

Digital and Intelligent Empowerment for the New Model of "Adoptive Agriculture": Empowerment Logic, Practical Dilemmas, and Future Avenues

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ABSTRACT

"Adoptive Agriculture" is a new agricultural consumption model emerging from economic and social development. Driven by both the policy support for comprehensive rural revitalization and the rapid development of digital and intelligent technologies, the integration of digital and intelligent technologies into "Adoptive Agriculture" has become a new channel to increase farmers' income and optimize consumer experience by promoting the digital and intelligent transformation of this model. However, in the practical application of digital and intelligent empowerment for "Adoptive Agriculture", challenges such as high empowerment costs, lack of a trust system, absence of supervision mechanisms, and unstable profitability have emerged, hindering the sustainable development of this model. Based on this, this paper analyzes the logical alignment mechanism between digital and intelligent technologies and the "Adoptive Agriculture" model from the perspectives of technology embedding, process re-engineering, and value reconstruction. It identifies the obstacles in the current digital and intelligent empowerment of "Adoptive Agriculture" by examining practical dilemmas, and proposes countermeasures accordingly to promote the development of "Adoptive Agriculture" and advance the realization of comprehensive rural revitalization.

Keywords: *Comprehensive rural revitalization, Digital and intelligent empowerment, Adoptive agriculture, Digital and intelligent transformation of agriculture.*

1. INTRODUCTION

On January 22, 2025, the National Plan for Comprehensive Rural Revitalization (2024 - 2027) (hereinafter referred to as the "Plan") issued by the Central Government proposed to "vigorously develop smart agriculture" and "orderly advance new formats such as agricultural experience activities, and explore an integrated development model of modern agriculture, leisure tourism, and rural communities".[1] The Plan clearly identifies smart agriculture as a key direction for China's modern agricultural development, and exploring new agricultural formats as a focal point for the high-quality development of rural industries. Subsequently, the No. 1 Central Document issued proposed to "develop new-quality productive forces in agriculture in light of local conditions".[2] For the first time, "new-quality productive forces" were incorporated into the No. 1 Central Document,

providing guidance for the future development of China's agriculture. The introduction of relevant policies has created a favorable policy environment for smart agriculture; the rapid iteration of technologies has offered technical support for the digital and intelligent transformation of agriculture; and the in-depth development of scenario-based applications of digital and intelligent technologies has laid a practical foundation for smart agriculture. Empowering traditional agricultural models through digital and intelligent means, and innovating to build digital and intelligent new agricultural formats, have become a timely, context-appropriate, and demand-driven feasible path to increase farmers' income and achieve comprehensive rural revitalization.

"Adoptive Agriculture" is an agricultural consumption model where consumers prepay and sign an adoption agreement to claim agricultural

products or agricultural production areas, and participate in the entire production process of the agricultural products. The core of this model is to break the linear process of "producer - middleman - consumer" in traditional agriculture, enabling direct connection between producers and consumers. The digital empowerment of "Adoptive Agriculture" is the product of the organic integration of digital and intelligent technologies with this model. It uses digital and intelligent technologies such as the Internet of Things (IoT), big data, and blockchain to record and trace data throughout the entire life cycle of agricultural products. Consumers can remotely monitor the adopted agricultural products through the built digital information sharing and interactive platform,[3] and participate in the entire agricultural production process online. This model addresses long-standing issues in traditional agricultural production, such as information asymmetry, difficulties in ensuring the quality and safety of agricultural products, and disconnection between production and sales. It can reduce information mismatches in the production and sales of agricultural products, and is characterized by pre-transaction behavior, in-depth consumer participation, customized product content, and transparent product production. As a new format that optimizes consumer experience in the agricultural sector, research on it holds both theoretical significance and practical value.

This study will start from the "triple logic" of digital and intelligent empowerment of "Adoptive Agriculture", analyze how empowerment is achieved, examine the current practical dilemmas faced by digital and intelligent empowerment of this model, and finally propose feasible development paths. It aims to provide a reference for promoting the development of smart agriculture in practice, thereby advancing the high-quality development of agriculture and comprehensive rural revitalization.

