



OPEN ACCESS

EDITED BY

Yang Shen,
Xiamen University, China

REVIEWED BY

Yuntao Tan,
Chongqing Technology and Business
University, China
Ting Lei,
Southwest University of Political Science &
Law, China

*CORRESPONDENCE

Zhongfeng Pan
✉ pan17386111942@126.com

RECEIVED 03 October 2025

ACCEPTED 23 October 2025

PUBLISHED 14 November 2025

CITATION

Wang Z, Pan Z, Lai W, Lu S, Liu H, Wang X and
Wu H (2025) How does digital technology
enhance sustainable operations in
agribusiness? A case analysis of a Chinese
agricultural enterprise.

Front. Sustain. Food Syst. 9:1718405.
doi: 10.3389/fsufs.2025.1718405

COPYRIGHT

© 2025 Wang, Pan, Lai, Lu, Liu, Wang and Wu.
This is an open-access article distributed
under the terms of the [Creative Commons
Attribution License \(CC BY\)](#). The use,
distribution or reproduction in other forums is
permitted, provided the original author(s) and
the copyright owner(s) are credited and that
the original publication in this journal is cited,
in accordance with accepted academic
practice. No use, distribution or reproduction
is permitted which does not comply with
these terms.

How does digital technology enhance sustainable operations in agribusiness? A case analysis of a Chinese agricultural enterprise

Zichen Wang¹, Zhongfeng Pan^{2*}, Wenling Lai¹, Shan Lu¹,
Haitao Liu¹, Xueqing Wang¹ and Haibo Wu¹

¹College of Innovation and Entrepreneurship, Wuchang University of Technology, Wuhan, China,

²Wuhan City Polytechnic, Wuhan, China

Background: Sustainable agricultural enterprise operations are pivotal for resolving market inefficiencies in global food systems including information asymmetry resource misallocation and productivity stagnation. These inefficiencies impede food security and rural development particularly amid the digital transformation of agricultural value chains.

Method: Grounded in resource-based view (RBV) model and dynamic capabilities theory this study employs a single-case longitudinal design with China Joyvio Group (JVG) as the focal enterprise. The case spans three distinct transformation phases enabling rigorous causal analysis of digital technology's impact on sustainable operations. By collating the company's annual reports, financial reports and in-depth interviews, we finally obtained the enterprise operation records of JVG. These records contain basic data, cases and achievements, providing supporting materials for us to conduct a detailed analysis of how digital transformation can enhance performance.

Results: JVG's dual-track digital strategy "organizational management" and "business operation" systematically resolves core inefficiencies through four empirically validated mechanisms: (1) Organizational empowerment via knowledge assetization; (2) Operational resilience through end-to-end digital integration; (3) Industrial chain innovation via three smart platforms "Agricultural and Food Digital Intelligence Brain," "YunAgri Prime," "YunAgri Select," enabling full-chain standardization and resource optimization; (4) Value chain upgrading with 28.6% higher product premiumization; (5) and the ecological and environmental benefits have been greatly enhanced. These mechanisms collectively address the efficiency, information, and resource predicaments of traditional agriculture.

Conclusion: It provides a quantitatively validated framework for agricultural enterprises to achieve sustainable operations balancing economic viability social equity and environmental sustainability. Findings offer actionable policy insights for national agricultural digitalization strategies and address a critical empirical gap in agricultural economics literature.

KEYWORDS

information technology, digital technology, digital transformation, digital agriculture, Joyvio group, agricultural enterprises, sustainable operation, agricultural talent cultivation

1 Introduction

Agriculture, as a fundamental industry of the national economy, its sustainable operation capacity is related to national food security, rural social stability and the livelihood wellbeing of farmers (Shen and Zhang, 2024a). The traditional agricultural operation results are influenced by multiple conditions such as scale, market and nature, making it difficult to achieve good economic benefits. The production mode urgently needs a fundamental transformation (Zhou et al., 2022). Traditional agricultural operation models have long faced multiple structural predicaments in the process of moving towards sustainable goals (Rijswijk et al., 2021). These defects can be demonstrated from three aspects. Low production efficiency. The production process is highly dependent on individual experience and extensive management. There is a lack of precise control in aspects such as planting density, fertilization and pesticide application, and irrigation operations, resulting in redundant resource input and limited output benefits. In the field of aquaculture, due to the lag in monitoring the growth environment and disease prevention and control, the risk of production loss remains high. (2) Poor information flow. Due to the limited channels for obtaining market information, producers have difficulty responding accurately to price fluctuations and changes in consumer demand, often falling into the cyclical predicament of “increased production but no increased income,” reflecting the distortion of resource allocation caused by information asymmetry in the agricultural value chain (Wang and Zhang, 2002). (3) Extensive utilization of resources. Traditional irrigation methods lead to low water resource utilization. The excessive use of chemical fertilizers and pesticides not only aggravates non-point source pollution but also causes soil degradation and a decline in ecological service functions, posing a severe challenge to the long-term sustainability of agriculture. The systematic deficiencies in the aspects of efficiency, information and resources mentioned above have seriously restricted the stable operation and sustainable development of agricultural enterprises.

In recent years, information technologies such as digital and artificial intelligence have developed rapidly, promoting the efficiency improvement of many traditional and emerging industries (Shaikh et al., 2025; Liu et al., 2024). Driven by the new round of global technological revolution and industrial transformation, digital technologies represented by big data, artificial intelligence and the Internet of Things are deeply penetrating the entire agricultural industrial chain, driving the industrial paradigm to shift from the traditional model that relies on natural conditions and human experience. Evolution toward precision agriculture and smart agriculture centered on data-driven and intelligent decision-making (Shi et al., 2025; Sargani et al., 2025). The digital transformation of agriculture has become the core path to enhance its sustainability and competitiveness (He et al., 2025). Agricultural sustainable operation, as a modern industrial organization form, covers the full-chain integration from production, processing, logistics to brand and consumption, emphasizing the coordinated realization of economic, social and environmental benefits (Roy and Medhekar, 2025). Digital agriculture, through data collection and analysis, can optimize each link of traditional agriculture from field management to sales terminals, laying a technical foundation for sustainable agricultural operation (Sun et al., 2024). The practical significance of digital agriculture lies in its ability to connect all links from production to

supply, sales and service, achieving integrated operation and refined control. This can effectively reduce production costs, enhance the efficiency of industrial chain collaboration, and promote industrial integration and green transformation. Help agricultural enterprises achieve value chain upgrading and sustainable operation goals (Ahmed and Shakoor, 2025).

When analyzing the sustainable development of agriculture, existing literature has conducted extensive explorations around aspects such as food security (Xu et al., 2025; Xu, 2025), pollution emissions (Shen and Zhang, 2024a; Shen and Zhang, 2024c), carbon reduction (Lu et al., 2025a). Multi-angle analysis provides methodological inspiration for deepening the research on sustainable operation. As a core element for achieving modernization in agriculture and rural areas, it has become a consensus in the academic circle that digital technology can empower the expansion and improvement of agriculture. The concept of empowerment originated from research fields such as “self-rescue” and “political awareness” in sociology in the 1960s and 1970s (Peterson et al., 2005). It is also known as “endowing energy or ability,” and thus is often associated with “authorization,” that is, endowing an individual or a certain subject with certain actions and energy. Therefore, the core idea of empowerment is how to make the relevant entities more capable of achieving their goals (Leong et al., 2015). Digital empowerment is a new development paradigm that emerged along with the development and promotion of digital technology. It applies the theory of empowerment to the application of digital technology to achieve the integrated development of digital technology and related industries. At present, digital technology has widely empowered the development and innovation of various fields such as agriculture, education, services, and business. Among them, the enabling role of digital technology in the agricultural sector is mainly manifested in depicting consumer demands, breaking spatial and geographical limitations, influencing people’s production methods, improving agricultural production efficiency, and promoting sustainable agricultural development (Lu et al., 2025b). The published literature, when analyzing the role of digital technology in the agricultural field, generally focuses on agricultural total factor productivity (Shen et al., 2023; Hu et al., 2024; Gong and Tang, 2025) and agricultural resilience (Quan et al., 2024; Wan et al., 2025); Environmental benefits (Papadopoulos et al., 2024; Sharma et al., 2024a, 2024b). The analysis was conducted from the perspectives of Wang et al. (2025), farmers’ entrepreneurial willingness (Li et al., 2023), and carbon emission reduction (Li et al., 2024b; Wang and Li, 2025; Shi et al., 2025). Although these factors are important variables that constitute the sustainable operation of enterprises, they are only partial and cannot fully clarify the relevant paths. Although some literatures have analyzed from the perspectives of rural development and enterprise organizational management, they mainly utilized historical data from statistics bureaus or listed companies and employed econometric methods to calculate the mean effect (Lyu et al., 2025; Peng et al., 2025; Fang and Shen, 2025). The biggest drawback of regression analysis is that the research conclusions cannot guide individual practice. This is because they are completely driven by data. Unlike the research paradigm of data analysis, this study takes typical agricultural enterprises in China as the research object and uses the case analysis method to understand the actual digital management practices. When contributing to the literature of this study, a single-case analysis method was adopted, and in combination with the resource-based

view theory, the significance of digital transformation for the sustainable development of agricultural enterprises was analyzed in detail. (1) Research methods Compared with the mean reversion method, the scheme analysis utilizes real-world practices to clearly explain how enterprises can apply digital technologies to improve their corporate strategies and daily business operations. This analytical method is a summary and development of theory and reality. (2) Research subject. We have selected representative enterprises in China's agricultural sector and used the case of JVG for description. This company has made outstanding contributions to economic development in blueberry production and human resource training. However, there is still a lack of case analysis of Jiawo Group at present. (3) Theoretical analysis. We have enriched the practical application of the resource-based management theory through case analysis.

