest loan system to reduce the capital burden of the lender; Second, the income earned by farmers in the work of forestry carbon sequestrations is not subject to tax; Third, setting an special priority trading rights and provide various preferential policies for farmers who are participating the forestry carbon sequestration projects. Finally, providing professional technical teams to help farmers participate in forestry carbon sequestrations.

5.1.5. Establishing a forestry carbon sequestration supervision mechanism to ensure farmers' rights and interests.

In order to reduce the risks, the government should establish corresponding regulatory mechanisms. First, it is necessary to improve relevant laws and regulations to regulate forestry carbon

sequestrations. Second, the government should set up special regulatory authorities to approve, implement, trade, and supervise. The third is to set up industry associations to strengthen the guidance of the industry and assist the government's regulatory authorities.

5.2. Establishing and implementing the compensation mechanism of forestry carbon sequestrations, improving the enthusiasm of farmers to operate forestry carbon sequestrations

In order to ensure that farmers can participate better, forestry carbon sequestrations should be implemented by farmers, led by forestry cooperatives or forest farmers. The scattered farmers will be brought together to participate in afforestation, management, trade, etc., while the government or NGO should provide corresponding technical support, and monitor forestry carbon sequestrations trade in the market. The income must be distributed to each farmer in proportion. At the same time, it is necessary to improve the ecological benefit compensation mechanism and improve the enthusiasm of farmers to operate forestry carbon sequestration by improving subsidy standards, implementing classified compensation methods, innovative project management models, and optimizing project management systems.

5.3. Carrying out education and training activities for farmers, improving farmers' awareness of forestry carbon sequestrations, and reducing operational risks

Forestry carbon sequestration projects are social welfare, and it requires the active participation of the whole society. Farmers should be educated on the ecological environment through media, network, and publicity activities to improve the education level of farmers in ecological environment protection. The training content may involve the importance of forestry carbon sequestration, relevant policies and regulations, role and significance and the urgency of forestry carbon sequestration trade. Through extensive education, more people will be aware of the importance of forestry carbon sequestration, and actively participate in it.

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