2. LITERATURE REVIEW

With the rapid development of digital and intelligent technologies in China and the continuous innovation of scenarios embedded with these technologies, "digital and intelligent empowerment +" has become a research hotspot in academia. Against the backdrop of comprehensive rural revitalization, digital and intelligent empowerment in agriculture has received widespread attention. By sorting through relevant literature, it is found that current academic research on digital and intelligent

empowerment of "Adoptive Agriculture" mainly focuses on three dimensions: technology embedding, model innovation, and value creation.

2.1 Tool Orientation: Technology Embedding

Digital and intelligent empowerment of "Adoptive Agriculture" is a development trend of this model, and some scholars have studied the technical support for "Adoptive Agriculture" from a tool perspective. Scholars such as Li Jiaoyue argue that digital and intelligent technologies (e.g., big data analysis and blockchain-based traceability) can be integrated to build an "Adoptive Agriculture" platform supported by technological empowerment.[4] Based on blockchain technology, Wu Jinhua studied the application of smart contracts in the "Adoptive Agriculture" model.[5] Taking the "adopt-a-tea-tree" project as a case, scholars such as Zhou Qingyu analyzed the practical application of Internet technology in this project.[6] Rao Huanan and others studied the role of Internet platforms in the precision marketing of agricultural products under the "Adoptive Agriculture" model, and also pointed out problems existing in Internet platforms for this model, such as unstable platform reputation, information asymmetry, imperfect logistics and distribution chains, and inadequate regulations.[7] Zhao Yu and others designed an IoT system for "Adoptive Agriculture" using the "interconnection of things" function of Huawei's IoT operating system.[8] Scholars generally agree that digital and intelligent technologies (e.g., blockchain, IoT, big data, and artificial intelligence) can significantly improve the precision and intelligence of agricultural production through real-time data collection, analysis, and decision support, and can provide support for the innovative development of the "Adoptive Agriculture" model.

2.2 Practical Orientation: Model Innovation

The "Adoptive Agriculture" model has evolved from the virtual online "Happy Farm" to the offline interactive "Adopted Farm", and further developed into a digital and intelligent model with the help of digital and intelligent technologies and platforms. Its evolution path reflects the two-way interaction between digital and intelligent development and the diversification of consumer demand. From the perspective of research on the practical models of "Adoptive Agriculture", model innovation is mainly

divided into two types: innovation in production and sales models, and product innovation. Zhang Siqi studied the "Adoptive Agriculture + N" business model in Panjin City, Liaoning Province. As the first "Internet + Adoptive Agriculture" model proposed nationwide, Panjin's model is co-built by the government and enterprises, with "crab-field rice" as the core adopted product, and displays the growth status of products to consumers through a mobile APP terminal.[9] Starting from the logistics link of "Adoptive Agriculture", Wang Huijuan and Sun Junfeng analyzed the path of integrated development between e-commerce platforms and this model, and believed that this path is an effective way to address the trust crisis of organic agricultural products in China.[10] Datong City, Shanxi Province innovatively developed the "Adoptive Agriculture" model into an "agriculture + ecology + culture" integrated "agri-tourism" model, exploring a method for agricultural consumption-based poverty alleviation.[11] Huang Qingfa studied the "Adopt-a-Cow" model in Hangzhou, which launched three adoption methods: cloud adoption, co-branded adoption, and real-name adoption.[12] Taking the project "I Have an Acre of Field in Sanjiang" as an example, Zou Wanyan argued that this "adopted field" model realizes the organic integration of centralization and decentralization without taking capital gains as the sole goal, making it an innovative model in "Adoptive Agriculture".[13]

2.3 Goal Orientation: Value Creation

Most scholars believe that the value of the "Adoptive Agriculture" model mainly includes two aspects: increasing the income of operators and optimizing consumer experience.

