Education and Social Work
ISSN Print: 3079-515X
ISSN Online: 3079-5168
https://doi.org/10.63313/ESW.9030

Research on the adoption and application of smart agriculture technology by rural residents driven by carbon inclusiveness——Based on the perspective of "cognition attitude behavior motivation"

Xiaolu Wang. Jiayi Du and Yu Zhang
School of Economics, Anhui University of Finance and Economics, Bengbu 233030, China

How to cite this paper: Wang, X. L., Du, J. Y., & Zhang, Y. (2025). Research on the adoption and application of smart agriculture technology by rural residents driven by carbon inclusiveness——Based on the perspective of "cognition attitude behavior motivation". Education and Social Work, 1(2), 252–262. ISSN Print: 3079-515X, ISSN Online: 3079-5168.
https://doi.org/10.63313/ESW.9030
Published: 2025-05-05

Abstract

In response to the severe challenges of global climate change and environmental protection, smart agriculture technology provides new impetus for the green transformation and low-carbon development goals of agriculture. The carbon inclusive policy aims to use market mechanisms and leverage to actively guide all sectors of society to participate in reducing greenhouse gas emissions and promoting the construction of a green and low-carbon economic system. Focusing on the agricultural field, relying on the innovative driving force of carbon inclusive mechanisms, deeply integrating modern information technology means such as the Internet of Things, big data, and cloud computing with agricultural practices, vigorously promoting the adoption and application of smart agricultural technologies, has profound significance for achieving sustainable agricultural development. This project is based on the perspective of "attitude cognition behavior motivation", with Anhui Province as the main research site and other regions as supplements. It conducts orderly visits, discussions, field interviews, and questionnaire surveys to explore the inherent fit between carbon inclusive mechanisms and the promotion of smart agriculture technology, as well as the acceptance and countermeasures of rural residents towards carbon inclusive driven smart agriculture technology. Finally, relying on the innovative driving force of carbon inclusive mechanisms, targeted countermeasures and suggestions are proposed, aiming to provide new research perspectives for expanding the application space of smart agriculture technology, promoting agricultural modernization transformation and sustainable development.

Keywords

Carbon Inclusive Mechanism; Smart Agricultural Technology; Agricultural Technology Extension

1. Introduction

The "No.1 Document" of the central government continues to focus on the development of "precision agriculture" and "smart agriculture", outlining a clear blueprint for China's agricultural modernization and transformation. The construction of digital rural areas is urgent, and the development of smart agricultural technology is an important component of digital rural construction. It not only provides solid technical support for improving agricultural production efficiency and the low-carbon and intelligent transformation of agriculture, but also broadens the application boundaries of agricultural and rural big data, and provides strong impetus for the intelligence and precision of agricultural production. To a certain extent, it has become the key to solving the "three rural issues" in China and building new advantages in modern agricultural international competition.

Under the severe situation of global climate change, low-carbon transformation in agriculture has become a key path to achieve the goal of "carbon neutrality". Climate change has become an urgent issue that attracts worldwide attention, with governments and international organizations setting carbon neutrality targets. As a responsible major country, China has clearly put forward the "dual carbon" goal, elevating low-carbon development in the agricultural sector to a national strategic level, and promoting green transformation in agriculture as a key link to achieving carbon neutrality goals.

Carbon inclusiveness encourages the public to actively participate in carbon reduction activities through policy guidance and market mechanisms, and provides corresponding economic incentives or carbon point rewards. In the field of agriculture, this mechanism is driven by innovation and utilizes economic incentives and carbon credit rewards to effectively stimulate the enthusiasm and creativity of rural residents, promote their gradual understanding of the practical benefits and long-term value of smart agricultural technology applications, and promote the widespread application and promotion of smart agricultural technology in rural areas. It is of great significance for achieving low-carbon, intelligent, and sustainable development of agriculture. In this context, this project conducts in-depth research on the adoption and application of smart agriculture technology by rural residents driven by carbon inclusiveness, which has important theoretical and practical significance for promoting the popularization of smart agriculture technology in rural areas, achieving low-carbon, intelligent and sustainable development of agriculture. Based on the perspective of "cognition attitude behavior motivation", this article explores this issue in depth, aiming to reveal the influencing factors and mechanisms of rural residents' adoption and application of smart agricultural technology, and provide theoretical basis and practical guidance for promoting the promotion and application of smart agricultural technology in rural areas.

