

Opportunities and Challenges of Digital Development in Circulation under the Background of Rural Revitalization

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Abstract The rural revitalization strategy aims to prioritize the development of agriculture and rural areas and promote the modernization of agriculture and rural areas. With the continuous advancement of the Fourth Industrial Revolution and breakthroughs in technologies such as artificial intelligence, big data, and blockchain, the traditional circulation industry is undergoing intelligent and digital transformation and upgrade. The digital development of agricultural product circulation will be a significant boost for the implementation of the rural revitalization strategy in the future. However, taking full advantage of the productive capacity of digitalized agricultural product circulation is currently accompanied by both opportunities and challenges. This article first analyzes the current status of digital development in circulation in China, provides a detailed analysis of the advantages and opportunities of digital circulation in the context of rural revitalization, and examines the shortcomings and challenges that may be faced behind these opportunities. Finally, the article proposes relevant policy recommendations to address the existing issues and promote the development of digitalized rural circulation.

Key words Rural Revitalization, Agricultural Product Circulation, Digitalization, Transformation and Upgrade

1 Introduction

Since the beginning of the 21st century, the internet digital information technology has experienced rapid development. Digital technology has gradually penetrated the field of circulation, promoting the overall digital transformation and upgrade of the entire circulation sector. Since the Communist Party of China introduced the rural revitalization strategy at the 19th National Congress of the Communist Party of China, the development of the rural economy and the improvement of rural residents' overall income have become key objectives. The overall internet penetration rate in rural areas and digital infrastructure has significantly improved. The integration of the primary, secondary, and tertiary industries in rural areas continues to deepen, and the scale and modernization of agricultural production have been increasing. This has also driven the growing demand for more efficient product distribution methods among rural residents. In this context, leveraging the digital transformation of the circulation sector has significant strategic importance in promoting rural economic development and increasing the income of farmers, aligning with the goals of the rural revitalization strategy. In this study, we summarized the current status of digital development in circulation in China and the implementation of the rural revitalization strategy. Then, we provide a detailed analysis of the development opportunities and challenges in the digitalization of circulation in the field of agriculture, rural areas, and farmers. Finally, we came up with targeted strategies and rec-

ommendations to provide valuable insights for the better development of rural digital circulation.

2 Essence and current status of digitalization in circulation

2.1 Essence of digitalization in circulation The essence of digitalization in circulation primarily manifests in leveraging the internet, integrating information, precise resource management and matching, accelerating the flow rate of all-round production factors, promoting the convergence and development of various market entities, restructuring the internal business environment using digital technology, and achieving multi-level interactive integration. The continuous development of digitalization in circulation significantly reduces the temporal and spatial barriers between products and information. It extends to various chains, including the industrial chain, supply chain, service chain, credit chain, capital chain, and value chain, further promoting the flexible adaptation of production and consumption. With the support of digital technology, both supply and demand sides can eliminate cognitive constraints on each other, resulting in mutually reinforcing synergy. Zhu Heliang^[1] identified four core characteristics of digitalization in circulation: data becoming a new production factor, precise supply and demand information matching driving business innovation, the industrial internet serving as a catalyst for industrial revitalization, and the combination of blockchain and supply chain as a technological foundation for large-scale industrial collaboration. Jin Jun^[2] suggested that the level of digitalization in a region should be assessed from four perspectives: Internet + logistics, cold chain logistics, offline new retail, and e-commerce. Wu Ting^[3] analyzed digitalization levels in the circulation industry across three dimensions: resource digitalization, service digitalization, and channel digitalization.

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Table 1 Levels of various indicators in the digital development of circulation

Indicators	Year									
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Number of rural postal service points//10 ³ units	36	40	44	63	77	100	100	101	111	115
Rural delivery routes//10 ³ thousand km	3 732	3 745	3 776	3 756	3 768	3 805	4 031	4 199	4 104	4 156
Number of Taobao Villages//1 unit	16	20	212	778	1 311	2 118	3 202	4 310	5 425	7 023
Rural Internet scale//10 ¹² yuan	0.16	0.18	0.18	0.20	0.20	0.21	0.22	0.23	0.31	0.28
Total cold storage capacity//10 ⁶ t	20.33	24.11	28.60	33.92	42	47.75	52.39	60.53	70.8	84.92
Scale of the cold chain logistics market//10 ¹² yuan	730	900	1 500	1 800	2 250	2 550	3 035	3 780	4 850	5 699
Rural e-commerce sales volume//10 ¹² yuan	0.07	0.11	0.23	0.35	0.89	1.24	1.37	1.7	1.79	2.05