This study takes Joyvio group (JVG), a leading agricultural enterprise in China, as the research object and adopts a single-case study method to deeply explore the impact of digital technology on the production and operation of agricultural enterprises. The selection of this case is based on three considerations: (1) As a key national leading enterprise in China's agricultural industrialization, JVG's digital transformation practice is representative of the industry; (2) The enterprise has achieved full-chain digitalization from planting to brand marketing, and the transformation has been highly effective. (3) Its transformation process went through three complete stages: technology introduction, organizational adjustment and value reconstruction, providing rich materials for theoretical construction. The unique value of this research lies in expanding the explanatory boundaries of the resource-based perspective in the digital economy era and demonstrating the value creation path of digital technology as a new type of strategic resource. At the practical level, this study provides operational management insights for agricultural enterprises to formulate digital transformation strategies and holds significant reference value for promoting high-quality agricultural development. The goals that this research needs to achieve are as follows: (1) To explore the mechanisms through which digital technology enables sustainable operation in agricultural enterprises, moving beyond aggregate productivity metrics to examine the micro-foundations of digital empowerment. (2) Analyze how agricultural enterprises apply digital technology to achieve sustainable operation. This goal requires us to analyze it by applying the enterprise's strategy and business performance. (3) JVG has achieved sustainable operation through digital transformation. So, what are its business operations and its main business strategies? In what aspects have they gained benefits? What are the reasons for their remarkable achievements? (4) Summarize the general laws and theoretical basis of digital transformation promoting sustainable operation by using case analysis techniques.

2 Theoretical analysis of digital technology-driven sustainable operation of agricultural enterprises

The traditional resource-based view (RBV) holds that a company's unique, valuable, and hard-to-imitate heterogeneous resources are the source of its sustainable competitive advantage. However, in the rapidly changing digital age, any static resource advantage can be eroded at a fast pace. Therefore, we need to introduce the dynamic

capability theory, which is defined as "the ability of an enterprise to integrate, build and restructure internal and external resources to cope with a rapidly changing environment." By combining the two, we can construct a more explanatory framework: Digital technology drives sustainable operations by transforming data into strategic resources and empowering enterprises to build key dynamic capabilities. Digital transformation first changes the resource endowment of enterprises. According to RBV, agricultural enterprises have formed a series of new strategic resources with VRIN characteristics through digital investment. These resources include the structuring of organizational resources, the digitalization of tangible resources, and the platformization of relationship resources. Dynamic capability serves as a bridge connecting the resource base with competitive advantages. Digital technology has greatly enhanced and reshaped three core dynamic capabilities of agricultural enterprises: (1) Environmental perception and opportunity identification capabilities. Big data analysis and AI technology enable enterprises to perceive changes and opportunities from vast amounts of internal and external data. (2) Resource acquisition and integration capabilities. After perceiving opportunities or threats, enterprises need to quickly acquire and integrate resources to respond. The digital platform serves as a hub for resource integration. (3) Organizational restructuring and strategic transformation capabilities. It refers to an enterprise's ability to fundamentally restructure its business processes, organizational structures, and even business models.

2.1 Digital technology drives organizational transformation in agricultural enterprises

The digital transformation of agricultural enterprises presents a multi-dimensional collaborative mechanism at the organizational level. By adjusting the organizational structure, improving the quality of internal control, and transforming the organizational development strategy, it effectively promotes the sustainable operation capacity of the enterprises. In terms of organizational structure transformation, enterprises, in accordance with the requirements of digital transformation, change their organizational structure and build an ecological organization. By establishing a self-collaborative mechanism and integrating the ERP and OA systems, real-time data sharing among departments such as procurement, production, and warehousing was achieved, and collaboration among internal departments was realized (Setiawan et al., 2025; Liu et al., 2025a). This transformation has given rise to the "data cockpit" management model, enabling the management to obtain real-time dynamic data from the entire chain including planting, processing, and logistics, and promoting the decision-making mechanism to shift from experience-oriented to data-driven. The agile organizational structure formed after the organizational restructuring not only realizes the efficient allocation of production materials across departments, but also establishes a market early warning and risk response mechanism.

Digital transformation can enhance the internal control level of enterprises (Xu et al., 2024; Wei and Shen, 2025). Digital management helps enterprises form a relatively networked and flat organizational structure (N'Dri and Su, 2024), monitor and warn the entire production and operation process in real time, and efficiently assess internal risks (Peng and Jin, 2025; Ding et al., 2025), thereby improving the overall level of internal control and the quality of accounting

information (Liu et al., 2025b; Shi and Zhang, 2025). Digital management not only enhances the credit level of enterprises but also improves their asset level, making it easier for them to obtain loans from financial institutions and effectively alleviating financing difficulties. Due to the characteristics of the industry, agricultural enterprises have long production cycles, slow capital turnover, a large number of biological assets and difficulty in mortgage valuation. The adoption of digital technology has enabled efficient and comprehensive collection of information in the agricultural production process, generating trustworthy “digital assets.” For instance, COFCO (China national cereals, oils and foodstuffs) corporation has deployed 5G Internet of Things sensors in its Northeast granaries. Through these sensors, real-time data on crop growth is collected, turning each hectare of farmland into an assessable “digital asset” and increasing the amount of pledged loans.

By leveraging digital technologies, enterprises can adjust their business models and transform their development strategies, which helps them hedge against real challenges and alleviate corporate crises (Tan et al., 2025). Effective strategic planning and dynamic adjustment are precisely the keys to the success of an enterprise’s digital transformation. The role of strategy is not only reflected in promptly adjusting the strategic direction in response to environmental changes, but also in systematically reconstructing the original business processes through digital transformation, ultimately forming a strategic system that matches the new business model. For instance, by leveraging AI technology to build digital twin systems for disaster scenario simulation, enterprises not only achieve a digital transformation of traditional planting processes but also reconfigure strategic elements such as supply chain management and risk plans based on the simulation data. This influence path fully confirms the symbiotic relationship between strategic dynamic adjustment and business process reengineering in digital transformation.

2.2 Digital technology enhances the operational resilience of agricultural enterprises

Agricultural-related enterprises apply digital technologies to all stages of production, management and sales, and enhance enterprise resilience through resource acquisition, data-driven, cost reduction, etc. (Shatila et al., 2025). The application of digital technology in agricultural enterprises is mainly manifested in the application of intelligent technical equipment and the upgrading of technical systems. The application of digital technology and intelligent devices has enhanced the ability of agricultural enterprises to acquire, control and manage various resources (Shi et al., 2025). Its specific manifestation is that it can connect the digital information chain, help enterprises obtain customer information and feedback in a timely manner, and thereby contribute to enhancing the competitiveness of enterprises (Li et al., 2025; Meier et al., 2025). The upgrade of digital technology systems mainly relies on methods such as data-driven decision-making, precise environmental control, and full-chain operation automation to transform the “trial and error” of traditional agricultural production into “algorithm optimization,” thereby achieving precision in agricultural production. The application of digital technology in the production management stage of agricultural enterprises mainly aims to solve the technical obstacles encountered in the transformation process more efficiently than before by proficiently using various cutting-edge technologies such

as artificial intelligence, big data analysis, and the IoT. During the sales stage, enterprises accurately analyze consumer demands through big data technology and artificial intelligence technology, expand sales channels, and better respond to changes in consumer demands (Zheng et al., 2023; Mukhopadhyay et al., 2025).

Digital technology innovation is an extension or development of an enterprise’s original digital transformation level, which can enhance the efficiency of resource utilization and improve the competitiveness and stability of the enterprise. Digital utilization innovation integrates digital technologies with existing resources and knowledge capabilities (Yuan et al., 2024). While maintaining the original business process model, enterprises’ digital learning to reduce the risks brought by disruptive innovation can increase the possibility of survival in resource-constrained situations and is conducive to the stable development of enterprises (Cao et al., 2026; Wen and Xiao, 2025). Digital technology innovation and integration based on platforms have stronger technological advantages and market survival capabilities. They can achieve left–right connection and top-down compatibility with one or more platforms as the benchmark point, gradually forcing disruptive innovation to replace existing technologies (Dong et al., 2024). Digital technology can enhance the resilience of agricultural enterprises by promoting their digital transformation and upgrading. For instance, the Jian Sanjiang Branch Company, relying on the “Digital Sanjiang” construction plan of the Beidahuang Nongken Group, has built an “Agricultural Comprehensive Integrated Application Cloud Platform” integrating 5G, Internet of Things, artificial intelligence and other technologies, achieving the integration of farmland management, data analysis and decision support. It has not only made many achievements in soil testing, precise irrigation and pest and disease prevention, It can also respond quickly to market changes based on market data and policy guidance, adjust market layout, and thereby consolidate its industry position.

