

Research on Farmers' Willingness to Participate in Agricultural Carbon Sequestration Projects under the Background of Carbon Trading Policies

-- Take Anhui as a Case

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Abstract

With the severe challenge of global climate change and the clear proposal of the "dual carbon" goal, the importance of agricultural carbon sequestration as an important way to mitigate climate change and promote sustainable development has attracted more and more attention from the international community. As an important agricultural province in China, Anhui Province has abundant agricultural resources and huge carbon sink potential, and the willingness of farmers to participate in agricultural carbon sink projects is of great significance to promote the low-carbon development of agriculture in the region and even the whole country. In this paper, we collected a wide range of first-hand data by means of questionnaire survey and field survey, and constructed a probit regression model based on the improved UTAUT model, and carried out a systematic and detailed quantitative analysis of the key factors affecting farmers' willingness to participate in agricultural carbon sequestration projects. The results show that farmers' personal characteristics, agricultural production conditions, government policy guidance and social environmental factors have a significant impact on their willingness to participate. Based on the above conclusions, this paper further puts forward policy suggestions to promote farmers' participation in agricultural carbon sequestration projects, in order to provide a scientific basis and decision-making reference for the government to formulate relevant policies.

Keywords

Carbon trading policy, Agricultural carbon sequestration projects, Farmers' wishes, Probit regression model.

1. Introduction

With the intensification of global climate change, reducing greenhouse gas emissions has become a common challenge for the international community. As an important part of human economic activities, agriculture is not only one of the important sources of greenhouse gas emissions, but also contains huge carbon sink potential. Through the implementation of a series of low-carbon agricultural technologies and management measures, such as straw returning, organic fertilizer application, and returning farmland to forest and grassland, agricultural carbon sequestration projects can effectively increase soil carbon storage and reduce greenhouse gas emissions, which is of great significance for mitigating climate change. The introduction of carbon trading policies provides market incentives for the implementation of agricultural carbon sequestration projects and promotes the process of low-carbon agricultural development. As a major agricultural province in China, Anhui Province has abundant agricultural resources and diverse agricultural ecosystems, and farmers' participation in

agricultural carbon sequestration projects plays a vital role in promoting regional low-carbon development and achieving the "dual carbon" goal.

The purpose of this paper is to deeply explore the willingness of farmers to participate in agricultural carbon sequestration projects and its influencing factors under the background of carbon trading policy, so as to provide a scientific basis and decision-making reference for the government to formulate relevant policies. Theoretically, the improved UTAUT model is applied to the study of farmers' willingness to participate in agricultural carbon sequestration projects, which expands the application scope of the UTAUT model in the agricultural field and provides a new perspective and theoretical support for the study of the influencing factors of farmers' behavior. At the same time, it also enriches the literature base of related research on agricultural carbon sequestration projects, and provides a useful reference for follow-up research. From a practical point of view, this study is helpful to gain an in-depth understanding of farmers' willingness to participate in agricultural carbon sequestration projects and the influencing factors behind them, and provide a reference for the government to formulate precise and effective policy measures. By optimizing policy design, strengthening technology promotion and publicity and guidance, we can stimulate the enthusiasm and initiative of farmers to participate in agricultural carbon sequestration projects, and promote the process of low-carbon agricultural development. At the same time, it will also help to promote farmers' income and rural economic development, and achieve a win-win situation of economic and environmental benefits.

2. Literature Review

2.1. Research on low-carbon production behavior of rural households

Scholars at home and abroad have conducted extensive and in-depth research on the low-carbon production behavior of farmers. In terms of the influencing factors of farmers' low-carbon production behavior, many scholars have discussed it from different perspectives. Some scholars have focused on the impact of farmers' personal characteristics on their low-carbon production behavior. For example, Xie Y, Su Y, Li F et al. (2022) did not directly and comprehensively elaborate on the relationship between farmers' personal characteristics and low-carbon production behaviors, but they have been involved in relevant studies. Zheng, H., Ma, J., Yao, Z., et al. (2022) pointed out that social embeddedness affects farmers' adoption of low-carbon agricultural technologies, and social embeddedness is also related to farmers' social circles and their own characteristics to a certain extent. Cao Tiantian (2019), a Chinese scholar, discussed in detail the impact of various factors on farmers' low-carbon production behavior, and explicitly mentioned education level as a key factor. Farmers with a higher level of education are more likely to understand and accept the significance and value of low-carbon production technologies, and they have stronger learning and information acquisition capabilities, and can grasp the key points and operation methods of low-carbon production technologies more quickly. On the contrary, He Ke (2021) analyzed the role of credit constraints on farmers' low-carbon production behavior, reflecting that farmers' own personal characteristics such as economic status and risk tolerance affect their production decisions. Older farmers may be less receptive to new technologies and policies due to habits and traditions, and are more inclined to follow traditional production methods, and the acceptance of low-carbon production technologies will take a longer process (Jing Hanjiao (2019)).