In terms of increasing operators' income, scholars such as Li Ziyi placed the "nurturing-type" agricultural e-commerce model in the context of relative poverty governance, and argued that the "nurturing-type" agricultural model provides new development ideas for relative poverty governance.[14] The "adoption model" in the agricultural field has become a new consumption growth driver in the agricultural economy, promoting the integration of primary, secondary, and tertiary industries, expanding farmers' income sources,[15] helping to increase the value of rural industries,[16] and advancing the realization of rural revitalization.[17] Yin Xiang believed that the "Adoptive Agriculture" model can provide consumers with more diversified experiences and

services, meeting their needs for experience value and leisure value.[18] Liang Dan and Huang Ping studied the development status and strategies of the "Internet + Adoptive Agriculture" model, which emerged in response to consumers' inner pursuit of a "poetic rural life".[19] By sorting through existing literature, it is found that although digital and intelligent empowerment of "Adoptive Agriculture" has received attention from academia, most studies focus on a single perspective (either technology or model), lacking a systematic discussion on the internal mechanism of empowerment, practical dilemmas, and future avenues. In addition, most existing studies focus on case descriptions, with relatively insufficient theoretical analysis, and the research content fails to deeply reveal the reshaping of the value chain and ecosystem of the "Adoptive Agriculture" model by digital and intelligent technologies. This study attempts to systematically analyze the digital and intelligent empowerment of "Adoptive Agriculture" from three aspects (empowerment logic, realistic dilemmas, and future avenues), providing a reference for theoretical research and practical exploration of this field.

3. THE EMPOWERMENT LOGIC OF DIGITAL AND INTELLIGENT EMPOWERMENT FOR "ADOPTIVE AGRICULTURE"

3.1 Technology Embedding to Build a "Transparent" Production System

Digital and intelligent empowerment of "Adoptive Agriculture" can build a "transparent" production system through technology embedding. Digital and intelligent technologies (e.g. IoT sensors, high-definition cameras, and blockchain) transform the agricultural production process from a "black box" to a "glass house", allowing consumers to monitor the growth status and environmental data of the adopted objects in real time. First, digital and intelligent technologies enable the comprehensive connection of people, machines, and things, breaking down information silos and improving the transparency of system operation through data sharing and process visualization. Technology embedding enhances the transparency of the production process, curbing issues such as illegal pesticide use and excessive chemical fertilizer application at the source, while the application of blockchain technology enhances the credibility of data. Second, with the help of platform-based and social functions, multi-stakeholder participation and

collaboration are promoted, subjecting the growth and processing of agricultural products to supervision by multiple entities. Third, leveraging the tamper-proof nature of distributed ledger data, blockchain technology can assign an exclusive "electronic ID card" to agricultural products. By scanning the code, consumers can view production records (e.g., agricultural material procurement records, inspection reports, and logistics information) of the agricultural products. Embedding digital and intelligent technologies (e.g., IoT, 5G, and blockchain) into the entire cycle of "Adoptive Agriculture" to build a "transparent" production system connecting production and sales is a key logic of digital and intelligent empowerment for this model.

3.2 Process Reconstruction to Achieve Accurate Connection Between Production and Sales

Traditional agricultural industries are characterized by long chains, multiple links, and information asymmetry, which make it difficult for producers to accurately grasp market demand, for consumers to obtain safe and reliable agricultural products, and lead to an imbalance in the connection between supply and demand of agricultural products. However, digital and intelligent empowerment of "Adoptive Agriculture" can realize accurate connection between production and sales by reshaping the process from the growth to the sales of agricultural products. Through platform-based operation and digital management, digital and intelligent empowerment of "Adoptive Agriculture" shortens the industrial chain and enables direct connection between producers and consumers. First, the "Adoptive Agriculture" system supports real-time video streaming, realizing "cloud supervision" and helping consumers check the status of agricultural products at any time. Second, the order management module helps farmers clarify adoption information and delivery schedules, improving the quality of agricultural services. Third, the agricultural experience section embeds a reservation function, allowing farmers to arrange agricultural activities in a timely manner according to consumer needs. The reshaping of the production and sales process of agricultural products by digital and intelligent technologies can improve operational efficiency, reduce transaction costs, and achieve a win-win situation for both producers and consumers.

3.3 Value Reconstruction to Expand the Diversified Functions of Agriculture

The "products" of the "Adoptive Agriculture" model include not only static agricultural products but also dynamic agricultural experience services, integrating elements such as education, tourism, and culture. It expands the single function of agricultural product production in traditional agriculture, builds multi-dimensional functions (e.g., ecological, social, and cultural), and can create multiple values. For example, in the carbon sink adoption model, users can obtain income from fruit trees and accumulate carbon credits to redeem benefits. Carbon sink trading creates economic and ecological value, encouraging producers to adopt more environmentally friendly production methods and promoting the sustainable development of agriculture. Agricultural experience activities combine farming culture with labor education, which is of positive significance for student education. Digital and intelligent technologies empower the "Adoptive Agriculture" model through technology embedding, process reconstruction, and value reconstruction, converting the "potential energy" of technology into the "kinetic energy" for the development of new-quality productive forces in agriculture, and enhancing the capacity for increasing farmers' income, agricultural development, and rural revitalization.