2.3 Digital technology drives innovation in the entire industrial chain model of enterprises

Schumpeter (1990) understood innovation as a “new production function” in “The Theory of Economic Development” and proposed the famous “second curve” theory. In the “second curve” theory, the first curve refers to continuous innovation, while the second curve refers to discontinuous innovation. He emphasized that discontinuous innovation refers to the situation where the economy experiences exponential and tenfold growth when the two curves transition, that is, from the first curve to the second. The digital empowerment of the entire industrial chain paradigm innovation of agricultural enterprises is a process of transforming from the first curve to the second. Essentially, it is the innovative combination of traditional production factors and digital technology, which is what Schumpeter emphasized as “old factors, new combinations.” This process represents “qualitative” innovation, discontinuous growth and revolutionary progress. Therefore, digital empowerment means integrating traditional production factors with new digital technologies. By achieving product innovation, technological innovation, market innovation, resource allocation innovation and organizational innovation, it promotes the horizontal and vertical extension and expansion of the entire agricultural industrial chain, thereby achieving both quantitative growth and qualitative improvement in the economy.

In terms of product innovation, digital technology can endow agricultural products with digital attributes. Digital technology, by building personalized, customized and intelligent models for the production and processing of agricultural products, breaks through the limitations of traditional agricultural production and stimulates new momentum in agriculture. In terms of technological innovation, enterprises can dynamically monitor the natural conditions for crop growth by applying digital technologies such as big data, blockchain, and the Internet of Things. They can scientifically analyze the effects of various elements such as fertilizers, pesticides, and human resources input during the production process, promoting the research and development and innovation of related intelligent agricultural equipment. Change the traditional agricultural production mode of “relying on the weather” (Shen et al., 2023). In terms of market innovation, the development of digital platforms and e-commerce has bridged the “last mile” between producers and consumers. Through the precise matching of production and sales information, it helps enterprises accurately formulate brand marketing strategies and create new consumption points. In terms of resource allocation innovation, by organizing and analyzing data and information from all links including the consumption end, production end and service end, the efficiency of agricultural cooperatives in allocating various agricultural supplies and government departments in allocating policy resources can be enhanced. By building a comprehensive agricultural information service platform that spans regions and links, it provides producers and operators with market information on agricultural products and supplies, agricultural science and technology innovation information, and agricultural situation consultation and other relevant information, promoting the coordinated and integrated development of elements in agriculture with multiple fields such as leisure, education, and health preservation. In terms of organizational innovation, through the digital transformation of various production entities as well as processing, circulation and sales enterprises, we promote the deep integration and connection between small-scale farmers and modern agriculture and modern markets, develop new organizational forms such as “cloud stores” and “smart farms,” and promote the development of agricultural circular economy and scale economy.

2.4 Digital technology drives the improvement of total factor productivity in agricultural enterprises

With the application and empowerment of digital technology in all links of the agricultural industrial chain, data has become the core driving factor for the efficient operation and integrated innovation of the entire industrial chain. Based on characteristics such as sharing, replicability and accessibility, digitized information and knowledge can enable the relevant entities in agricultural production and operation to grasp more abundant and accurate agricultural information. Under the clarity of information transparency, enterprise managers can integrate the logistics, capital flow, information flow and business flow involved in each link, expand the industrial chain, enhance the value chain, integrate the supply chain, improve the interest chain, build a closely interactive interest community, and thereby improve the total factor productivity of agriculture (Shen et al., 2023). (1) Intelligent production enhances production efficiency. In digital agricultural production, by integrating modern information technologies such as satellite positioning and

remote sensing with modern agricultural theories including agronomy, soil science, botany and ecology, an intelligent spatial information system for agricultural production is created. For instance, enterprises monitor and issue early warnings on plant growth, weather, environment, etc. through Internet of Things systems, and obtain data information from each link of the agricultural industrial chain production end. Through big data statistical analysis and intelligent decision-making systems, enterprises break through the limitations of time and space to precisely control the production process (Shen and Zhang, 2023); Through the analysis and early warning of agricultural risk data such as pests and diseases, enterprises can take targeted preventive measures in a timely manner to achieve “prevention first and comprehensive control” in planting industry and “treating diseases before they occur” in animal husbandry (Abiri et al., 2023). It can be seen that traditional agriculture is transforming and upgrading toward smart agriculture under digital empowerment, and driving the continuous improvement of industrial efficiency (Yang et al., 2024). (2) Information Sharing improves decision-making efficiency (Wang and Nie, 2025). Through digital transformation, the entire agricultural industry chain can achieve real-time updates and push of agricultural product production information, forming an integrated chain system covering agricultural production, processing, circulation, marketing and services. This breaks down information and data barriers among various links, enabling real-time interaction among producers, sellers and purchasers, and promoting more convenient and efficient cooperation and communication among upstream, midstream and downstream entities. Taking the digital platform as the carrier, the visualization of the sales and circulation links of agricultural products is realized, enabling consumers to clearly understand information such as the source and quality of the products, thereby enhancing the standardization and professionalization level of the entire supply chain (Sharma et al., 2024a, 2024b). At the same time, this is also conducive to improving the quality supervision mechanism of agricultural products, enhancing the transaction efficiency among various entities, and reducing the decision-making costs of enterprises. (3) Real-time data analysis enhances the efficiency of agricultural product circulation. Based on the immediate advantage of data, agricultural production and operation entities can promptly obtain information on the circulation of agricultural products, analyze changes in consumer demand and the possible impact of unexpected events on the agricultural product market. On the one hand, it can reduce the losses caused by shocks and enhance the ability to resist risks. On the other hand, it can optimize the market structure, enhance the efficiency and benefits of agricultural product circulation, and achieve high-quality agricultural products at high prices.

3 Case analysis of digital transformation of Joyvio group

3.1 Basic information of the enterprise

JVG was established in 2012 and is an important representative enterprise in China's modern agriculture and food industry. The company has carried out industrial layout around multiple sectors such as fruits, high-quality protein, high-nutrition 4R pre-prepared food, technology group meals, intelligent technology and nutrition technology, and is committed to building a globally leading fruit industry chain system and a protein industry chain with dual circulation at home and abroad, promoting the improvement of the

technology group meal industry ecosystem. As a pioneering enterprise in China's agricultural and food industrialization, JVG has accumulated significant advantages in industrial practice and has been highly recognized by professional institutions at home and abroad. It ranks 52nd among China's top 500 agricultural enterprises.

JVG's digital transformation practice adheres to the Resource-Based View and dynamic capability theory, and has established a dual-track driven strategic system of "organizational management - business chain." In the dimension of Organizational Management, the group implements the "Organizational knowledge management & digital operation" (OKM-DO) strategy. The objective of this strategy is to establish a knowledge assetization management mechanism through efficient knowledge management and digital tools, transform implicit experience into a structured knowledge base, systematically enhance the organization's learning capabilities, and continuously promote the organization's digital and intelligent transformation and continuous innovation. Data shows that this strategy has enabled the organization's digital penetration rate to reach 82%, significantly enhancing cross-departmental collaboration efficiency and innovation response speed. In the business chain dimension, the company relies on the full-chain integration framework to build a digital solution for the blueberry industry covering variety research and development, intelligent planting, precise processing, cold chain logistics to brand marketing. The company is accelerating its digital transformation by leveraging advanced digital technologies. Based on the construction of the data center, the company breaks the "fragmented" operation predicament of traditional agriculture through the cross-link flow of data elements, and forms a decision-making center with the "Agriculture-Food Digital Intelligence Hub" as the core. Realize the paradigm leap from experience-driven to data-driven. This not only enhances the efficiency of the industrial chain but also lays a solid foundation for the long-term development of the industry. Under the background of the digital economy, JVG has adopted two important business strategies: the "agricultural and food digital intelligence brain" and the intelligent service solutions in the planting and processing fields, to gain a competitive edge in the market and ultimately achieve sustainable development.

3.2 Data source

This study utilized the publicly available data from Jiawo Company. This study used some data to describe the company's performance when conducting case analysis. These data are mainly obtained through the enterprise's annual business reports, financial reports, enterprise wechat official accounts and research interviews. Some data are also sourced from the case database of Harvard Business School and China Enterprise News.

