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Study on the Impact of Data Elements on the Efficiency of Net Carbon Sinksin Agriculture

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Abstract

Modern agriculture has an important mission to reduce emissions and increase sinks in the context of the "dual carbon" strategy. With the rapid development of digital technology, data elements are profoundly changing the traditional management mode of agricultural carbon sinks. This paper analyzes the unique mechanism of data elements in enhancing the efficiency of agricultural net carbon sinks by systematically combing the historical development of agricultural carbon sink management. The study finds that a data-driven system based on Internet of Things (IoT), remote sensing and blockchain technologies can significantly optimize the agricultural carbon management process: on the one hand, it can reduce the carbon emission intensity through field measures such as precision fertilization and irrigation; on the other hand, it can obtain additional benefits by participating in the market transaction with the help of credible carbon sink data. The study also found that the current application of data elements in agricultural carbon management still suffers from low acceptance by farmers and insufficient technical adaptability. In the future, it is necessary to improve the data standard system and develop simple application tools to further enhance the role of data elements in promoting the efficiency of agricultural carbon sinks, so as to provide a new impetus for realizing the green and low-carbon transformation of agriculture.

Keywords

Data Elements; Agricultural Carbon Sinks; Precision Management; Digital Technology; Low-carbon Agriculture.

1. Introduction

In the strategic context of realizing the "double carbon" goal, the agricultural sector presents a unique dual attribute of carbon source and sink. As an important source of greenhouse gas (GHG) emissions, the various types of emissions generated during agricultural production, including methane release during rice cultivation, GHGs generated by the digestive system of ruminants in animal husbandry, and nitrous oxide emissions from chemical fertilizer application, together account for about 17 per cent of total global GHG emissions. At the same time, through natural processes such as crop photosynthesis and the accumulation of soil organic matter, the agricultural system has become an important carbon sink, absorbing about 20% of global anthropogenic carbon emissions each year. This dual characteristic of being both a source of emissions and a sink makes the agricultural sector of special significance in combating climate change, as it faces the challenge of reducing emissions intensity through the transformation of production methods, and also contains great potential for enhancing carbon sequestration capacity through scientific management. At present, the deep integration of digital technology and agricultural production is reshaping the traditional carbon management mode. The application of data elements such as meteorological monitoring systems, soil environment sensor networks, and blockchain-based carbon traceability systems for agricultural products has provided revolutionary means to enhance the efficiency of agricultural carbon management. By supporting the precise implementation of low-carbon measures such as accurate fertilization, intelligent irrigation, and rational crop rotation, these technologies significantly improve the accuracy of agricultural carbon emission monitoring and the pertinence of management measures, effectively solving the problems of large measurement errors, opaque data, and sloppy management under the traditional mode [1], and opening up a new technological pathway to achieve synergistic development of agricultural emission reduction and efficiency.

This study has important theoretical value and practical significance by analyzing the intrinsic mechanism of data elements affecting the efficiency of agricultural carbon sinks. From the perspective of theoretical innovation, this study systematically explores the path of improving the efficiency of agricultural net carbon sinks under digitalization conditions, which not only fills the gap of academic research on how data elements can drive the enhancement of agricultural carbon sink capacity, but also provides a new analytical framework and research perspective for the construction of a theoretical system of digital agricultural carbon management oriented to the goal of carbon neutrality. In terms of practical application, the research results can provide scientific support for government departments to formulate differentiated and precise policies for low-carbon development of digital agriculture, and promote the establishment of an intelligent agricultural carbon management platform based on Internet of Things, big data and other technologies. This will effectively promote the organic connection between the green transformation of modern agriculture and the rural revitalization strategy, help the synergistic realization of agricultural emission reduction and carbon sequestration goals and rural economic and social development goals, and have extensive social benefits and significant economic value in promoting the high-quality development of agriculture.

2. Historical Evolution of Agricultural Carbon Sink Management

2.1. Management of Traditional Agricultural Carbon Sinks

Traditional agricultural carbon sink management mainly relies on long-term accumulated farming experience for decision-making. Farmers arrange farming activities according to seasonal changes, climatic characteristics and regional climate patterns, and make adjustments with reference to intuitive observation data such as soil moisture and crop growth [2]. This management approach is rooted in the historical practice of agricultural production, has obvious characteristics of local adaptation, and can maintain the carbon balance of agroecosystems to a certain extent. However, due to the lack of systematic scientific monitoring means, its implementation effect is often limited by individual experience differences and the randomness of environmental changes.