2. Research Status and Literature Review

The research on carbon inclusive mechanisms and smart agriculture mainly relies on domestic literature. The literature on carbon inclusive mechanisms covers multiple aspects such as carbon framework design, implementation effect analysis, and policy optimization. Currently, a relatively complete research system has been formed, but there is little analysis on practical application and industrial integration, and further research and exploration are needed to supplement it. However, although there is a large amount of literature exploring the development prospects and practical difficulties of smart agriculture, there is relatively little research on its adoption and application, and a systematic and comprehensive theoretical research framework has not yet been formed.

2.1 Research on Carbon Inclusive Mechanisms

The carbon inclusive mechanism is an innovation and expansion of existing carbon emission trading, which is of great significance in promoting the achievement of carbon peak and carbon neutrality standards. In terms of framework design, Liu Hang (2018) believes that the carbon inclusive mechanism is an innovative mechanism artificially promoted, and proposes a carbon inclusive system framework plan that adapts to China's national conditions, covering four main aspects: clarifying participating subjects, formulating behavior lists, implementing quantitative incentives, and improving trading mechanisms. In terms of implementation effectiveness, Gao Shang (2022) pointed out that time is tight, tasks are heavy, and pressure is high. It is increasingly urgent to quickly guide the lifestyle and consumption behavior of Chinese residents towards low-carbon transformation; Huang Danwen (2020) takes the forestry carbon universal benefit system as an effective entry point and proposes the use of market mechanisms to achieve universal benefits for the public; Liu Qilong and Liu Wei (2023) emphasize the importance of a positive guidance mechanism, which can help accelerate the implementation of the "dual carbon" goals by guiding the public to participate in green living and form green lifestyles to achieve carbon reduction in the consumption side of daily life; In terms of policy optimization, Wan Guangyu and Hua Jingfen (2024) have expanded the effective use of carbon inclusive mechanisms through various channels such as strengthening top-level design, promoting digital platform construction, guiding emission reduction entities to purchase carbon, and leveraging multiple support forces.

2.2 Research on Smart Agriculture Technology

Smart agriculture promotes development through the integration of modern information technology and innovative production methods. From the perspective of theoretical interpretation, Yang Darong (2014) introduced the concept and characteristics of smart agriculture, and combined with the development experience of smart agriculture in developed countries, proposed development strategies for China's actual situation; Wen Tao and Chen Yiming (2020) summarized typical practice models at home and abroad, systematically analyzed the obstacles in China's reality,

and proposed corresponding breakthrough paths, providing useful references for achieving high-quality and efficient sustainable development of agriculture, rural areas, and farmers; Zhao Chunjiang (2021) explained the concept and connotation of smart agriculture from the perspective of systems engineering, and introduced the strategic layout and action plans related to smart agriculture abroad [8]. From the perspective of practical development, Cui Ningbo (2022) believes that the development of smart agriculture currently faces multiple challenges, including incomplete policy guidance and low levels of data collection and integration. Wu Qun (2018) proposed in his research directions for the development of smart agriculture, including agricultural layout based on location characteristics, strengthening the construction of geographical indication agricultural product brands, and building high-level modern agricultural industrial parks.

3. Analysis of Relevant Factors for the Adoption and Application of Smart Agriculture Technologies by Rural Residents in Anhui Province Driven by Carbon Inclusion

3.1 Cognitive analysis of the adoption and application of smart agriculture technology by rural residents in Anhui Province driven by carbon inclusiveness