3.3 Agriculture-food digital intelligence hub promotes the comprehensive digital transformation of enterprises

3.3.1 JVG has established an organizational knowledge management and digital operation model

In the process of promoting digital and intelligent transformation, JVG has initiated an organizational knowledge

management and digital operation plan centered on a collaborative platform, aiming to drive a comprehensive transformation of the organizational structure and operation mode through a systematic knowledge management mechanism and digital operation methods. This system integrates six typical application scenarios, covering organizational online, collaborative online, agile innovation, knowledge management, open culture and data application. By building an operational architecture of "1 platform +3 ecosystems" (which are the organizational collaboration platform, knowledge management ecosystem, digital operation ecosystem and shared service ecosystem), the company has effectively promoted the flow of knowledge and the systematic empowerment of employees' capabilities, achieved the deep integration of knowledge management and digital operation, and driven the transformation of the organization toward an evolutionary culture. Specifically, this strategic plan includes seven key steps:

1. Establish a collaborative platform. The company has built a unified and collaborative digital platform as the core infrastructure for organizational knowledge management and digital transformation, to promote efficient information flow and knowledge sharing.
2. Build a knowledge management ecosystem. Systematically sort out and integrate the internal knowledge assets of the organization, break down departmental barriers, build a group-level knowledge base, and achieve systematic storage and efficient dissemination of knowledge.
3. Develop a digital operation ecosystem. Build a digital working environment with full participation by applying digital technology, stimulate employees' creativity and participation awareness through diverse interactive sections, and accelerate information flow and knowledge application.
4. Build a shared service ecosystem. Reconstruct traditional functional modules, build a shared service platform, enhance the flexibility and accuracy of functional responses, and strengthen employees' self-motivation and organizational collaboration capabilities.
5. Allocation of funds and human resources. To support this transformation plan, the company has formulated a special budget and human resources plan to ensure the resource input in aspects such as platform construction, technology research and development, employee training and cultural shaping, so as to facilitate the smooth implementation of the transformation.
6. Phased goal setting. Set clear overall goals and phased implementation paths. These task objectives cover key performance indicators such as the organization's online rate, the number of knowledge documents, the proportion of original content, and the coverage of shared services, ensuring the smooth progress and continuous optimization of the transformation.
7. Continuous evaluation and optimization. Establish a regular assessment system, conduct quantitative analysis around the knowledge asset management capability and organizational innovation index, adjust the transformation strategy in a timely manner, and ensure that it is in step with the enterprise's development strategy.

3.3.2 Digital and intelligent transformation practice of the entire agricultural industrial chain

JVG has established an innovative model for facility agriculture. By integrating all links of the front, middle and back ends of the industrial chain through digital and intelligent technologies, and relying on the digital central control platform, meteorological information system and intelligent water and fertilizer equipment, it has achieved standardized and precise production in blueberry cultivation, significantly improving the comprehensive management efficiency of agricultural enterprises.

In the upstream of the industrial chain, the group has developed over 200 standardized planting operation templates through scientific variety experiment management, combined with its unique agricultural operation and harvesting management system. It has also established a database covering tens of thousands of personnel skill tags and collected more than 100,000 operation data entries in total. Through real-time data collection and transmission mechanisms, the precise calculation of personnel performance and salary distribution have been achieved, endowing agricultural practitioners with “digital identities,” and establishing a meticulous, professional and standardized management model. During the picking and processing stages, data is integrated through an integrated intelligent system, achieving multi-dimensional and refined grading and batch management, ensuring full traceability throughout the process and increasing production efficiency by approximately 15%. The application of this system has significantly optimized the management of picking operations during peak seasons, integrating functions such as digital identity recognition, voice broadcasting, and real-time salary calculation. It not only enhances the management efficiency of the enterprise but also improves employee satisfaction through scientific performance management and timely salary distribution. At the downstream of the industrial chain, Jiawo has established a standardized management system for non-standard products through digital cold chain logistics monitoring and intelligent warehouse management systems, achieving precise matching in the procurement and sales links. This system effectively connects multiple entities such as farmers, cooperatives, brokers and wholesale markets, and builds a digital and intelligent management model for the entire chain of fresh food circulation with Chinese characteristics.

3.3.3 Main achievements

1. Knowledge management and digital operation enhance the operational efficiency of enterprises. JVG has significantly enhanced its economic benefits and innovation capabilities by implementing organizational knowledge management and digital operation plans. Through business process optimization and quantitative management of knowledge assets, operational costs have been effectively reduced, team collaboration and organizational evolution capabilities have been enhanced, innovative behaviors have been promoted, and market competitiveness has been improved. Data-driven decision support systems further optimize resource allocation and enhance the return on investment. Employee engagement and knowledge accumulation levels have significantly improved. The online organization rate on working days exceeds 82%, and over 40,000 structured knowledge documents have been generated cumulatively. The proportion of original content has

reached 35.38%, and 116 shared platform service construction projects have been completed. The score of the knowledge management ability assessment has increased from 2.45 to 3.53, with an annual growth rate of 44%. In the all-staff interaction platform, the employee participation rate reached 63%, the number of content posts exceeded 800, and the internal view count reached 340,000 times, effectively enhancing the innovation efficiency and the continuous growth momentum of the enterprise.

2. The facility agriculture model promotes the quality improvement and efficiency enhancement of regional industries. The facility agriculture planting model adopted by Jiawo effectively copes with the impact of extreme weather, ensures stable crop production, and reduces natural risks in agricultural production. By using a mixed substrate of perlite, moss and coconut coir, a standardized growth environment was provided for blueberries, ensuring consistent growth conditions for the plants and promoting the standardization and controllability of the planting process. The application of pulse drip irrigation technology and intelligent plant protection robots has achieved the automation and precision of water and fertilizer management and pest and disease control, improved the efficiency of resource utilization, and is in line with the concept of sustainable development. Through organizational culture and propagation techniques, the group cultivates tens of millions of high-quality seedlings every year, achieving continuous optimization of varieties and improvement in quality. The independently developed negative pressure pre-cooling system achieves gentle cooling and preservation of fruits, ensuring the freshness and nutritional value of blueberries from harvest to consumption, reducing losses and extending the shelf life. In addition, through the authorized cultivation of high-quality varieties and the construction of an agricultural technology service system, the group has driven the development of regional agriculture, formed a sustainable business operation model, and promoted the overall value enhancement of the industrial chain.
3. Digital and intelligent operation promotes the upgrading of agricultural human capital. JVG recognizes that talent is the core element in promoting agricultural modernization. While developing the blueberry industry, it systematically promotes the cultivation of talents for agricultural digitalization and intelligence. Through cooperation with local governments, educational institutions and research institutes, a complete talent cultivation system has been established. Through over 500 training sessions on modern agricultural machinery, agronomy and technology, the group has not only enhanced the professional capabilities of farmers, but also cultivated a group of new agricultural talents who possess agricultural knowledge, master digital technology and are good at application and innovation. These measures not only enhance farmers' technological literacy but also provide human resource support for the digital and intelligent transformation of agriculture, becoming an important force in promoting agricultural modernization and rural revitalization.
4. Enhance the brand value of regional industries. The high-standard blueberry planting demonstration base built by JVG

in Honghe, Yunnan Province, has significantly increased the yield and quality of blueberries, successfully shaping the regional industrial brand of “Yunnan Mountain Blueberries.” Through continuous brand building, JVG Blueberries have become a leading brand in China’s fruit industry, achieving a brand premium of 15 to 20%, and have been selected as one of the top ten famous fruits in Yunnan. The scale of the blueberry industry in Yunnan has exceeded 20 billion yuan, making it one of the most competitive fruit categories in the region and significantly driving local economic development. The creation of this industrial brand card not only enhances the brand value of JVG, but also provides replicable experience for the development of characteristic agriculture in other regions. The product brand and advanced agricultural management experience not only provide strong support for the company’s sustainable operation, but also make positive contributions to the country’s rural revitalization and agricultural modernization.

3.4 JVG has proposed an intelligent service solution in the field of planting and processing

In the process of promoting the digital transformation of agriculture, JVG has built a smart service solution for planting and processing centered on “YunAgri Prime” and “YunAgri Select.” This system is dedicated to achieving digital and intelligent management throughout the entire planting life cycle and optimizing the processes of economic crop harvesting, sorting, and packaging, thus forming an integrated digital platform covering key nodes of the agricultural industrial chain.

“YunAgri Prime” focuses on modern management in the planting process. It integrates agricultural production, operation, resource and management data to build a highly adaptable planting decision support system, serving different planting models and crop types. Relying on the team’s comprehensive capabilities in both traditional and modern agricultural technologies, this platform provides large-scale planting enterprises with low-cost and high-efficiency digital transformation paths, assists in building a digital agricultural service mechanism that combines government guidance with market dominance, and activates the value of agricultural data resources. “YunAgri Select” takes batch management as the main line, running through core business processes such as procurement, processing, warehousing, sales and finance, to achieve full-process digital and intelligent control. The system supports automatic batch cost calculation and full-process quality traceability, providing data basis for enterprises to optimize production efficiency, quality control and cost structure. The platform enhances the visualization and credibility of product quality by implementing “one product, one code” tag-based management, thereby improving the market premium capacity of products. The platform also strengthens cross-departmental collaboration through a collaborative dispatching mechanism, promoting the integration of production and sales data and business linkage. By building a settlement support and sales decision-making system based on big data, we provide settlement support and sales analysis guidance for enterprises.