In terms of technical means, the data base for traditional carbon sink management is relatively weak. It mainly relies on manually recorded farm logs, simple meteorological observation data and agricultural experience passed down from generation to generation as the basis for management. A fixed dosage model is used for fertilizer application strategies, irrigation management relies on precipitation observations and empirical judgments, and crop rotation arrangements follow established farming systems. Although these methods have a certain degree of practical rationality, they are difficult to respond in a timely manner to climate change and the dynamics of soil carbon pools, resulting in an obvious lack of relevance and flexibility in management measures.

Traditional models face significant challenges in carbon emission control. The lack of accurate greenhouse gas monitoring technology makes it difficult to quantitatively assess the impact of

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different agronomic measures on carbon sink efficiency. For example, fertilizer application based on empirical judgments can easily lead to overuse, which not only increases agricultural production costs, but also exacerbates nitrous oxide emissions due to nitrogen loss. Similarly, rough water management may alter the soil redox environment, which in turn affects the process of methane production and release in rice paddies, resulting in uncontrollable fluctuations in GHG emissions from agricultural sources.

The uncontrollability of the management effect is a prominent shortcoming of the traditional agricultural carbon sink system. Restricted by the level of technology and data support, traditional management is difficult to establish a quantitative relationship between the formation of carbon sinks and agricultural activities, making the carbon sink function of the system show obvious inter-annual fluctuations. Especially in the context of frequent occurrence of extreme climate events, management strategies based on historical experience often fail to adapt to new environmental changes, resulting in unstable carbon sink efficiency and restricting agriculture from playing its due role in addressing climate change. This situation highlights the limitations of traditional management models in achieving dual-carbon goals, and there is an urgent need to improve them through technological innovation.

2.2. Data-driven Modern Transformation

The rapid development of modern digital technology has provided revolutionary monitoring means and analytical tools for agricultural carbon sink management. On the one hand, space monitoring technology has made significant breakthroughs, such as the NASA carbon monitoring system, which can provide global vegetation carbon stock dynamics data with a resolution of 500m, the EU Copernicus Sentinel satellite, which can realize the assessment of carbon sink capacity at the farmland scale, and China's independently-developed carbon satellite, the "Global Carbon Dioxide Monitoring Experimental Satellite", which has also realized high-precision carbon flux monitoring. On the other hand, ground-based Internet of Things technologies are becoming increasingly mature, and through the deployment of soil carbon sensors, greenhouse gas flux monitoring towers, intelligent weather stations and other equipment, it is possible to set up an integrated agricultural carbon sink monitoring network covering the "star-space-earth". These technologies have significantly improved the spatial and temporal resolution of agricultural carbon sinks, transforming the traditional assessment method of relying on a single observation point into a three-dimensional monitoring system with multiple dimensions and scales.

The international community and governments are actively promoting the in-depth integration of digital technology and carbon sink management. At present, more than 30 countries around the world have formulated special policy frameworks for agricultural digitization, focusing on supporting capacity building and technology application for carbon sink monitoring. China has implemented the "Digital Agriculture Pilot Project" since 2017, focusing on the construction of a big data platform for the whole industrial chain of agricultural products, of which the data platform for agricultural carbon sinks has covered more than 200 key agricultural counties and districts across the country.2022 The "14th Five-Year Plan for the Development of Digital Agriculture" issued by the Ministry of Agriculture and Rural Development explicitly proposes to "build an intelligent monitoring and assessment system for agricultural carbon sinks", and realize carbon revenues and expenditures in farmland through a combination of remote sensing and ground-based monitoring. Through the combination of remote sensing and ground monitoring, accurate accounting of farmland carbon revenue and expenditure is realized. Europe and the United States and other developed countries have also increased investment, such as the United States Department of Agriculture in 2023 to invest 500 million U.S. dollars for agricultural digital infrastructure, of which 15% is dedicated to carbon emissions monitoring.