Through descriptive statistics, we have gained a comprehensive understanding of the basic information such as gender, age, and education level of the respondents, ensuring the representativeness of the sample. Analysis shows that there are slightly more women than men, mainly concentrated in the age range of 18-30 years old, with a higher proportion of college and bachelor's degrees. Farmers and other industry practitioners make up the majority, and the proportion of middle-class households is considerable. Moreover, the majority of households have a farming area between 10-40 acres. In terms of cognitive channels, mobile network platforms have become the main channel, while the role of traditional media and research institutions is relatively small. The application areas of smart agriculture technology have been highly recognized in multiple fields, demonstrating its potential for widespread application. In terms of benefit perception, most respondents agree that smart agriculture technology has a positive effect on agricultural production, especially in improving the quality of agricultural products, increasing production efficiency, increasing farmers' income, and reducing agricultural carbon emissions. However, regarding risk perception, the respondents' cognition is relatively scattered, and most people believe that there is a certain level of risk, reflecting a lack of unified understanding of risk.

Using K-means clustering analysis, rural residents are divided into three categories: proficient, potential, and waiting to be discovered, which helps to gain a deeper understanding of the cognitive characteristics of different groups. Cluster analysis is based on six dimensions: cognitive level, participation experience, digital literacy,

adoption attitude, external environment, and interest orientation. The results show that the proficient population has a high understanding and digital literacy of smart agriculture technology, and holds a positive attitude towards the technology; Although the potential population has a general understanding of technology and digital literacy, they hold a positive attitude towards technology and are willing to participate in promotion activities, making them an important target group for promoting smart agricultural technology; The waiting age group has a lower level of understanding of technology, average digital literacy, and a less positive attitude towards technology adoption, requiring more guidance and education.

There are differences in the understanding of smart agriculture technology among rural residents in different aspects, but most people are willing to adopt and participate in promotion activities. However, the overall level of understanding still needs to be improved. In the future, efforts should be made to strengthen the promotion and training of smart agriculture technology, especially for the disadvantaged population, to enhance their awareness and acceptance of the technology, in order to promote the widespread application of smart agriculture technology in rural areas of Anhui Province.

3.2 Attitude analysis of rural residents in Anhui Province towards the adoption and application of smart agriculture technology driven by carbon inclusiveness

Driven by carbon inclusiveness, rural residents in Anhui Province have a relatively positive attitude towards the adoption and application of smart agriculture technology. Most respondents showed strong interest and high acceptance of smart agriculture technology, with 90.63% of residents willing to adopt it and only 9.38% holding a reserved attitude. In terms of promotion willingness, 51.16% of respondents are very willing to promote, 76.25% are willing to participate in training and promotion activities, and 91.43% are willing to promote in rural areas. However, 51.25% of respondents believe that high costs are one of the main factors hindering adoption, while complex operations and lack of training are also important obstacles. Nevertheless, the high production and environmental benefits of smart agriculture technology are highly attractive to respondents, such as water-saving and efficient irrigation through intelligent irrigation systems, efficient and precise operation through autonomous driving of agricultural machinery and unmanned aerial vehicle (UAV) crop protection technology. In addition, most respondents hope to achieve energy conservation, health and environmental protection through smart agriculture technology, but there is also a considerable number of people who are skeptical about the effectiveness of technology and changing traditional agricultural habits.

By constructing an evaluation system and quantitatively analyzing the attitudes and intentions of respondents, it was found that there are differences in attitude characteristics among different groups of people. Overall, the public has a high willingness to participate in smart agriculture technology, with most scores ranging from 0.9 to

1.2. Among them, the respondents' recommendation of smart agriculture technology to others and the application of smart agriculture in their region have the deepest impact on their attitude and willingness. Among people with different levels of cognition, proficient individuals are more concerned with cost-effectiveness, interest tendencies, and adoption attitudes; Potential individuals are more sensitive to their interests, external environment, and adoption attitudes; The waiting to be initiated group scored low in all aspects and had a weak willingness to participate. This indicates that when promoting smart agriculture technology, emphasis should be placed on cost-effectiveness, interest stimulation, environmental creation, and attitude guidance to enhance the participation enthusiasm of different groups of people.