4. PRACTICAL DILEMMAS OF DIGITAL AND INTELLIGENT EMPOWERMENT FOR "ADOPTIVE AGRICULTURE"

4.1 High Cost of Digital and Intelligent Construction

Digital and intelligent construction covers the construction, development, operation, and maintenance of digital and intelligent hardware and software facilities. Currently, the digital and intelligent empowerment of "Adoptive Agriculture" is confronted with high costs in early-stage construction, mid-stage operation, and late-stage maintenance. First, the early-stage construction cost of digital and intelligent facilities is high. On one hand, achieving visualization requires significant investment in equipment and technical support, including high-definition cameras, sensors, network equipment, and the development and installation of software platforms—costs that are burdensome for

small and medium-sized farms. Farms in remote areas may also face unstable network signals, which cause interruptions in real-time data transmission and undermine consumers' visual experience. On the other hand, the perishable nature of agricultural products demands cold chain logistics. However, the current coverage of cold chain logistics in rural areas is limited, and distribution costs are high. Constructing and developing cold chain logistics equipment and facilities suitable for rural areas requires substantial capital and technical support, which restricts the development of visualized "Adoptive Agriculture". Second, the mid-stage operation threshold of digital and intelligent facilities is high. After the completion of digital and intelligent facilities, scientific operation is required, but there is a threshold for technical operation. Due to factors such as age and knowledge structure, some farmers struggle to master the operation of digital and intelligent equipment, easily making mistakes in links like equipment debugging and data upload, which in turn affects the operation of the digital and intelligent "Adoptive Agriculture" model. Additionally, the design of consumer-side platforms must consider the needs of different groups to ensure service accessibility—for instance, addressing the personalized needs of the elderly, a potential consumer group. Third, the late-stage maintenance cost of digital and intelligent facilities is high. Digital and intelligent technologies are updated and iterated rapidly; this year's Government Work Report identifies the deployment of future industries as a key development task, and future industries include digital and intelligent technology sectors such as 6G and embodied intelligence. After the construction and operation of digital and intelligent technologies in "Adoptive Agriculture", continuous investment in capital and technology is still needed to maintain the normal operation of equipment and facilities, which increases the cost of digital and intelligent empowerment for "Adoptive Agriculture".

4.2 Difficulties in Full-Process Supervision

Although digital and intelligent technologies break the constraints of time and space, allowing consumers to remotely monitor the production of agricultural products in "Adoptive Agriculture", the authenticity of monitoring data is still prone to manual manipulation. Moreover, the lack of supporting supervision mechanisms and improved

relevant laws and regulations makes full-process supervision of the digitally and intelligently empowered "Adoptive Agriculture" extremely difficult. First, there is a lack of supporting process supervision mechanisms. Currently, unified production standards and supervision mechanisms have not been established, leading to significant differences in the quality of agricultural products provided by different producers—making it hard to meet consumers' expectations for high-quality agricultural products. Technologies such as blockchain-based traceability and slow live streaming can enhance the transparency of agricultural products, but the absence of supervision mechanisms fails to bridge the cognitive gap between "virtual rights" and "physical products", leaving technological empowerment limited to the marketing level. Second, there is a lack of supporting legal and regulatory guarantees. At present, the value of "Adoptive Agriculture" is only elaborated at the policy level; the 2024 No. 1 Central Document mentions the positive role of the adoption model in stabilizing grain production and ensuring national food security. However, laws and regulations related to the practice of "Adoptive Agriculture" are not yet improved, and issues such as agricultural product quality standards, the signing of adoption agreements, and dispute resolution are not regulated by corresponding laws and regulations.