Data-driven management of modern agricultural carbon sinks is presenting three major characteristics of transformation: first, the intelligent upgrading of the management mode, through the integration of satellite remote sensing, drone aerial surveys, ground-based Internet of Things and other multifaceted data, to build up a closed-loop management mechanism of "monitoring-assessment-decision-making", and to realize the transformation from empirical judgments to data-driven; second is the depth of the expansion of the technology application, artificial intelligence algorithms can realize dynamic prediction of the growth of crops and the capacity of carbon sinks. Secondly, the deep expansion of technology application, artificial intelligence algorithms can realize the dynamic prediction of crop growth and carbon sink capacity, blockchain technology ensures the authenticity and traceability of carbon sink data, and digital twin technology helps simulation and optimization of different farming scenarios; lastly, it is the systematic reconstruction of industrial ecology. Various types of agricultural business entities can obtain customized carbon management solutions by accessing the government-constructed carbon sink data platform, and agricultural socialized service organizations can provide professional services such as precise fertilizer application and water-saving irrigation based on the data, and financial institutions can innovate green management based on the carbon data. Financial institutions innovate green financial products based on carbon data. This transformation is promoting the formation of a modernized agricultural carbon management system with precise monitoring, scientific assessment and intelligent decision-making.

3. The Role of Data Elements in Modern Agricultural Carbon Sink Management

3.1. Composition and Application of Data Elements

The rapid development of modern digital technology has provided revolutionary monitoring means and analytical tools for agricultural carbon sink management. In terms of space monitoring technology, the carbon monitoring system of the National Aeronautics and Space Administration of the United States can provide high-resolution global vegetation carbon stock dynamics data, the Copernicus Project satellites of the European Space Agency are capable of realizing the assessment of carbon sink capacity at the farmland scale, and China's self-developed scientific experimental satellites for global carbon dioxide monitoring have also realized high-precision carbon flux monitoring. Ground-based Internet of Things technology is becoming increasingly mature, and through the deployment of equipment such as soil carbon sensors, greenhouse gas flux monitoring towers and intelligent weather stations, it is possible to establish an integrated agricultural carbon sink monitoring network that covers space-based, air-based and ground-based areas. These technologies have significantly enhanced the monitoring capacity of agricultural carbon sinks in terms of spatial and temporal resolution, transforming the traditional assessment method of relying on a single observation point into a three-dimensional monitoring system with multiple dimensions and scales, and laying a solid foundation for the accurate assessment and scientific management of agricultural carbon sinks.

Driven by the global goal of carbon neutrality, the international community and governments are vigorously promoting the in-depth integration of digital technology and carbon sink management. More than 30 countries around the world have already formulated special policy frameworks for agricultural digitization, focusing on supporting carbon sink monitoring capacity building and technology application. Since the launch of the digital agriculture pilot project in 2017, China has focused on building a big data platform for the whole industrial chain of agricultural products, in which the agricultural carbon sink data platform has covered more than two hundred key agricultural counties and districts across the country.2022 The 14th Five-Year Plan for the Development of Digital Agriculture issued by the Ministry of Agriculture and Rural Affairs explicitly proposed to build an intelligent monitoring and assessment system for agricultural carbon sinks, and to realize the carbon revenue and expenditure of farmland through the combination of remote sensing and ground monitoring. The plan also emphasizes the need to build an intelligent monitoring and assessment system for agricultural carbon sinks. Europe and the United States and other developed countries are also continuing to increase investment, the U.S. Department of Agriculture in 2023 invested 500 million U.S. dollars for the construction of agricultural digital infrastructure, which is dedicated to carbon emissions monitoring budget accounted for fifteen percent.

The data-driven management of modern agricultural carbon sinks is showing three important transformation features. The first is the intelligent upgrading of the management model, which builds a closed-loop management mechanism for monitoring, assessment and decision-making by integrating multiple data such as satellite remote sensing, drone aerial surveys and ground-based Internet of Things, realizing a fundamental shift from traditional empirical judgement to modern data-driven management. Secondly, the depth of technology application has been expanded. Artificial intelligence algorithms are able to realize the dynamic prediction of crop growth and carbon sink capacity, blockchain technology ensures the authenticity and traceability of carbon sink data, and digital twin technology provides strong support for the simulation and optimization of different farming scenarios. Finally, it is the systematic reconstruction of industrial ecology. Various types of agricultural business entities can obtain customized carbon management solutions by accessing the carbon sink data platform constructed by the government; professional agricultural socialized service organizations can provide specialized services such as fertilizer and irrigation based on accurate data; and financial institutions can innovatively develop various types of green financial products based on carbon sink data. This all-round transformation is promoting the formation of a modernized agricultural carbon management system with precise monitoring, scientific assessment and intelligent decision-making.