3.3 Behavior analysis of rural residents in Anhui Province adopting and applying smart agricultural technologies driven by carbon inclusiveness

Through descriptive statistics, the study found that 71.25% of respondents had used smart agriculture technology, with about half using it regularly. Most respondents have participated in relevant training and demonstration projects, demonstrating a strong willingness to learn. The carbon inclusive policy has a high level of awareness among farmers and is considered to play an important role in promoting smart agricultural technologies. More than 60% of the respondents have recommended smart agriculture technology to others, demonstrating a good willingness to disseminate technology. In agricultural production, nearly 20% of respondents have taken carbon reduction actions, indicating that they have begun to take practical actions to reduce carbon emissions. The motivations for using smart agriculture technology are diverse, including community recognition, increasing yields, reducing costs, and increasing profits.

Multivariate logistic regression analysis further revealed the key factors influencing the adoption behavior of smart agriculture technology. For the proficient population, farming methods, risk perception, economic development level, and adoption willingness are the main influencing factors. Pure manual farming farmers are less willing to adopt new technologies, while agricultural enterprises are more inclined to adopt them. The higher the risk perception, the lower the likelihood of technology adoption. In areas with lower levels of economic development, residents have a lower adoption rate of smart agriculture. The behavior of potential individuals is influenced by gender, farming methods, risk perception, practical application of smart agriculture, and willingness to adopt it. Men are more actively adopting new technologies, while farmers who rely solely on manual farming are more resistant. Risk perception and practical application have a significant impact on technology adoption. The adoption behavior of the waiting type population is mainly influenced by age, risk perception, and the practical application of smart agriculture. Young people are more inclined to accept new technologies, and risk perception directly affects technology adoption decisions.

3.4 Incentive analysis on the adoption and application of smart agriculture technology by rural residents in Anhui Province driven by carbon inclusiveness

Through in-depth exploration of the incentive factors for rural residents in Anhui Province to adopt and apply smart agricultural technology driven by carbon inclusiveness. Through the use of online information text mining and sentiment analysis, it was found that the public's overall awareness and attitude towards carbon inclusive mechanisms are positive, and rural residents have a high level of attention to carbon inclusive mechanisms and smart agriculture technologies. The analysis of open-ended questionnaire questions shows that respondents expect to receive more support in areas such as funding, policies, technology, education and training, and infrastructure. At the same time, they are also full of expectations for the application of smart agriculture technology driven by carbon inclusiveness. Further analysis reveals that the carbon inclusive mechanism and smart agriculture technology have a high degree of compatibility and mutual promotion in terms of goals, technology, policies, and markets. Finally, taking Wuhu City as an example, the successful practice of combining carbon inclusive mechanisms with smart agricultural technology was demonstrated, emphasizing the importance of developing characteristic brands, improving infrastructure, innovating mechanisms, cultivating talents, and establishing incentive policies. At the same time, the issues that need to be paid attention to in the process of transforming agricultural scientific and technological achievements were also pointed out.

4. Research Conclusion

4.1 Current Status of Rural Residents' Understanding of Smart Agriculture Technology

The cognitive level of rural residents in Anhui Province towards smart agriculture technology is generally at a moderate level. This reflects that although smart agriculture technology has been widely promoted in theory, the depth and breadth of understanding in practical applications still need to be improved. There is a clear imbalance in digital literacy, differences in risk perception among rural residents towards smart agricultural technology, and insufficient application and popularization of smart agricultural technology in rural areas. These factors have to some extent affected rural residents' understanding and application of smart agriculture technology. The improvement of digital literacy is the key to the popularization of smart agriculture technology, and it is necessary to strengthen farmers' information technology capabilities through education and training to promote the acceptance and application of smart agriculture technology. It is particularly important to enhance farmers' risk awareness and management capabilities through education and publicity.

4.2 Attitude and willingness of rural residents towards the adoption

and application of smart agricultural technology

Rural residents hold a positive attitude towards smart agriculture technology, believing that it can help reduce carbon emissions and are willing to adopt new technologies. However, cost, complexity of technical operations, doubts about the effectiveness of technology, and lack of government support are the main obstacles to adoption. Most rural residents recognize the potential benefits of new technologies, such as technological instability and insecurity, but they are willing to learn and adopt them through training and promotion activities. The economic environment is an important factor affecting adoption, and the lack of sufficient economic sources is one of the reasons for unwillingness to adopt. Government subsidies or incentive policies are considered important factors in promoting adoption. Lack of government policy support is considered a significant reason for unwillingness to adopt.