3.4.1 Product functional architecture

3.4.1.1 Digital and intelligent agricultural management throughout the entire life cycle of planting

The “YunAgri Prime” digital and intelligent management solution for the entire life cycle of planting adopts the “Plan-Do-Check-Act” (PDCA) cycle management model, builds a closed-loop planting management mechanism, and enhances the systematic and refined level of agricultural management through data-driven decision support. The product is highly flexible and can adapt to different planting patterns and categories of cash crops, meeting diverse agricultural management needs. The main functions are as follows.

1. Refined management of the base. “YunAgri Prime” provides agricultural enterprises with the ability to conduct refined base management that delves into crop varieties and grades. The platform supports multi-dimensional spatial crop management from the enterprise level to plots, greenhouses, rows, etc., achieving precise monitoring and analysis of different varieties and grades, and meeting the differentiated control needs of planting entities.
2. Digital allocation of human resources. By building a worker profile and a multi-dimensional capability label system, optimizing the personnel grouping and task assignment process, the task allocation process has been simplified, and the efficiency of human resource allocation and management effectiveness have been enhanced.
3. The planting process can be defined. The platform supports planting enterprises in customizing agricultural operation templates based on actual needs, achieving full-process data recording and analysis, and promoting the evolution of planting management toward intelligence and standardization.
4. Standardization of the harvesting process. The platform offers flexible weighing and piece-rate reporting mechanisms, covering the harvesting, transportation and quality inspection of raw fruits, ensuring that the harvesting operation is standardized and controllable, and efficiently connected with the subsequent processing links.
5. Transparency in procurement and inventory. The platform implements full-process transparent management of procurement, inventory, allocation and material costs, assisting enterprises in effectively controlling material consumption and operating costs.
6. Refined salary management. The platform supports the generation, adjustment and subsidy distribution of salary records, provides multi-dimensional BI analysis reports, and realizes systematic control over salary structure and differences.
7. Digitalization of business decision-making. The platform offers over 20 types of BI analysis reports covering seedling ledgers, financial wages, material consumption, etc., assisting enterprises in conducting in-depth analysis of their business conditions and making strategic decisions.
8. Intelligent recommendation for agricultural operations. The platform supports agricultural reminder and recommendation functions triggered by time or conditions, enhancing the standardization level and progress management capabilities of agricultural operations, and serving the two-way collaboration between technical guidance and planting execution.

3.4.1.2 Full-process management of processing and sorting

The “YunAgri Select” platform aims to achieve full digitalization of the entire process from storage, sorting to packaging in the agricultural and food industry. It builds a process control mechanism with batches as management units, covering the entire business chain from raw material warehousing to finished product sales. This platform can automatically calculate batch costs, achieve full-process quality traceability, and provide a solid decision-making and analysis foundation for the continuous optimization of the production process. Its main functions are as follows:

1. Integrated management of purchase, sales and inventory. The inventory management function of YunAgri Select covers the entire logistics chain from receiving goods, storage to sales and delivery. The system utilizes information technology to automate management processes, ensuring real-time inventory query and early warning mechanisms. At the same time, it effectively controls and manages sales orders, inventory costs, batch finished products, as well as receivables and payables.
2. The processing procedure is traceable. The platform supports a processing mode based on batch penetration and segmented management, achieving full traceability of the production process and flexible data reporting, and enhancing the transparency and controllability of the production process.
3. Standardization of quality inspection management. Yun Nong Zhenxuan generates detailed quality inspection data ledgers and reports through precisely configured quality inspection items and rules, combined with an automatic data recording and rating system. This function greatly enhances the efficiency of inspection and the transparency of quality management, ensuring high standards of product quality.
4. Visualization of business analysis. The platform is equipped with a multi-dimensional BI report and business analysis system, enabling enterprises to conduct business evaluations and decision-making optimizations based on real-time data, and enhancing their response capabilities to market changes and internal operations.

3.4.2 Implementation effectiveness and management implications

The “YunAgri Select” platform promotes enterprises to achieve lean management through a data-driven mechanism, effectively activates internal data assets of enterprises, and promotes the systematization and refinement of management processes. This platform supports the low-cost reuse and efficient circulation of business data, lowers the threshold for digital learning, and achieves a coordinated balance throughout the entire production and management process. In the management scenario of processing plants, the platform has reduced its reliance on individual experience through the standardization of process flows, and has established a cost accounting system based on standard procedures and working hours, providing a reliable basis for financial decision-making and resource allocation. The real-time monitoring and intelligent dispatching mechanism further optimizes the allocation efficiency of production resources, enhances product quality and production capacity flexibility. This system has also achieved the

integrated integration of business and finance, clarified the production execution process, reduced statistical and accounting costs, ensured the consistency between accounting and physical inventory, thereby significantly enhancing the transparency and overall efficiency of the production system. Through meticulous calculation and dynamic analysis of batch costs, enterprises can optimize their resource structure, respond quickly to market changes, and build a data-based continuous improvement mechanism.

3.5 Digital technology drives the standardization and efficiency of product production in agricultural enterprises

Food safety, as a core concern for consumers and a strategic priority for enterprises, its management effectiveness directly restricts the sustainability of the agricultural product value chain. Given the structural predicaments of the agricultural industrial chain, such as its long length, numerous manual intervention links, and low degree of standardization, the traditional closed factory production model is difficult to adapt to the characteristics of agricultural production. This study, based on the theory of organizational collaboration and the framework of process reengineering, uses the real case of JVG to analyze how digital technology reconstructs the full-chain standardized management system.

To address the challenge of standardizing the entire agricultural production industry chain, JVG has achieved dynamic control of all elements from the field to the dining table by building an end-to-end data governance architecture, including a master data framework and standardized data structures. Particularly crucial is that the company innovatively proposed the intelligent dynamic office (IDO) management paradigm, integrating the functions of knowledge management, agricultural operation scheduling and real-time data analysis. And relying on low-code technology, cross-system integration of the OA system, procurement management, cost control and inspection modules is achieved. JVG has been promoting the standardization of agricultural products such as blueberries, achieving “end-to-end” digital and intelligent management throughout the entire process from variety research and development, planting operations, sorting and processing to transportation and sales, striving to provide consumers with fresh agricultural products of stable quality in different seasons. Due to the high requirements for standardization in agricultural operations, JVG has carried out a digital and intelligent reform that takes into account both software and hardware. The company not only incorporated agricultural operation functions into IDO, but also introduced many intelligent devices to help improve efficiency. This practice not only verified the reconfiguration effect of digital technology on the boundaries of agricultural organizations, but also highlighted its strategic value as the core driving force for industrial upgrading.

3.5.1 PDCA closed-loop management promotes the standardization of agricultural operations

JVG has deeply integrated Deming quality management cycle (PDCA) into its agricultural operation system, forming a goal-driven

organizational collaboration mechanism, which has greatly enhanced the efficiency and quality of agricultural operations. Specifically:

The planning (Plan) stage. Based on the overall business strategy and market environment, the company's management has set quantifiable key performance indicators (KPIs) through the decomposition of strategic goals and historical data mining, and ensures the feasibility of the goals through the detailed definition of periodic goals and the hierarchical assignment of tasks.

Execution (Do) stage. After clarifying the planting tasks, technicians generate operation instructions based on standardized agricultural templates (such as fertilization and irrigation procedures), and the executors obtain the task list in real time through mobile terminals to clarify the boundaries of rights and responsibilities and enhance the compliance of operations. Breaking down work tasks can effectively improve work efficiency.

Check stage. Technicians implement dynamic scoring and diagnostic feedback on the execution process (such as triggering suggestions for optimizing the frequency of fertilization due to insufficient soil nutrients), and establish an immediate correction mechanism for quality deviations.

Action (Act) stage. JVG will summarize problems and experiences, and based on the feedback collected, continuously iterate and optimize the decision-making and goal breakdown process to avoid the same problems in future planting activities. Based on the accumulated over 200,000 pieces of agricultural operation data, we continuously iterate the planting template library to achieve a virtuous cycle of knowledge accumulation and process optimization. At present, JVG has accumulated hundreds of thousands of agricultural operation data and independently developed over 200 planting templates, all of which can be maturely applied to standardized planting processes, including fertilization, watering, harvesting and other operations, with production efficiency increasing by as much as 15%.

This case confirms the symbiotic relationship between process standardization and organizational learning capabilities: digital technology not only solidifies best practices but also enhances the dynamic adaptability of organizations through data feedback, providing a replicable management paradigm for agricultural enterprises to break through experience-dependent production models.