2.2 Current status of digitalization in circulation At the current stage, China's rural digitalization in circulation is progressing rapidly. In terms of the infrastructure for digital development, in 2021, the number of postal service points in China reached 412 522, representing an approximately 332% increase compared with the year 2012. In the same year, rural delivery routes extended to 4 155 000 km, showing an 11.4% growth over the past decade. The coverage of rural express delivery points reached 98%, and the number of Taobao Villages across the nation reached 7 023, marking a 29.5% increase year-on-year. Furthermore, in 2021, the scale of rural internet users in China reached 284 million, with a rural internet penetration rate of 59.2%. These statistics indicate that more rural residents have access to digital circulation services, making internet transactions more convenient for rural residents and leading to increased online trading of agricultural products between regions^[4-6].

Cold chain logistics, as an essential component of the digital development of agricultural product circulation, has also achieved notable growth in recent years. By 2021, China's total cold storage capacity reached 84.92 million t, marking a 16% year-on-year increase. The overall construction area exceeded 10 million square meters, with more than 100 000 large cold storage facilities located primarily along the Yangtze Economic Belt. Leveraging cold chain logistics, "new retail" food and fresh produce companies like Hema Fresh and Missfresh have emerged, holding 90% of the market share in China's cold chain logistics market. The market scale of cold chain logistics has consistently grown, with a total of 569.9 billion yuan in 2021 and an annual growth rate exceeding 10%.

The development of digitalization in circulation has driven both online and offline "new retail" models. Online sales primarily rely on major e-commerce platforms such as Taobao, JD.com, and Pinduoduo, while offline retail utilizes comprehensive retail stores, department stores, and supermarkets. In 2021, the total rural e-commerce sales in China reached 2.05 trillion yuan, reflecting an 11.3% increase year-on-year. National agricultural product e-commerce sales reached 422.1 billion yuan, with a 2.8% year-on-year increase. Textiles, daily necessities, and furniture manufacturing contributed significantly, with sales proportions of 29.4%, 18.6%, and 7.8%, respectively. Due to the impact of the pandemic, people's income and consumption levels decreased, leading to a decline in retail sales at department stores nationwide. However, supermarket sales remained stable, with a total of 1.08 trillion yuan in 2021, representing a 3% year-on-year increase, but overall offline retail showed a weakening trend^[7].

3 Advantages and opportunities of digitalization in circulation in the context of rural revitalization

3.1 Quality agricultural products and vast consumer markets The vigorous implementation of the Rural Revitalization strategy in China has furthered the development of the rural economy, promoted the integration of the primary, secondary, and tertiary industries in rural areas, and facilitated the production of distinctive and scaled agricultural products. Industrial revitalization aids rural revitalization. China boasts a significant number of high-quality rural agricultural products that can benefit from digital distribution platforms to expand their sales channels and markets. China possesses abundant labor resources, capable of meeting the labor demands of digital development in circulation. Additionally, the scale of industries can provide stable upstream supply, greatly enhancing the efficiency and profits of the overall circulation system^[8-9].

3.2 Robust e-commerce infrastructure After decades of development, China's e-commerce sector has established a comprehensive ecosystem, including e-commerce platforms, buyers and sellers, logistics providers, payment service providers, digital marketing companies, data analysts, financial institutions, and more, all interconnected and mutually influencing each other. Outstanding e-commerce platforms like Taobao and JD.com have emerged, backed by advanced technology and substantial funding, leading the development of the entire e-commerce industry. A well-established e-commerce system promotes the health of the logistics sector, and intense competition among major e-commerce platforms drives the overall development of the industry. For example, JD.com has built self-owned logistics warehousing bases nationwide, significantly improving product transport efficiency and service quality.

3.3 Emphasis on high-quality talent development and rapid progress in logistics and supply chain technology In recent years, China has placed greater emphasis on cultivating and attracting high-quality talent. Numerous universities are continuously supplying specialized talent to society, making significant breakthroughs in logistics and supply chain technology. The application of technologies like "Internet + Logistics," intelligent logistics, drone delivery, and blockchain technology has significantly expanded the circulation channels for rural agricultural products, further enhancing their distribution speed.

3.4 Widespread digital payments and increased digital awareness China's digital payment market is a global leader, dominated by companies like Tencent and Alibaba, with a market

size 90 times that of the United States. Digital payments have become the mainstream payment method in the Chinese market. Chinese consumers are increasingly accustomed to online shopping and digital payments, making them highly adaptable to digital circulation. For rural areas, digitizing the management and transactions at various points in the agricultural product distribution chain can optimize routes, help achieve the rational allocation of agricultural products, reduce the waste of social resources and transaction costs, enhance the efficiency of agricultural product transactions, and better expand both national and global markets.