4.3 Behavioral choices of rural residents towards the adoption and application of smart agricultural technology

Rural residents have shown a positive attitude and behavior towards the adoption and application of smart agriculture technology. Many rural residents have already used smart agriculture technology and use it regularly, but their frequency of use varies from weekly to annual. Some rural residents have stated that they have never used them but are willing to share their experiences and recommend new technologies to others. Under the guidance of relevant policies, rural residents have adopted some carbon reduction behaviors through training and demonstration projects on smart agriculture technology. However, there are differences in usage frequency, with some rural residents stating that they have never used smart agriculture technology, which may be related to factors such as lack of understanding and complexity of technical operations. Many rural residents use smart agriculture technology to increase crop yields, reduce agricultural factor inputs, and thus obtain additional economic benefits. Some rural residents have taken carbon reduction measures, such as reducing pollution in agricultural production, implementing water-saving measures, and using organic fertilizers instead of chemical fertilizers.

5. Suggestions for countermeasures

5.1 Strengthen the publicity and education of carbon inclusive policies, enhance the awareness and acceptance of rural residents

Firstly, we need to promote carbon inclusive policies through multiple channels, especially on specialized platforms in rural areas such as "Rural Loudspeakers" and WeChat groups of agricultural cooperatives, to extensively publicize the specific content, implementation effects, and reward mechanisms of carbon inclusive policies. Effectively enhance rural residents' awareness of carbon inclusive policies, enabling them to better understand the details and benefits of the policies. Secondly, we need to carry out special educational activities, form expert teams, go deep into

rural areas, hold special lectures, training courses, and on-site demonstration activities, aiming to combine the concept of carbon inclusiveness with smart agricultural technology. Through various forms such as case analysis and interactive Q&A, we aim to enhance rural residents' profound understanding of smart agriculture technology and its environmental benefits. In addition, demonstration sites can be established to lead the selection of villages with mature conditions, serving as demonstration sites for the combination of carbon inclusiveness and smart agriculture. Through demonstration sites, demonstrate to the outside world the practical achievements of smart agriculture technology in reducing carbon emissions and improving production efficiency.

5.2 Optimize the promotion strategy of smart agriculture technology and lower the adoption threshold

A series of targeted and differentiated promotion strategies must be developed to address the differences in cognitive level and economic conditions among rural residents, in order to ensure that all types of farmers can benefit from them. For farmers with higher cognitive levels and better economic conditions, high-end smart agriculture technologies can be directly promoted to help them improve production efficiency and economic benefits. For farmers with lower cognitive levels and limited economic conditions, more cautious and gradual promotion strategies need to be adopted. Starting from low-cost and easy-to-use technologies, gradually guide these farmers to experience the practical benefits brought by technology, laying a solid foundation for their transition to more advanced technologies. The government should further strengthen the financial subsidy policy for smart agriculture technology to alleviate the economic pressure on farmers during initial investment. More preferential policies can also be formulated to encourage financial institutions to develop and promote specialized loan products for smart agriculture technology, thereby promoting the modernization process of the entire agricultural industry. In addition, building a comprehensive smart agriculture technology training system is particularly crucial. By adopting diversified training methods such as online courses, on-site operational drills, and one-on-one guidance from experts, farmers can systematically learn and master the key operational processes and daily maintenance knowledge of smart agriculture technology.