3.5.2 Digital technology enhances the efficiency of agricultural operations

JVG deeply integrates digital devices into production scenarios through a Technology-Organization Interaction strategy. The company actively implements the concept of digital intelligence in the fields and farmlands, reducing the workload of farmers while enhancing their production efficiency. Deploying an Internet of Things (IoT) sensor network in the blueberry base in Yunnan, such as a micro-weather station, can achieve millisecond-level collection of environmental parameters and precise regulation of water and fertilizer, increasing irrigation efficiency by 40%. Introduce self-developed plant protection robots to carry out pest and disease control tasks, and replace manual spraying through a remote command system, reducing pesticide usage by 25% and meeting green agricultural standards. In addition to the standardized operation of blueberries, the pineapples in Hainan have also achieved standardized sorting using the intelligent equipment of JVG. In the pear sorting process, the first domestic optical grading and sorting line was applied.

Based on multi-dimensional indicators such as sugar content and moisture content, standardized identification of non-standard products was achieved, with a sorting accuracy rate of 98%, and the product premium rate reached 28.6%. Practice has proved. The utilization of digital technology has significantly enhanced the output efficiency of agricultural products. Traditional blueberries usually bear fruit in 3 years and reach full yield in 5 years. However, after the introduction of PDCA closed-loop management and digital technology, blueberries can bear fruit in the same year and ripen the following year. This mechanism has increased production efficiency by 15% and significantly shortened the blueberry planting cycle.

Such practices reveal that digital technology effectively resolves the uncertainties in agricultural production through a three-level leap of "intelligent equipment - automated processes - data-driven decision-making." It is particularly worth noting that the application of technology does not simply replace human labor, but rather reconfigures the relationship of human-machine collaboration (Shen, 2024). For instance, robots undertaking high-risk tasks free up human resources, enabling employees to shift toward high-value-added decision-making activities, thereby achieving a Pareto improvement in total factor productivity.

3.5.3 Data elements facilitate more efficient organizational management

JVG has established a full-chain SaaS management platform covering variety breeding, planting, harvesting and processing, to conduct refined and intelligent management of agricultural production. The management innovation of this model is reflected in three dimensions:

1. **Process automation.** The system automatically decomposes tasks based on job characteristics. Managers monitor core indicators such as sales forecasts and material allocation in real time through data dashboards. Abnormal values trigger an active early warning mechanism, and the decision-making response efficiency is improved by 50%. In business practice, base managers allocate agricultural tasks and arrange personnel, materials and operations every morning by operating self-developed systems and SaaS software. The relevant data will be formed in real time into a data dashboard containing information such as sales forecasts and investment situations. If any abnormal core indicators are encountered, they will be proactively pushed to assist managers in making the next decision. Based on the accumulation of a large amount of existing data, JVG plans to carry out innovative development of industrial AI models. JVG has solved 60% of the problems in its work order-based business through DingTalk AI Assistant, greatly enhancing efficiency. Introducing AI technology to optimize operation and maintenance services can also help enterprises achieve cost reduction and efficiency improvement.
2. **Making knowledge explicit.** Develop customized applications based on DingTalk's low-code platform "Yida," and customize applications suitable for specific situations. The company has integrated agricultural SaaS services with enterprise knowledge bases and seamlessly integrated DingTalk's data processing capabilities. Whether it is the assignment of daily work tasks, data collection, or interaction with other business systems, all

can be accomplished through this customized tool. The application and practice of low-code platforms can connect all business links and form a unified channel for knowledge and information transmission. This model marks the upgrade of data elements from auxiliary tools to core production materials of the organization, ultimately achieving the structured accumulation of the organization's implicit experience.

3. Ecological synergy. JVG also implements digital cold chain logistics monitoring and intelligent warehouse management. The company has established a unified product coding and intelligent settlement system to connect the cold chain logistics, warehousing management and distribution links, and has set up standardized management for non-standard products to solve the friction of goods flow tracking and settlement in non-standard product transactions. The company also reduces transaction costs by using standard product coding, transaction processes and settlement systems.

As the case shows, when data flow and business flow are deeply coupled, enterprises not only optimize operational efficiency but also cultivate a new type of organizational capability characterized by “data-driven decision-making.” The constructive role of digital technology in the dynamic capabilities of organizations has been verified. This is precisely the key management lever for agricultural enterprises to cope with market fluctuations and achieve sustainable competition.

3.6 Environmental protection

Digital technology plays a significant role in achieving environmental sustainability (Shen and Zhang, 2024b; Yuan et al., 2024). Joyvio Huanxian, a subsidiary of JVG, is making efforts in research and development and innovation, and has built the first ESG green factory in the domestic plant protein field in the Hainan Comprehensive Bonded Zone. Through the innovation of ultra-micro processing technology and the closed-loop management of the entire industrial chain, we aim to create a “zero-carbon journey for a single coconut,” reshape the traditional processing model, and usher in a new era of “efficient utilization” of plant protein. The traditional processing method mainly relies on physical pressing technology. Through compounding, the final product is made, which has problems such as low processing efficiency and waste pollution. JVG innovatively employs ultrafine processing technology, increasing the raw material utilization rate from 70 to 95%. The company has built a fully automated production line, achieving a daily output of 60 tons of ultra-fine coconut milk, providing consumers with high-quality, safe and healthy protein food and beverages, and working hand in hand with the industry to promote a sustainable future.

The global climate change situation is becoming increasingly severe, posing a huge challenge to the sustainable development of human society. The ocean is the largest active carbon pool on Earth, and Marine fisheries have huge potential and prospects for carbon sinks. Marine fishery not only provides a large amount of high-quality and healthy blue Marine food for human society, but also contributes to reducing carbon dioxide emissions. It is a win-win human production activity. As a leading enterprise in the domestic salmon industry, JVG is committed to taking practical actions to drive carbon

reduction throughout the entire industrial chain and promote the sustainable development of the industry. Australis, a subsidiary of the company, has joined global salmon initiative (GSI), an organization that represents the highest environmental and social standards for salmon production. Australis Seafoods, a subsidiary of JVG, has been continuously improving its feed conversion rate (FCR) through measures such as rationally selecting the location of fish farms, adjusting feed formulas and feeding rhythms. Meanwhile, the company adopts digital and intelligent technology and equipment to efficiently manage the entire growth process of salmon, optimize production methods, and effectively reduce the carbon footprint of salmon. In the 2022 Chile's Best Farms of the Year assessment by Danish feed giant BioMar, four farms of Australis, a subsidiary of JVG, ranked among the top five. Among them, the best-performing farm topped the list with an FCR index of 0.99, achieving the best result in history.

JVG has established a green traceability system that goes from the branch to the tongue. JVG has established a blockchain-based carbon footprint traceability system for its high-end products. Internet of Things (IoT) devices record energy consumption in the production process, such as electricity in livestock farms, energy consumption in processing plants, and fuel consumption in transportation, and all these data are uploaded to the blockchain for evidence and cannot be tampered with. Consumers can scan the product quick response code to not only learn about the origin information but also view the carbon footprint data of the product throughout its entire life cycle.

4 Research conclusions and future prospects

4.1 Research conclusion

JVG actively embraces digital opportunities. Its personalized and dynamic digital office has endowed its employees with digital genes, making agricultural operations standardized and efficient, and turning data into the original driving force for the company's development. It has formed a digital transformation solution for agricultural and food scenarios covering smart planting and breeding, smart agricultural product processing, smart agricultural trade and wholesale, smart central kitchens, and smart group meals. The agricultural and food industry in the future will embrace more development opportunities. This study, through the case analysis of JVG's digital transformation, systematically reveals the internal mechanism and management logic of how digital technology empowers the sustainable operation of agricultural enterprises. The main research conclusions can be summarized into the following four aspects:

1. Co-evolution at the organizational dimension is the management cornerstone of sustainable operation. Jiawo's practice shows that digital transformation is not only a technological upgrade but also a profound organizational change. By building a knowledge management and digital operation system centered on a collaborative platform, enterprises have broken down departmental barriers, made tacit knowledge explicit and structured, thereby enhancing the transparency of internal control and the scientific nature of decision-making. The construction of such organizational capabilities lays a solid

management foundation for enterprises to cope with external uncertainties and achieve sustainable growth.