3.5 Strong government support The government has introduced numerous policies and increased financial investments to create a favorable environment for the development of digitalization in circulation. In January 2022, the National Development and Reform Commission issued the *14th Five-Year Plan for the Construction of a Modern Circulation System*, stating the need to enhance the network of commodity trading markets, accelerate the construction of digital and intelligent facilities such as 5G networks and smart terminals, and foster a group of commodity market demonstration bases characterized by strong supply chain services and seamless online-offline integration, all to promote the digitalization of agricultural product production and circulation. The development of digitalized agricultural product circulation in rural areas can lead to various derivative industries such as rural e-commerce training and consulting, and digital financial services for rural areas, creating more employment opportunities, further increasing rural income, and promoting rural economic prosperity.

4 Deficiencies and challenges in the digital development of circulation in the context of rural revitalization

4.1 No standard links in the logistics of agricultural products Rural agricultural product production comes from individual farmers, and the quality of products is uneven. In the process of later product processing, storage, and transportation, the overall industry chain is complex, resources are dispersed, and it is difficult to maintain a unified standard for the quality of agricultural products. In addition, many transport personnel such as truck drivers are individual practitioners, and there is a high degree of personnel mobility, lacking uniform standardized management. Loss and waste of agricultural products are prone to occur during storage and transportation. In terms of logistics technology, technologies such as GPS, big data, and cloud computing still have many application spaces, and the technology for cold chain storage and transportation needs to be improved^[10]. While emphasizing transportation speed and cost, it is also necessary to consider different geographical and transportation conditions in different regions, rationally plan logistics routes, and achieve precise temperature control and continuous freshness from production to transportation.

4.2 Supporting financial services facilities need improvement

To comprehensively promote the digitalization of rural industries, comprehensive financial service facilities (such as rural credit cooperatives, financial insurance companies, internet financial platforms, and technology companies, *etc.*) are needed as

support. They can provide loans and financing services to farmers, help provide funds for the digital transformation of agricultural product circulation platforms and agricultural enterprises in procurement, warehousing, and logistics. At the same time, financial service institutions provide risk management tools such as insurance and financial derivatives to reduce uncertainty and risks in digital circulation. However, due to the lag in the development of rural financial service facilities in China compared with the needs of production and consumption, there are still many deficiencies in achieving the functionality and universality of financial service facilities.

4.3 Development of digital circulation in rural areas started late and is unbalanced and needs phased support

(i) Compared with large enterprises, rural agricultural product production enterprises in China have insufficient capital investment and are not mature enough in terms of digital technology, making their product competitiveness weaker. There is a wide gap in the development of digital circulation between regions, with eastern regions such as Zhejiang and Jiangsu leading by a large margin compared to central and western regions. (ii) With the advancement of urbanization, a large number of rural labor force migrates to cities, making it more difficult to attract labor, especially professional and high-quality talent, to return to rural areas due to the gap in education, healthcare, catering, and entertainment facilities between urban and rural areas. This restricts the scale of industrial production and hinders the development of digital circulation in rural areas. There is fierce market competition in the digital circulation field, and some rural enterprises may find it difficult to compete with large e-commerce platforms. Without external intervention, the development of rural digital circulation in China is prone to the "Matthew effect," which affects the overall circulation industry chain from the supply side.

4.4 Farmers are in a disadvantaged position in the digital circulation industry chain, and their own rights are difficult to protect

Firstly, farmers tend to lag behind when it comes to accessing digital technology and information compared to wholesalers and retailers. For most farmers, their digital empowerment often focuses on the production of agricultural products. However, after agricultural products go through vertical multi-level and horizontal multi-channel circulation, the final transaction value is often far removed from the income received by the farmers. The digitization of circulation makes agricultural product quality and prices more transparent, and consumers have more choices in the online market. To enhance the competitiveness of their products, many farmers are compelled to further compress production costs and profit margins. With the support of digital and intelligent production, many agricultural products have seen rapid price increases, but the growth of farmers' income is slower, leading to increased life pressures. This does not favor the enthusiasm of rural residents for the digitization of agricultural product circulation.