Government policies also play an important role in guiding and promoting farmers' low-carbon production behavior. Du Tingting (2012) and other scholars also involved the influence of policy factors when studying the relevant content of farmers' participation in agricultural carbon sequestration projects. The policy support and technology promotion provided by the government can significantly reduce the costs and risks of adopting low-carbon production

technologies for rural households. For example, government subsidies for the purchase of low-carbon agricultural equipment, as well as technical training and guidance, can make farmers more willing to try low-carbon production technologies (Luo Qingwen (2020)). Gao Ming and Zhang Zhexi (2022) emphasized the importance of policy guidance in the study of agricultural green development, and reasonable policies can stimulate farmers' enthusiasm to participate in low-carbon production. Socio-environmental factors should also not be overlooked. Pan Hesi and Lan Xiting (2024) studied the impact of farmers' multi-dimensional cognition on their willingness to adopt low-carbon production technologies, and mentioned that social environmental factors such as social networks and neighborhood effects will indirectly affect farmers' adoption decisions by affecting their information acquisition and communication methods. Communication and information sharing among farmers can enable them to learn more about low-carbon production technologies and experiences, thereby increasing the likelihood that they will adopt low-carbon production technologies (Zhao, Nan Ling, Li Xiaoqing et al. (2019)).

2.2. Research on agricultural carbon sequestration projects

As one of the important means to mitigate climate change, agricultural carbon sequestration projects have received extensive attention in recent years. Scholars have studied multiple aspects of agricultural carbon sequestration projects. In terms of the development and implementation of agricultural carbon sequestration projects, Huang Zuhui and Mi Songhua (2011) took Zhejiang Province as an example to study the agricultural carbon footprint, which provided basic data and theoretical support for the development of agricultural carbon sequestration projects. Different scholars such as Du Tingting (2012), Lai Guanxiu (2019), and Tian Xianghe (2022) have discussed the willingness of farmers to participate in agricultural carbon sequestration projects and their influencing factors, which can help to understand farmers' attitudes and behaviors during the implementation of the project, so as to better adjust the project strategy. In terms of the economic benefits of agricultural carbon sequestration projects, the results show that agricultural carbon sequestration projects can not only effectively increase soil carbon storage and reduce greenhouse gas emissions, but also promote sustainable agricultural development and increase farmers' income (Wu X, Zhang Y (2020)). For example, by implementing low-carbon agricultural technologies such as straw returning, soil quality can be improved and crop yields can be increased, while reducing the use of chemical fertilizers and pesticides, reducing production costs and increasing farmers' economic benefits. However, there are relatively few studies on farmers' willingness to participate in agricultural carbon sequestration projects, which need to be further explored and improved (Du Tingting (2012) et al.). Due to the differences in economic development level, cultural background, agricultural production conditions and other factors, the willingness of farmers in different regions to participate in agricultural carbon sequestration projects may be quite different, and more in-depth research is needed to reveal the rules and influencing factors.

3. Research Methods and Data Sources

3.1. Research Methodology

In this paper, a combination of questionnaire survey and field survey was used to conduct research. Firstly, by reviewing relevant literature and data, a scientific and reasonable questionnaire was designed. Then, representative rural areas in Anhui Province were selected for field research, and data were collected through face-to-face interviews and questionnaire filling. In the data analysis stage, this paper constructs a probit regression model based on the improved UTAUT model, and quantitatively analyzes the key factors affecting farmers' willingness to participate in agricultural carbon sequestration projects. The specific formula of the model is as follows:

$$P(Y=1|X) = \Phi(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k)$$

Among them, P represents the probability of farmers adopting low-carbon production technology, β_0 is a constant term, β_1 to β_n is the regression coefficient of their respective variables, and X_1 to X_n represents different independent variables. These independent variables cover multiple dimensions such as farmers' personal characteristics (age, gender, household registration, etc.), agricultural production conditions (planting area, income level, etc.), government policies (credit lending), and social environment (environmental awareness, etc.).

3.2. Data Sources

The data in this paper are based on a questionnaire survey and field survey of 980 rural households in Anhui Province. The questionnaire covers the basic information of farmers (such as age, gender, education level, household income, etc.), agricultural production (such as planting area, crop type, fertilizer and pesticide use, etc.), awareness of carbon trading policies, and willingness to participate in agricultural carbon sequestration projects. Through a combination of field research and questionnaire survey, this paper ensures the authenticity and reliability of the data, and provides a solid foundation for follow-up research.