5.3 Improve the carbon inclusive incentive mechanism to stimulate rural residents' adoption motivation

Build a carbon inclusive point exchange mechanism aimed at converting the carbon emissions reduced by farmers in the agricultural production process into points with practical value. These points can be used by farmers to exchange for various rewards, including but not limited to agricultural inputs, daily necessities, and technical training courses. The government should strengthen policy incentives and guidance, formulate and implement more policy measures that are conducive to the

development of smart agriculture, in order to provide solid policy guarantees for farmers. We should actively encourage the participation of diverse entities such as enterprises, research institutions, and social organizations. With the guidance and support of the government, the leading role of market mechanisms, and the active participation of all sectors of society, we are committed to building a multi-party collaborative promotion system. This system aims to effectively reduce the cost of technology promotion and improve promotion efficiency through collaborative construction and resource sharing. In this way, all parties can benefit and achieve a win-win situation.. Research institutions can provide the latest research results and technical support to help enterprises achieve better results in practical applications. Social organizations can leverage their influence and organizational capabilities at the grassroots level to promote the application of smart agricultural technology in broader regions. We firmly believe that through this multi-party cooperation model, smart agriculture technology will accelerate its popularization and application, making greater contributions to agricultural modernization and rural revitalization.

5.4 Strengthen infrastructure construction and technical support to ensure the smooth application of smart agriculture technology

Firstly, we need to improve rural information infrastructure, increase investment, and promote advanced information transmission technologies such as 5G and the Internet of Things to improve the efficiency and reliability of data transmission. Through these measures, agricultural producers in rural areas can better utilize smart agricultural technology to achieve precise planting and intelligent management, thereby improving agricultural production efficiency and product quality, and promoting the process of agricultural modernization. Secondly, a smart agricultural technology service platform can be established that integrates technical consultation, fault diagnosis, remote control, and other functions to provide timely and professional technical support and service guarantees for farmers, helping them solve various technical problems encountered in the planting and breeding process. It also has fault diagnosis function, which can quickly identify and solve problems with agricultural machinery and equipment. In addition, the platform also supports remote control function, allowing farmers to achieve precise control of agricultural equipment and improve agricultural production efficiency through remote operation. In addition, promote technological innovation and upgrading. To promote agricultural modernization, it is necessary to increase investment in the research and development of smart agricultural technologies, ensuring that the technology is in line with rural needs, easy to operate, and cost-effective. Strengthen the transformation and application promotion of technological achievements, establish mechanisms to serve farmers with scientific research results, and enhance farmers' skills through training, guidance, and consulting services.

Acknowledgements

Undergraduate Research Innovation Fund Project of Anhui University of Finance and Economics (XSKY25004ZD)

References

[1] Liu Hang Carbon Preferential System: Theoretical Analysis, Experience Reference, and Framework Design [J]. Research on Socialism with Chinese Characteristics, 2018, (05):86-94+112.

[2] Noble Carbon Inclusion for Chinese Residents from the Perspective of "Dual Carbon": Connotation, Framework System, and Policy Suggestions [J]. Journal of Nanhua University (Social Sciences Edition), 2022, 23 (03): 37-42

[3] Huang Danwen Meizhou: Promoting Carbon Inclusion in Forestry, Blooming and Fruiting [J]. Environment, 2020, (12):32-33.

[4] Liu Qilong, Liu Wei Experience and Suggestions on Local Carbon Inclusion Practice in China under the "Dual Carbon" Goal [J]. Environmental Impact Assessment, 2023, 45 (06): 41-49

[5] Wan Guangyu, Hua Jingfen Research on the Construction of Carbon Inclusive System in Hunan Province under the Green Collaborative Development of the Central Region [J]. Hunan Social Sciences, 2024, (04):38-43.

[6] Development Strategy of China's Smart Agriculture Industry [J]. Jiangsu Agricultural Science, 2014, 42 (04): 1-2

[7] Wen Tao, Chen Yiming Integrated Development of Digital Economy and Agricultural Rural Economy: Practical Models, Practical Obstacles, and Breakthrough Paths [J]. Agricultural Economic Issues, 2020, (07):118-129.

[8] Zhao Chunjiang The Development Status and Future Prospects of Smart Agriculture [J]. Journal of South China Agricultural University, 2021, 42 (06): 1-7

[9] Cui Ningbo The significance, challenges, and implementation paths of empowering rural revitalization with smart agriculture [J]. People's Forum, 2022, (05):26-28.

[10] Wu Qun Research on the Main Directions and Countermeasures of Agricultural Innovation Development in the Perspective of Rural Revitalization [J]. Economic Journal, 2018, (10): 67-72