4.3 Unstable Profitability

The profitability of the digitally and intelligently empowered "Adoptive Agriculture" remains unstable, mainly due to the lack of a production-sales trust mechanism, the failure to form high-quality interactive participation, and the absence of a stable profit model. First, the production-sales trust mechanism has not been established. For one thing, some farms choose low-quality equipment to cut costs, leading to frequent problems such as blurry images and data delays, which reduces consumers' trust. Differences in product packaging, distribution methods, and quality standards among different farms result in uneven consumer experiences, affecting the reputation and development of the entire industry. For another, some unethical businesses conduct false advertising under the banner of "visualized Adoptive Agriculture", but the actual quality of their agricultural products fails to match their commitments, causing consumers to question this model. Furthermore, some consumers lack understanding of this new agricultural model and

blindly follow the trend to adopt agricultural products; when they find that the actual situation differs from their expectations, the trust environment for "Adoptive Agriculture" is further damaged. Coupled with the lack of legal and regulatory constraints, dishonest behaviors in the digitally and intelligently empowered "Adoptive Agriculture" are not effectively addressed, making it difficult to establish a production-sales trust mechanism. Second, high-quality interactive participation has not been formed. The single "remote monitoring" method of participation weakens the "emotional connection" between consumers and agricultural products. Insufficient consumer participation leads to low sustained attractiveness of "Adoptive Agriculture"; some consumers lose interest after the initial novelty due to low participation, resulting in low repurchase rates of agricultural products. Third, a stable profit model has not been found. Currently, many "Adoptive Agriculture" projects face the problem of insufficient sustainable profitability, and challenges to sustainable development also include talent shortages and inadequate brand building. The digital and intelligent empowerment of "Adoptive Agriculture" requires interdisciplinary talents with expertise in both "agriculture and technology", but such talents are currently in short supply. Inadequate brand building leads to indistinct product differentiation, making it difficult to form a differentiated competitive advantage.

5. FUTURE AVENUES FOR DIGITAL AND INTELLIGENT EMPOWERMENT OF "ADOPTIVE AGRICULTURE"

The practical dilemmas of digital and intelligent empowerment for "Adoptive Agriculture" are both dilemmas in the practice of digital and intelligent technologies and obstacles to the sustainable development of "Adoptive Agriculture". Therefore, countermeasures must be proposed based on a comprehensive consideration of both digital and intelligent empowerment and the "Adoptive Agriculture" model itself. To address the above practical dilemmas, future avenues can be explored from three aspects.

5.1 Strengthening Supporting Support for Digital and Intelligent Empowerment of "Adoptive Agriculture"

Since small and medium-sized farms are key entities in the development of "Adoptive Agriculture", a systematic policy support system can be established to assist these farms in their digital and intelligent transformation for "Adoptive Agriculture", reducing their transformation burden. At the same time, large-scale farms should be encouraged to take the lead in trials to drive the development of small and medium-sized farms through demonstration effects. First, the government should improve supporting policy support. To begin with, fiscal subsidy policies for the digital and intelligent empowerment of "Adoptive Agriculture" should be refined. It is crucial to increase support for the digitally and intelligently empowered "Adoptive Agriculture", and the costs of equipment procurement and technological upgrading for farms — especially small and medium-sized ones — can be reduced through financial subsidies and tax incentives. Next, financial support policies for the digital and intelligent empowerment of "Adoptive Agriculture" should be implemented. Green loan channels can be provided for eligible "Adoptive Agriculture" farms, and the digital and intelligent transformation of small and medium-sized farms for "Adoptive Agriculture" can be supported by lowering loan thresholds and reducing loan interest rates. Finally, subject assistance policies for the digital and intelligent empowerment of "Adoptive Agriculture" should be established. It is necessary to clarify the government's role in promoting the digital and intelligent empowerment of "Adoptive Agriculture", and the government should be urged to increase investment in optimizing digital infrastructure in rural areas, improving network coverage and quality to provide reliable infrastructure guarantees for the digitally and intelligently empowered "Adoptive Agriculture". Large enterprises should be guided to provide targeted assistance to small and medium-sized farms, offering them technical support and operational guidance. Second, relevant departments should improve the support for key elements. For one thing, the construction of technical standardization should be advanced. It is essential to establish unified technical standards and interface specifications for "Adoptive Agriculture" to promote data interconnection between different systems and reduce cross-platform development costs; standards for data

collection and transmission in "Adoptive Agriculture" should be formulated to ensure data authenticity and comparability. For another, an extensive cold chain logistics network should be built. Shared cold chain logistics centers for multiple farms can be established, and innovative methods such as shared logistics and joint distribution can be adopted to reduce logistics costs and achieve economies of scale; the smart agricultural command and dispatch center can be leveraged to realize full-process management and control of farmland status visualization, agricultural operation intelligent scheduling, and production-sales data transparency, providing data support for the optimization of logistics distribution; it is effective to improve the accuracy of logistics distribution and ensure the quality of agricultural products through big data analysis, path optimization algorithms, and intelligent temperature control technologies.