4. Results and Analysis

The benchmark regression results are as follows, among which (1) is the first regression result, which shows that the likelihood ratio is significant at the 1% level, and the model fitting effect is acceptable. (2) The model still has a high degree of fit after excluding the less significant variables, so this paper will analyze the results based on the results after excluding irrelevant variables. It can be seen that the coefficient of the household variable is -1.125, which is significant at the 10% level, that is, the low-carbon behavior of agricultural household is lower. The index coefficient of credit borrowing was 0.775, which was significant at the level of 1%, that is, the low-carbon behavior of farmers borrowing with credit was higher. The coefficient of environmental concern variable was -1.272, which was significant at the 1% level, that is, the low-carbon behavior of farmers with lower environmental concern level was lower. The coefficient of skill learning ability was 0.385, which was significant at the 5% level, that is, the low-carbon behavior of farmers with higher skill learning ability was higher.

4.1. Analysis of farmers' willingness to participate in agricultural carbon sequestration projects

The survey results show that the willingness of farmers to participate in agricultural carbon sequestration projects is generally low. Specifically, only a small number of rural households expressed their willingness to actively participate in agricultural carbon sequestration projects; However, most farmers do not know enough about agricultural carbon sequestration projects or have a wait-and-see attitude. The results show that the awareness and participation of farmers in agricultural carbon sequestration projects still need to be improved. The government and all sectors of society need to strengthen the publicity and promotion of agricultural carbon sequestration projects, and increase the awareness and participation of farmers.

Table 1. Regression analysis results

VARIABLES	(1) lowc	(2) lowc
gender	-0.027 (0.326)	
age	0.013 (0.013)	0.013 (0.012)
edu	0.050 (0.044)	0.050 (0.042)
hukou	-1.056 (0.688)	-1.125* (0.674)
health	0.090 (0.152)	
tpa	0.306 (0.237)	
income	-0.261 (0.193)	
debt	0.848*** (0.294)	0.775*** (0.280)
env	-1.276*** (0.335)	-1.272*** (0.334)
skill	0.365** (0.167)	0.385** (0.159)
dist	-0.063 (0.201)	
Log likelihood	-311.15***	-312.28***
Observations	204	204
Standard errors in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

4.2. Influencing factor analysis

4.2.1. Personal characteristics of farmers

The personal characteristics of farmers have a significant impact on their willingness to participate in agricultural carbon sequestration projects. Farmers with a higher level of education are more likely to understand and accept the significance and value of agricultural carbon sequestration projects, and are therefore more willing to participate in them. This is because farmers with a higher level of education usually have stronger learning and information acquisition skills, and are better able to understand and grasp the relevant policies and technical requirements of agricultural carbon sequestration projects. Older farmers may be less receptive to new technologies and policies due to habits and traditions. These farmers may be more inclined to adopt traditional agricultural production methods and management models, and be cautious about new technologies and policies such as agricultural carbon sequestration projects. Although gender has a relatively small impact on farmers' willingness to participate in agricultural carbon sequestration projects, there are still some differences in the willingness of farmers of different genders to participate. In general, male farmers may be more adventurous and innovative, and more willing to experiment with new technologies and

policies. Female farmers, on the other hand, may be more concerned about practical benefits and stability.

4.2.2. Conditions of agricultural production

Agricultural production conditions are also one of the important factors affecting farmers' willingness to participate in agricultural carbon sequestration projects. Farmers with larger acreage may be more able and willing to participate in agricultural carbon sequestration projects to increase productivity and income. These farmers usually have a large production scale and strong economic strength, and can bear the costs and risks required for the implementation of agricultural carbon sequestration projects. Farmers with higher income levels may be more willing to participate in agricultural carbon sequestration projects because they are better able to bear the costs and risks involved in implementing them. In addition, farmers with higher income levels generally have higher awareness and concern about environmental protection and sustainable development, and are more willing to contribute to environmental protection. Farmers in good health may be more able to tolerate the risks and uncertainties associated with new technologies and policies, and are therefore more willing to participate in agricultural carbon sequestration projects. These rural households usually have strong physical fitness and resilience to stress, and are better able to adapt to the changes and challenges brought about by new technologies and policies. Farmers with good credit positions are more likely to receive financial support to implement agricultural carbon sequestration projects. These rural households usually have good credit histories and repayment capabilities, and are more likely to obtain loan support and other forms of financial support from financial institutions.