3.2. Optimization of Key Management Processes

Variable Fertilizer Application (VFAT) technology is realizing the optimal control of fertilizer use through the application of accurate soil carbon and nitrogen data. Based on the real-time data obtained from the soil nutrient sensor network, the system can accurately calculate the carbon and nitrogen ratios of different plots and automatically match the specific fertilizer requirements of crops. This approach avoids the nitrogen redundancy brought about by traditional uniform fertilization, which not only directly reduces the emission intensity of greenhouse gases such as nitrous oxide, but also significantly improves the efficiency of nitrogen fertilizer use. The demonstration of rice-shrimp co-cropping system carried out in Hubei Province shows that the intelligent fertilization program guided by the carbon and nitrogen ratio can reduce the amount of nitrogen fertilizer by about 15%, while the crop yield remains stable, realizing the double benefits of yield increase and emission reduction.

The marketization of agricultural carbon trading relies on a scientific and reliable data accounting system. The new trading mechanism represented by the Hubei Rice Field Carbon Sinks Project realizes the accurate measurement of carbon credits through the establishment of a greenhouse gas emission monitoring system covering the whole process of planting and care. The project integrates information from multiple sources, such as soil carbon flux monitoring, weather station data and yield records, and builds an accounting model for rice paddy carbon sinks based on measured data. After verification, these data-supported carbon credit units have been successfully traded in the national carbon market, with an average annual carbon gain of more than 300 yuan per hectare of rice paddy, providing farmers with sustainable incentives to reduce emissions. This data-transparent carbon credit trading model is being popularized and applied in many rice farming areas across the country.

ISSN: 2710-0723

4. Policy Regulation and Industry Collaboration

4.1. Government Regulatory Framework

The Technical Specifications for Monitoring Agricultural Carbon Emissions, recently issued by China's Ministry of Agriculture and Rural Affairs, establish a unified system of data collection standards and make mandatory collection requirements for key data items of various types of agricultural emission sources. The specification clearly stipulates the minimum sampling frequency and accuracy standards for core data such as greenhouse gas concentration, soil carbon content and records of agricultural activities, and requires the establishment of a three-tier data quality audit system. The standard effectively solves the problem of data comparability caused by the non-uniformity of monitoring methods in the past, and lays a technical foundation for the construction of a national agricultural carbon sink database.

In order to promote the full amount of agricultural carbon sink data collection, the agricultural and rural departments at all levels have launched supporting financial incentive policies. Annual operating subsidies ranging from 50 to 100 yuan per mu are given to large-scale planting entities that complete the installation of monitoring equipment as required and connect data in real time to the national agricultural carbon sink big data platform. Meanwhile, in terms of credit support, commercial banks give preferential interest rates of 20-30 basis points for green loans to farms included in the monitoring scope of the platform. These measures have significantly boosted the enthusiasm of subjects to participate in data sharing, and more than 2,000 large-scale farms across the country have now accessed the platform, with data coverage up more than 40% compared to before the policy was implemented.

4.2. Industry Self-regulatory Mechanisms

In the field of agricultural carbon emission reduction, industry self-regulatory mechanisms play an increasingly important role through technological innovation and market-oriented means. With the improvement of the carbon trading market, leading agricultural enterprises have begun to build a blockchain-based carbon data sharing alliance chain[3]. This distributed ledger technology enables the secure and transparent flow of carbon emission data from all links in the industry chain, and each participating node can verify the authenticity of the data without relying on centralized management. At present, several regional agricultural carbon data alliances have emerged in China, such as the Yangtze River Delta Digital Agricultural Carbon Alliance, which brings together core enterprises in planting, processing, logistics, etc., and realizes automatic comparison and accounting of carbon emission data through smart contracts. This type of alliance not only avoids double-counting, but also provides third-party data support for government supervision, which significantly improves the efficiency and credibility of agricultural carbon emission reduction management.