5 Policy recommendations

5.1 Enhancing the development of the digital system and infrastructure for agricultural product circulation (i) It is rec-

ommended to strengthen control over the circulation of agricultural products, standardize management in product processing, storage, and transportation, and enhance the selection and training of personnel involved in the logistics process, cooperative wholesalers, distributors, and retailers to create a conducive business environment for the digital development of agricultural product circulation. (ii) By introducing more advanced equipment and technologies (such as cold chain storage and transportation), update the infrastructure for digital circulation, reduce resource loss during agricultural product circulation, and lower production costs. It is necessary to establish an integrated big data control center to promote the digital transformation of agricultural production. (iii) It is recommended to develop the deep integration of digital technologies such as 5G, blockchain, cloud computing, artificial intelligence in the field of circulation, allowing traditional circulation industries to better meet market consumer demands. Strengthening the development of digital infrastructure in rural areas also helps promote the spread of digital skills in rural areas, bridging the "digital divide" between urban and rural areas, aligning with the development trends of the internet age, and facilitating long-term regional economic coordination and development.

5.2 Improving rural financial service facilities and institutions to provide financial support for the development of digital circulation in rural areas On the one hand, enhance various financial service businesses of institutions, broaden channels for rural residents' financial management and fund acquisition. It is recommended to build an intelligent digital information sharing platform to increase the depth and breadth of rural financial service coverage while making it easier for rural residents to access financial information. On the other hand, we should encourage city and county-level state-owned enterprises to invest in rural banks through methods like paid-in capital, thereby strengthening the capital reserves of rural banks. Additionally, it is possible to strengthen "supporting agriculture and small businesses" loans from rural banks. In addition to existing policy financing guarantees and other assistance policies, further increase the central bank's interest rate subsidy policy, effectively easing the lending pressure on local banks, and enhancing the responsiveness of local financial institutions to "supporting agriculture and small businesses." This allows farmers to have more funds for expanding the scale of digital agricultural product circulation, driving the development of digital circulation in rural areas to "expand capacity, improve quality, and increase efficiency."

5.3 Strengthening government support for the development of digital circulation in rural areas It is necessary to continue to introduce relevant support policies, actively attract foreign investment, and create a relatively stable environment for its development in the early stages. Besides, we should emphasize the coordinated development of digital circulation between regions, increase investment in the construction of digital logistics infrastructure in central and western regions, especially in remote rural areas, reduce the gap in digital levels between urban and rural areas, break the dual flow of factors in traditional agricultural product circulation, and facilitate agricultural products entering cities more quickly, effectively increasing the overall scale and operational ef-

ficiency of the agricultural product circulation industry, significantly reducing operational costs, and achieving the modernization upgrade of agricultural product circulation. In addition, it is necessary to gradually improve rural medical, educational, catering, accommodation, and various entertainment facilities, promote the return of local labor to rural areas, assist with talent introduction policies, drive the construction of a professional talent team for the development of digital rural circulation, and teach digital knowledge and professional skills to rural residents through professional talents, improving the comprehensive literacy of digital construction in rural circulation, and better expanding the overall scale of digital rural circulation construction.

5.4 Transforming the participation forms of rural residents in the industry chain to protect the income of farmers in the process of digital agricultural product circulation from the source

The fundamental reason for the low income of farmers from agricultural products lies in the fact that most farmers only engage in the production and initial transactions of products, and subsequent value addition of products is not connected to them. Therefore, innovative forms of participation and profit for farmers in the industry chain can be introduced, such as through methods like contract farming, profit-sharing through stock ownership, trustee services, *etc.*, to integrate small-scale farmers into the entire agricultural industry chain. It is also possible to leverage e-commerce platforms to facilitate farmers conducting "live-streamed product sales," reducing intermediary links and shortening the cost of product circulation. The role of farmers' cooperatives and industry associations can be effectively utilized to enhance the business environment of agricultural product circulation, promote the scaling and intensification of circulation at the farmer level, and leverage industrial internet to drive the integration of production and circulation entities into the rapid development trend of agricultural product e-commerce.

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bei Province and well-known trademarks in China.

5.6 Opening up the whole chain of intellectual property rights and improving the level of intellectual property protection Hubei Province should strengthen the protection of intellectual property rights of cultural heritage, scientific and technological innovation and brand labeling in the whole industrial chain of herbaceous edible oil crops in the province. In addition, it is recommended to promote the level of the whole chain of intellectual property creation, application, protection, management and service, and take agricultural intellectual property rights as the guide of geographical indication industry, rapeseed and cotton national important agricultural product production protection zones, rapeseed national superior characteristic industrial clusters in Jiangnan Plain, Hubei Province, and provincial double-low high-quality rapeseed protection zones, to promote the high-quality development of the whole industry of herbaceous edible oil crops.

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