5.2 Improving the Supervision System for Digital and Intelligent Empowerment of "Adoptive Agriculture"

The supervision system for the digital and intelligent empowerment of "Adoptive Agriculture" should be improved, and the production-sales mutual trust and win-win mechanism should be reshaped. First, relevant regulatory authorities should build a credible data traceability system. It is vital to establish a credible data traceability system to address the dilemma of data authenticity; a full-chain data traceability system from production to consumption can be constructed through the in-depth integration of blockchain, IoT, and big data technologies to ensure data authenticity and immutability. A third-party supervision mechanism should be introduced to enhance data credibility-independent verification of farms' production data and quality inspections should be conducted by third-party institutions, and the verification results should be published to strengthen consumers' trust. Second, government departments should improve relevant legal and regulatory guarantees. It is necessary to formulate relevant laws and regulations to standardize the behaviors of subjects in the process of digital and intelligent empowerment of "Adoptive Agriculture", so that all subjects involved in "Adoptive Agriculture" can be ensured to act in accordance with the law; industry norms should be formulated jointly with enterprises related to "Adoptive Agriculture" and internal industry standards should be unified. Third, operating entities of "Adoptive Agriculture" should

innovate the production-sales subject trust mechanism. It is effective to design a more transparent and participatory trust mechanism to enhance consumers' sense of trust and belonging in "Adoptive Agriculture", thereby enabling more proactive consumer supervision. On one hand, classified and hierarchical agricultural experience activities should be provided, experience links should be designed based on consumer needs, and "physical souvenirs" should be set up in each link to convert fragmented experiences into emotional assets. On the other hand, community operation should be strengthened to improve consumer participation and loyalty. A combination of online communities and offline activities should be established to promote interactive communication among consumers, a stable consumer community can be formed, and consumer "traffic" can be converted into long-term "customer retention".

5.3 Innovating the Profit Model for Digital and Intelligent Empowerment of "Adoptive Agriculture"

It is crucial to explore diversified profit models to promote the sustainable development of the digitally and intelligently empowered "Adoptive Agriculture". On one hand, relevant operators should promote the organic integration of digitally empowered "Adoptive Agriculture" with multiple fields. The diversified values of "Adoptive Agriculture" in education, tourism, culture, ecology, and other areas should be fully unlocked. Functional modules such as "Adoptive Agriculture + Education" and "Adoptive Agriculture + Tourism" should be explored to improve the profitability of projects. On the other hand, the operators of digitally empowered "Adoptive Agriculture" should advance its brand building. Based on high quality, collaboration with well-known brands should be carried out to jointly build a digital and intelligent "Adoptive Agriculture" IP; a subscription-based model should be innovatively developed to stabilize income sources, and consumer stickiness and repurchase rates should be improved.

6. CONCLUSION

The digital and intelligent empowerment of "Adoptive Agriculture" not only improves the efficiency and transparency of agricultural production but also expands the diversified functions of agriculture, creating multiple values in the economy, society, ecology, and culture. In the

face of the practical dilemmas confronting the digitally and intelligently empowered "Adoptive Agriculture", people can effectively promote its sustainable development by strengthening supporting support, improving the supervision system, innovating profit models, and building collaboration among multiple subjects, including the government, enterprises, social organizations, and consumers. In conclusion, as an important innovation in the digital transformation of agriculture, the digital and intelligent empowerment of "Adoptive Agriculture" has broad development prospects and great social value. It is necessary to apply this new agricultural model correctly, effectively, and flexibly, enabling "Adoptive Agriculture" to inject "intelligent momentum" into agricultural modernization and comprehensive rural revitalization.

AUTHORS' CONTRIBUTIONS

Xiaoxia Wang is responsible for the thesis research theme confirmation and thesis writing.

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