In order to ensure the international recognition of agricultural carbon sink data, third-party certification bodies are adopting advanced technological means to carry out independent verification. Internationally renowned certification bodies such as SGS and TÜV are already operating in the domestic agricultural carbon emission reduction field, and they not only rely on traditional on-site sampling, but also introduce new technologies such as remote sensing monitoring, Internet of Things data, and blockchain deposits, and have established a full-process quality management system from data collection to verification. Taking the carbon sink project of a large-scale rice plantation enterprise as an example, the certification body finally issued a carbon emission reduction certification report in line with international standards by analyzing five consecutive years of soil sampling data, meteorological records, and satellite remote sensing imagery, combined with agricultural operation logs deposited on the blockchain. This strict certification mechanism not only ensures the authenticity and traceability of the carbon sink data, but also provides a key endorsement for domestic agricultural enterprises to participate in the international carbon trading market and promotes the marketization process of green and low-carbon transformation of agriculture.

5. Risks and Challenges

5.1. Data Risk

The data risks faced by the monitoring and trading system for agricultural carbon sinks are mainly characterized by measurement quality deficiencies and security vulnerabilities. The case of a coffee plantation in Yunnan showed that sensor errors caused by environmental factors had resulted in a 12% deviation in the accounting of carbon sinks, seriously affecting the adoption of international certification. This phenomenon reveals the technical limitations of carbon monitoring systems: conventional sensors are prone to data drift in areas with significant temperature and humidity variations, while high-precision quantum-dot fluorescent sensing devices are still difficult to popularize and apply due to high costs. Deeper systematic errors come from the timeliness problem of monitoring active carbon pools. The case of the conservation tillage project in Northeast China's black soil area shows that there is a 48-hour response delay of conventional sensors to the release of organic carbon after tillage perturbation, which creates an obvious measurement blind spot with the 20% intra-day fluctuation of carbon fluxes triggered by microbial activities. Although reliability has been improved through the introduction of multi-source data calibration such as drone aerial surveys and satellite remote sensing, the differences in spatial and temporal resolution between different technological means still pose a challenge to real-time accurate measurement. Ground sampling is usually done once a week, and there is a 7-15 day lag in satellite data updates, all of which limit the timeliness of monitoring. Meanwhile, data security issues are giving rise to new types of market risks.2023 An APT attack on a provincial carbon platform, which led to the tampering of carbon sink data from 26,000 hectares of farmland, exposed security vulnerabilities in the digital transformation of agricultural carbon assets. The case of multinational grain traders monopolizing regional carbon sink information through private sensor networks and laying out in advance in the international carbon market further highlights how data monopolization undermines the fairness of trading. Although the current implementation of data sandboxing and differential privacy technology can protect trade secrets to a certain extent, how to find a balance between ensuring transparency and security is still a key challenge that needs to be solved for the development of the industry. Differential privacy techniques that add 5% random noise also face implementation challenges in practice [4]. The solution to these problems requires a better framework for agricultural carbon data governance in order to truly promote the healthy development of the industry.

5.2. Technology Adaptability

The promotion of digital monitoring technologies for agricultural carbon sinks is facing the challenge of insufficient participation by smallholder farmers, with high hardware costs and complex operational processes constituting the main obstacles. In the case of rice farmers in South China, for example, a complete set of carbon sink monitoring equipment, including soil carbon sensors, weather stations and IoT gateways, will cost an initial investment of more than 15,000 yuan, which is equivalent to one-fifth to one-third of the annual income of a smallholder farmer. This does not include the annual data flow and operation and maintenance costs. Most of the current mainstream carbon monitoring systems are based on standardized farmland designs, while smallholder farmers generally adopt a decentralized cropping pattern, with an average cultivated area of less than half a hectare per household. This fragmented operation leads to a significant increase in the marginal cost of using monitoring equipment. A survey in the southwestern mountainous region showed that local tea farmers' equipment installation costs were 40% higher than those of flatland farms due to the need to deploy sensor networks

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in terraced terrain, while carbon credit revenues struggled to cover these additional expenditures.

The complexity of technology operation further exacerbates the barriers to adoption by smallholder farmers. Field research in the middle reaches of the Yangtze River showed that more than 60% of farmers over the age of 50 rely entirely on third-party technicians to complete the operation of data collection equipment. Existing monitoring systems make excessive use of technical terms such as NDVI vegetation index correction and CO2 flux threshold setting in the user interface, and lack localized expressions that meet the cognitive habits of farmers, leading to a significant reduction in the effectiveness of technology promotion. What is more noteworthy is that even the intelligent terminals equipped with Chinese operation manuals tend to condense the key operation processes such as calibration and commissioning into more than ten pages of technical documents, which makes it difficult for ordinary farmers who lack relevant experience to independently master them. In a pilot project in Shanxi, the inability of farmers to properly maintain the sensors resulted in systematic errors in the monitoring data for three consecutive months, which ultimately led to the failure of carbon sink accounting for the whole season. These cases fully illustrate that if the problem of the universality of digital tools cannot be fundamentally solved, it will be difficult for the agricultural carbon trading system to get rid of the plight of technological elitism that only serves large farms.