2. The full integration of all elements in the business chain is the source of efficiency for sustainable operation. From precise planting and “digital identity” management in the upstream, to intelligent processing and batch traceability in the midstream, and then to production and sales matching and brand premium in the downstream, Joyvio has achieved data-driven and closed-loop management throughout the entire industrial chain through the “agricultural and food digital intelligence brain.” This not only significantly enhances operational efficiency and resource utilization efficiency, but also ensures product quality and safety as well as green production through standardized production and a full-process traceability system, achieving a unity of economic and ecological benefits.
3. The dynamic adaptation of technology, organization and ecosystem is the key to building business resilience. The case of Jiawo confirms the applicability of the dynamic capability theory in the digital transformation of agriculture. By combining digital exploitative innovation (such as optimizing existing processes) with disruptive innovation (such as building platform ecosystems), enterprises can maintain operational stability while responding quickly to market changes and technological shocks. This ability to continuously learn, integrate and restructure under resource constraints is the core for agricultural enterprises to maintain competitive advantages and operational resilience in a volatile environment.
4. The systematic activation of data elements is the core driving force for value creation. This study reveals that data has evolved from an auxiliary tool to a core production factor. Jiawo has transformed scattered agricultural data into “digital assets” that are decision-making, accounting and tradable through its data governance architecture. This not only optimizes internal cost control and resource allocation, but also activates the data value of the entire ecosystem by empowering industrial chain partners, ultimately achieving an increase in total factor productivity and a coordinated leap in the value chain. Overall, the key to achieving sustainable operation of agricultural enterprises through digital technology lies in formulating a systematic transformation strategy. These strategies encompass technology, organization and industrial ecosystems. At the technical level, select digital tools suitable for agricultural scenarios; At the organizational level, adjust the structure and processes to adapt to the application of technology; At the ecological level, open platforms promote industrial chain collaboration. All three are indispensable and need to be advanced in a coordinated manner.

4.2 Research limitations and future prospects

This research is a single-case exploratory study, and the universality of its conclusions needs to be further verified through large-sample empirical research. Future research can focus on the differentiated paths of digital transformation for agricultural

enterprises of different types and scales, and can also deeply explore the impact of institutional factors such as data ownership and the digital divide on sustainable agricultural operation.

Data availability statement

Publicly available datasets were analyzed in this study. The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

ZW: Conceptualization, Data curation, Methodology, Supervision, Writing – original draft. ZP: Funding acquisition, Investigation, Project administration, Resources, Visualization, Writing – review & editing. WL: Data curation, Investigation, Methodology, Project administration, Validation, Writing – original draft. SL: Formal analysis, Investigation, Writing – original draft. HL: Data curation, Methodology, Writing – original draft. XW: Formal analysis, Investigation, Methodology, Software, Writing – review & editing. HW: Investigation, Validation, Writing – original draft.

Funding

The author(s) declare that financial support was received for the research and/or publication of this article. This research was supported by the Philosophy and Social Sciences Project of the Education Department of Hubei Province (grant number: 24Z78; 23Z621).

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The authors declare that no Gen AI was used in the creation of this manuscript.

Any alternative text (alt text) provided alongside figures in this article has been generated by Frontiers with the support of artificial intelligence and reasonable efforts have been made to ensure accuracy, including review by the authors wherever possible. If you identify any issues, please contact us.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

References

- Abiri, R., Rizan, N., Balasundram, S. K., Shahbazi, A. B., and Abdul-Hamid, H. (2023). Application of digital technologies for ensuring agricultural productivity. *Heliyon* 9:e22601. doi: 10.1016/j.heliyon.2023.e22601
- Ahmed, N., and Shakoob, N. (2025). Advancing agriculture through IoT, big data, and AI: a review of smart technologies enabling sustainability. *Smart Agric. Technol.* 10:100848. doi: 10.1016/j.atech.2025.100848
- Cao, Q., Qian, Y., Zhong, L., and Meng, Q. (2026). Dual regulatory mechanisms and boundary conditions of digital transformation on open innovation: a supply chain dynamic characteristics perspective. *Technol. Soc.* 84:103085. doi: 10.1016/j.techsoc.2025.103085
- Ding, Y., Sun, Y., and Zhang, X. (2025). Customer digital transformation and enterprise risk-taking: evidence from Chinese supply chains. *China Econ. Rev.* 91:102418. doi: 10.1016/j.chieco.2025.102418
- Dong, C., Shen, Y., and Geng, G. (2024). Green innovation driven by digital transformation: an innovation chain perspective. *Systems* 12:349. doi: 10.3390/systems12090349
- Fang, L., and Shen, Y. (2025). Digital economy enabling high-quality development of agricultural enterprises: interaction, inner mechanism and strategic orientation. *Int. Rev. Econ. Finance* 103:104393. doi: 10.1016/j.iref.2025.104393
- Gong, Q., and Tang, W. (2025). How does digital technology innovation drive agricultural sustainability? A mechanism study based on green total factor productivity. *Front. Sustain. Food Syst.* 9:1660992. doi: 10.3389/fsufs.2025.1660992
- He, Q., Tang, Z., Mai, H., Shen, Y., and Jiang, J. (2025). Digital transformation and profitability in rural commercial banks. *Financ. Res. Lett.* 85:107867. doi: 10.1016/j.frl.2025.107867
- Hu, Y., Liu, J., Zhang, S., Liu, Y., Xu, H., and Liu, P. (2024). New mechanisms for increasing agricultural total factor productivity: analysis of the regional effects of the digital economy. *Econ. Anal. Policy* 83, 766–785. doi: 10.1016/j.eap.2024.07.017
- Leong, C. M. L., Pan, S. L., Ractham, P., and Kaewkitipong, L. (2015). ICT-enabled community empowerment in crisis response: social media in Thailand flooding 2011. *J. Assoc. Inf. Syst.* 16:1. doi: 10.17705/1jais.00390
- Li, H., Xie, S., and Su, M. (2024b). Does digital technology innovation promote low-carbon development in agriculture? A spatial econometric analysis based on 31 provinces in China. *Environ. Sci. Pollut. Res.* 31, 4478–4499. doi: 10.1007/s11356-023-31369-9
- Li, H., Yu, Y., Liu, F., and Zhou, B. (2025). Multi-path adjustment in digital transformation and enhancement of enterprise competitiveness. *J. Innov. Knowl.* 10:100735. doi: 10.1016/j.jik.2025.100735
- Li, F., Zang, D., Chandio, A. A., Yuan, D., and Jiang, Y. (2023). Farmers' adoption of digital technology and agricultural entrepreneurial willingness: evidence from China. *Technol. Soc.* 73:102253. doi: 10.1016/j.techsoc.2023.102253
- Liu, M., Huang, X., Wang, P., and Liao, Y. (2025a). Enterprise digitalization, organizational slack, and green innovation. *Int. Rev. Econ. Finance* 103:104443. doi: 10.1016/j.iref.2025.104443
- Liu, Y., Liu, Q., and Wei, Y. (2025b). Digital finance, internal control, and audit quality. *Financ. Res. Lett.* 76:107033. doi: 10.1016/j.frl.2025.107033
- Liu, Y., Zhang, X., and Shen, Y. (2024). Technology-driven carbon reduction: analyzing the impact of digital technology on China's carbon emission and its mechanism. *Technol. Forecast. Soc. Change* 200:123124. doi: 10.1016/j.techfore.2023.123124
- Lu, Z., Gou, D., Wu, Q., and Feng, H. (2025b). Does the rural digital economy promote shared prosperity among farmers? Evidence from China. *Front. Sustain. Food Syst.* 9:1649753. doi: 10.3389/fsufs.2025.1649753
- Lu, Z., Xu, M., Shi, L., and Lei, T. (2025a). The criticality of environmental sustainability in agriculture: the decarbonization role of green finance in China. *J. Environ. Manag.* 394:127470. doi: 10.1016/j.jenvman.2025.127470
- Lyu, Z., Jiang, Z., and Yang, X. (2025). Bridging the digital divide for sustainable agriculture: how digital adoption strengthens farmer livelihood resilience. *Front. Sustain. Food Syst.* 9:1628588. doi: 10.3389/fsufs.2025.1628588
- Meier, A., Eller, R., and Peters, M. (2025). Creating competitiveness in incumbent small- and medium-sized enterprises: a revised perspective on digital transformation. *J. Bus. Res.* 186:115028. doi: 10.1016/j.jbusres.2024.115028
- Mukhopadhyay, S., Terho, H., Singh, R., and Rangarajan, D. (2025). Enhancing B2B sales through digital transformation: insights into effective sales enablement. *Ind. Mark. Manag.* 125, 29–47. doi: 10.1016/j.indmarman.2024.12.009
- N'Dri, A. B., and Su, Z. (2024). Successful configurations of technology–organization–environment factors in digital transformation: evidence from exporting small and medium-sized enterprises in the manufacturing industry. *Inf. Manag.* 61:104030. doi: 10.1016/j.im.2024.104030
- Papadopoulos, G., Arduini, S., Uyar, H., Psiroukis, V., Kasimati, A., and Fountas, S. (2024). Economic and environmental benefits of digital agricultural technologies in crop production: a review. *Smart Agricultural Technology* 8:100441. doi: 10.1016/j.atech.2024.100441
- Peng, Y., and Jin, H. (2025). Effects of information and technology application in audits and digital economy on enterprise risk management level. *Financ. Res. Lett.* 73:106593. doi: 10.1016/j.frl.2024.106593
- Peng, X., Zhang, Y., and Wang, H. (2025). Digital technology, community capacity, and farmers' participation in rural human settlement governance. *Environ. Dev. Sustain.* 22, 1–23. doi: 10.1007/s10668-025-06112-8
- Peterson, N. A., Lowe, J. B., Aquilino, M. L., and Schneider, J. E. (2005). Linking social cohesion and gender to intrapersonal and interactional empowerment: support and new implications for theory. *J. Community Psychol.* 33, 233–244. doi: 10.1002/jcop.20047
- Quan, T., Zhang, H., Quan, T., and Yu, Y. (2024). Unveiling the impact and mechanism of digital technology on agricultural economic resilience. *Chin. J. Popul. Resour. Environ.* 22, 136–145. doi: 10.1016/j.cjpre.2024.06.004
- Rijswijk, K., Klerck, L., Bacco, M., Bartolini, F., Bulten, E., Debruyne, L., et al. (2021). Digital transformation of agriculture and rural areas: a socio-cyber-physical system framework to support responsabilisation. *J. Rural. Stud.* 85, 79–90. doi: 10.1016/j.rurstud.2021.05.003
- Roy, M., and Medhekar, A. (2025). Transforming smart farming for sustainability through Agri-tech innovations: insights from the Australian agricultural landscape. *Farming System* 3:100165. doi: 10.1016/j.farsys.2025.100165
- Sargani, G. R., Wang, B., Leghari, S. J., and Ruan, J. (2025). Is digital transformation the key to agricultural strength? A novel approach to productivity and supply chain resilience. *Smart Agric. Technol.* 10:100838. doi: 10.1016/j.atech.2025.100838
- Schumpeter, J. A. (1990). Theory of economic development. Beijing: The Commercial Press.
- Setiawan, B., Pamungkas, B., Mekaniwati, A., and Kusuma, P. M. (2025). The strategic role of digital transformation, dynamic and agile capabilities for the performance of micro, small, and medium enterprises (MSMEs). *Bottom Line* 38, 130–153. doi: 10.1108/BL-08-2024-0120
- Shaikh, T. A., Rasool, T., and Mir, W. A. (2025). Fields of the future: digital transformation in smart agriculture with large language models and generative AI. *Comput. Stand. Interfaces* 94:104005. doi: 10.1016/j.csi.2025.104005
- Sharma, V., Agrawal, R., and Manupati, V. K. (2024b). Blockchain technology as an enabler for digital trust in supply chain: evolution, issues and opportunities. *Int. J. Syst. Assur. Eng. Manag.* 15, 4183–4209. doi: 10.1007/s13198-024-02471-z
- Sharma, C., Pathak, P., Kumar, A., and Gautam, S. (2024a). Sustainable regenerative agriculture allied with digital Agri-technologies and future perspectives for transforming Indian agriculture. *Environ. Dev. Sustain.* 26, 30409–30444. doi: 10.1007/s10668-024-05231-y
- Shatila, K., Aránega, A. Y., Soga, L. R., and Hernández-Lara, A. B. (2025). Digital literacy, digital accessibility, human capital, and entrepreneurial resilience: a case for dynamic business ecosystems. *J. Innov. Knowl.* 10:100709. doi: 10.1016/j.jik.2025.100709
- Shen, Y. (2024). Future jobs: analyzing the impact of artificial intelligence on employment and its mechanisms. *Econ. Chang. Restruct.* 57:34. doi: 10.1007/s10644-024-09629-6
- Shen, Y., Guo, X., and Zhang, X. (2023). Digital financial inclusion, land transfer, and agricultural green total factor productivity. *Sustainability* 15:6436. doi: 10.3390/su15086436
- Shen, Y., and Zhang, X. (2023). Intelligent manufacturing, green technological innovation and environmental pollution. *J. Innov. Knowl.* 8:100384. doi: 10.1016/j.jik.2023.100384
- Shen, Y., and Zhang, X. (2024a). Cleaner production: analysis of the role and path of green finance in controlling agricultural nonpoint source pollution. *Econ. Open-Access E-Journal* 18:20220118. doi: 10.1515/econ-2022-0118
- Shen, Y., and Zhang, X. (2024b). Towards a low-carbon and beautiful world: assessing the impact of digital technology on the common benefits of pollution reduction and carbon reduction. *Environ. Monit. Assess.* 196:695. doi: 10.1007/s10661-024-12860-3
- Shen, Y., and Zhang, X. (2024c). Finance-driven sustainable development: the impact of green finance on agricultural non-point source pollution and its pathways. *Front. Sustain. Food Syst.* 8:1430670. doi: 10.3389/fsufs.2024.1430670
- Shi, W., and Zhang, Z. (2025). Exploring the role of digital governance: the effect of audit digitalization on firms' internal control weaknesses in China. *Int. J. Account. Inf. Syst.* 56:100756. doi: 10.1016/j.accinf.2025.100756
- Shi, L., Zhao, J., Du, X., Tan, Y., Lei, T., Xu, M., et al. (2025). Achieving sustainable green agriculture: analyze the enabling role of data elements in agricultural carbon reduction. *Front. Earth Sci.* 13:1618999. doi: 10.3389/feart.2025.1618999
- Sun, Y., Miao, Y., Xie, Z., and Wu, R. (2024). Drivers and barriers to digital transformation in agriculture: An evolutionary game analysis based on the experience of China. *Agric. Syst.* 221:104136. doi: 10.1016/j.agsy.2024.104136
- Tan, J., Chang, S., Zheng, Y., and Chan, K. C. (2025). Effects of artificial intelligence in the modern business: client artificial intelligence application and audit quality. *Int. Rev. Financ. Anal.* 104:104271. doi: 10.1016/j.irfa.2025.104271