4.2.3. Government Policies

Government policies play an important role in promoting farmers' participation in agricultural carbon sequestration projects. By providing financial subsidies and tax incentives, the government can reduce the cost and risk of farmers' participation in agricultural carbon sequestration projects, and increase their willingness and enthusiasm to participate. These policies and measures can effectively motivate farmers to actively participate in agricultural carbon sequestration projects and achieve practical results. By strengthening technology promotion and training, the government can increase farmers' awareness and participation in agricultural carbon sequestration projects. Popularizing the relevant knowledge and technical requirements of agricultural carbon sequestration projects to farmers through organizing expert lectures, training courses and other activities can help farmers better understand and master new technologies and policies. The government can provide a strong guarantee for the implementation of agricultural carbon sequestration projects by establishing and improving relevant systems and regulations. By clarifying the project implementation process, regulatory requirements and incentive mechanisms, the smooth implementation and sustainable development of agricultural carbon sequestration projects can be ensured.

4.2.4. Socio-environmental factors

Socio-environmental factors also have a significant impact on farmers' willingness to participate in agricultural carbon sequestration projects. Farmers with high environmental concerns may be more inclined to participate in agricultural carbon sequestration projects to reduce negative environmental impacts. These farmers usually have a strong sense of environmental protection and social responsibility, and are willing to contribute to environmental protection and actively participate in related activities. Farmers with strong skills learning skills may be more likely to master and apply technologies and knowledge related to agricultural carbon sequestration projects. These rural households usually have strong learning ability and practical experience, and are better able to adapt to the changes and challenges brought about by new technologies and policies. Social networks also have an impact

on farmers' willingness to participate in agricultural carbon sequestration projects. Communication and cooperation among rural households can promote the dissemination and application of new technologies and policies, thereby increasing farmers' willingness and enthusiasm to participate. At the same time, social networks can also provide assistance to farmers in terms of information support and resource sharing.

5. Policy Recommendations

5.1. Increase policy support

The government should further increase policy support for agricultural carbon sequestration projects. Reduce the cost and risk of rural households' participation by providing financial subsidies, tax incentives and other policy measures; At the same time, we should strengthen technology promotion and training to improve farmers' awareness and participation. In addition, the government can also consider setting up a special fund to support the research and development and implementation of agricultural carbon sequestration projects.

5.2. Improve the carbon trading market system

Further improve the carbon trading market system to provide stable market demand for agricultural carbon sink projects. Promote the market-oriented operation and sustainable development of agricultural carbon sequestration projects through the establishment of an open, transparent and efficient carbon trading platform; At the same time, market supervision and law enforcement should be strengthened to ensure the fairness and stability of the carbon trading market.

5.3. Strengthen publicity and education guidance

Strengthen the publicity, education and guidance of agricultural carbon sequestration projects. Popularize the relevant knowledge and technical requirements of agricultural carbon sequestration projects to farmers through training courses, lectures and other activities; At the same time, media publicity and network communication are used to expand the scope and influence of publicity, and improve the awareness and participation of farmers.

5.4. Establish and improve incentive mechanisms

Establish and improve incentive mechanisms to encourage and support rural households to participate in agricultural carbon sequestration projects. Encourage farmers to actively participate and achieve practical results by setting up incentive funds and providing technical support; At the same time, we will strengthen the recognition and publicity of outstanding projects and advanced models, set an example and demonstration effect, and drive more farmers to participate in agricultural carbon sink projects.

6. Conclusions and Prospects

6.1. Conclusions

This paper discusses the willingness of farmers to participate in agricultural carbon sequestration projects and its influencing factors under the background of carbon trading policy through questionnaire survey and field research. The results show that farmers' personal characteristics, agricultural production conditions, government policy guidance and social environmental factors have a significant impact on their willingness to participate. Based on the above conclusions, this paper puts forward policy suggestions to promote farmers' participation in agricultural carbon sequestration projects, in order to provide a scientific basis and decision-making reference for the government to formulate relevant policies.

6.2. Prospects

Future research can further explore the willingness and influencing factors of farmers in different regions and different crop types to participate in agricultural carbon sequestration projects, and put forward more targeted policy recommendations. At the same time, the evaluation of the economic and environmental benefits of agricultural carbon sequestration projects should be strengthened to provide a more scientific basis for the government to formulate relevant policies. In addition, it can also be combined with the theories and methods of other disciplines to comprehensively analyze the behavior of farmers participating in agricultural carbon sequestration projects, reveal the deep-seated reasons and mechanisms behind them, and provide more comprehensive and in-depth theoretical support and practical guidance for promoting low-carbon agricultural development.

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