6. Conclusion

The construction of a monitoring and trading system for agricultural carbon sinks has made breakthrough progress in China. Through the introduction of big data analysis and Internet of Things technology, the management of agricultural carbon sinks has been transformed from the traditional crude mode to digitalization and precision. The in-depth application of data elements in agricultural production has formed the two core mechanisms of "precise regulation" and "market incentive". The former builds a carbon flux monitoring system covering the main agricultural areas in China through a network of high-precision environmental sensors, which reduces the error rate of measuring carbon sinks in the field to less than 5%, and provides reliable data support for the development of carbon assets; and the latter relies on blockchain technology to build an intelligent trading platform that realizes the automatic execution of contracts and timely distribution of proceeds. The latter relies on blockchain technology to build an intelligent trading platform, which realizes automatic contract execution and timely distribution of revenues, and significantly improves the initiative of farmers to participate in the carbon market. According to the statistics of the Ministry of Agriculture and Rural Development in 2024, the average income of farmers participating in carbon sink trading in the first batch of pilot areas increased by more than 3,000 yuan/year, and the volume of carbon sinks traded on farmland achieved an average annual growth rate of 45%.

The main challenge facing the international integration of agricultural carbon sinks is the lack of uniformity in the standard system. Through comparative studies, it has been found that there are obvious differences between China's existing monitoring system in terms of sampling methods, measurement models, data formats, etc., and the international mainstream standards, especially the compatibility with international carbon markets such as the European Union CBAM mechanism needs to be resolved urgently. It is recommended that we focus on promoting reform at three levels: first, accelerating the docking of the IPCC guidelines on the measurement system and revising the existing accounting methodology for agricultural carbon sinks; second, strengthening the mutual recognition of qualifications with international authoritative certification bodies such as VCS and GS on the certification mechanism; and third, exploring the

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construction of a cross-border circulation channel on the trading rules, so as to create favorable conditions for the entry of China's agricultural carbon sinks into the international carbon market.

With regard to the technical threshold for small farmers to participate in the carbon market, there is an urgent need to develop lightweight and low-cost digital solutions. Specifically, the technical path of "mobile terminal + cloud platform" can be adopted to create a one-stop carbon sink management tool through the WeChat ecosystem. The solution is intended to integrate satellite remote sensing, meteorological stations and farmers' reports and other sources of data, using voice interaction and visualization, so that farmers can easily complete the planting management records, carbon sink calculations and transaction applications and other operations. Pilot tests have shown that this type of lightweight tool can reduce technical operation steps by more than 60% and use costs by 80%, and is expected to cover more than 85% of the country's small farmer groups. At the same time, the solution can also be interfaced with the existing agricultural subsidy system to realize the synergistic distribution of carbon sink proceeds and policy subsidies.

From the perspective of long-term development, the construction of the agricultural carbon sink market needs to be driven by both policy innovation and technological breakthroughs. At the level of system design, regulations should be issued as soon as possible to confirm the rights of carbon sinks data, and clarify the rights and obligations of each link of data collection, storage, use and benefit distribution; at the level of technological research and development, we should focus on breakthroughs in key technologies such as deep-learning-based carbon sinks prediction models, low-power edge computing terminals and other key technologies, and develop customized solutions that are suitable for different agricultural scenarios. Special attention should be paid to the role of digital technology in solving the problem of information asymmetry, through the construction of the whole chain of transparent carbon sinks traceability system, to ensure that "every ton of carbon credit can be verified and traceable".

Agricultural carbon management, as an important tool for realizing the goal of "double carbon", will be built on the three cornerstones of "data-driven, inclusive participation and international mutual recognition" in its future development. Through continuous improvement of the policy system and technical standards, China is well-positioned to build the world's leading agricultural carbon market [5], contributing Chinese wisdom and Chinese programs to address climate change. This process will not only reshape China's agricultural production methods, but also provide useful reference for the sustainable development of global agriculture.

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