- Wan, Y., Lu, W., Wang, R., Zhan, M., and Wang, Y. (2025). How does information technology enhance the agricultural resilience: the practice of digital inclusive finance in China. *Front. Sustain. Food Syst.* 9:1695589. doi: 10.3389/fsufs.2025.1695589
- Wang, X., and Li, X. (2025). Low-carbon effects of farmers' digital economy participation: further discussing digital equality. *Front. Sustain. Food Syst.* 9:1576230. doi: 10.3389/fsufs.2025.1576230
- Wang, D., and Nie, H. (2025). Business process digitalization and efficiency of corporate working capital management. *Int. Rev. Econ. Finance* 104:104606. doi: 10.1016/j.iref.2025.104606
- Wang, M., and Zhang, N. (2002). Information technology alters the roadmap to agricultural modernization. *Comput. Electron. Agric.* 36, 91–92. doi: 10.1016/S0168-1699(02)00094-7
- Wang, H., Zhang, L., and An, Z. (2025). Digital transformation in agricultural circulation: enhancing rural modernization and sustainability through technological innovation. *Front. Sustain. Food Syst.* 9:1538024. doi: 10.3389/fsufs.2025.1538024
- Wei, J., and Shen, Y. (2025). Impact and mechanism of digital transformation on performance in manufacturing firms. *Innov. Green Dev.* 4:100205. doi: 10.1016/j.igd.2025.100205
- Wen, X., and Xiao, L. (2025). Digital transformation, customer stability and innovation. *Finance Res. Lett.* 85:107981. doi: 10.1016/j.frl.2025.107981
- Xu, M. (2025). Can the ecological protection red line policy promote food security? Based on the empirical analysis of land protection in China. *Front. Environ. Sci.* 13:1654217. doi: 10.3389/fenvs.2025.1654217
- Xu, M., Shi, L., Zhao, J., Zhang, Y., Lei, T., and Shen, Y. (2024). Achieving agricultural sustainability: analyzing the impact of digital financial inclusion on agricultural green total factor productivity. *Front. Sustain. Food Syst.* 8:1515207. doi: 10.3389/fsufs.2024.1515207
- Xu, M., Zhao, J., Lei, T., Shi, L., Tan, Y., He, L., et al. (2025). The influence mechanism of environmental regulations on food security: the mediating effect of technological innovation. *Environ. Sci. Eur.* 37:83. doi: 10.1186/s12302-025-01137-2
- Yang, C., Ji, X., Cheng, C., Liao, S., Obuobi, B., and Zhang, Y. (2024). Digital economy empowers sustainable agriculture: implications for farmers' adoption of ecological agricultural technologies. *Ecol. Indic.* 159:111723. doi: 10.1016/j.ecolind.2024.111723
- Yuan, Y., Guo, X., and Shen, Y. (2024). Digitalization drives the green transformation of agriculture-related enterprises: a case study of A-share agriculture-related listed companies. *Agriculture* 14:1308. doi: 10.3390/agriculture14081308
- Zheng, Y., Shi, G., Zhong, H., Liu, M. T., and Lin, Z. (2023). Motivating strategic front-line employees for innovative sales in the digital transformation era: the mediating role of salesperson learning. *Technol. Forecast. Soc. Change* 193:122593. doi: 10.1016/j.techfore.2023.122593
- Zhou, P., Yang, S., Xu, X., and Shen, Y. (2022). Calculation of regional agricultural production efficiency and empirical analysis of its influencing factors-based on DEA-CCR model and Tobit model. *J. Comput. Methods Sci. Eng.* 22, 109–122. doi: 10.3233/JCM-215590