

Research on digital economy empowering agricultural development

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Abstract. The application of the digital economy in the agricultural sector is rapidly changing traditional agriculture and injecting new impetus into rural revitalization and digital rural strategies. The digital economy plays an important role in the production and sales of agriculture. This article explores the application of digital economy in agricultural production, agricultural product circulation and marketing, and analyzes its four enabling roles in agricultural development: improving production efficiency, reducing production risks, promoting industrial chain upgrading and promoting green development. At the same time, the study pointed out that there are deficiencies in rural areas in digital infrastructure, data resource integration and professional talents, which restrict the further development of digital agriculture. To address these problems, policy recommendations are put forward to strengthen digital infrastructure construction, promote the sharing of agricultural data resources, and cultivate digital agricultural talents, aiming to provide support for agricultural digital transformation and rural revitalization.

Keywords: Digital economy, rural revitalization, smart agriculture, digital infrastructure.

1. Introduction

Agricultural digital production, driven by technology, shows significant features of intelligent upgrading, promotes the revitalization of rural industries, provides important support for the structural elements of the digital rural strategy, and has a profound impact on traditional agriculture. By transforming from traditional small farmers to digital small farmers, the development direction of smart agriculture has been repositioned. However, although the digital economy has injected strong momentum into agricultural development, the advancement of agricultural digitalization still faces many challenges. Problems such as the general lack of high-tech talent in rural areas, slow agricultural technology transformation, and insufficient supply of basic factors have restricted the comprehensive application of the digital economy in agriculture. Existing research shows that digital tools are profoundly changing agricultural production and marketing models by improving agricultural production efficiency, reducing risks, promoting industrial chain upgrading and promoting green and low-carbon development, especially in the application of agricultural product circulation and precision agriculture. However, the lag in rural digital infrastructure construction remains one of the key factors hindering the further development of smart agriculture. Some scholars pointed out that smart agriculture can improve the efficiency of agricultural resource allocation through data sharing and information technology, which not only helps to optimize the production process, but also improves agricultural production and management models and promotes the comprehensive revitalization of rural areas. However, the practical application of digital agriculture is still constrained by insufficient infrastructure, poor data integration and a shortage of high-quality talent resources. Therefore, in order to accelerate the construction of digital villages and promote high-quality agricultural development, it is urgent to take a number of measures at the policy level. First, the digital infrastructure in rural areas should be improved to enhance the accessibility and popularity of information technology in agricultural production; second, a sound agricultural database must be established to realize the integration and sharing of agricultural data and provide data support for precision agriculture and smart agriculture; third, the training of digital talents should be strengthened, and high-tech talents should be encouraged to enter the agricultural field to provide intellectual support for agricultural modernization; finally, agricultural demonstration zones should be built to

promote digital ecological agricultural models, so as to help agricultural transformation and upgrading with intelligent production methods and business models. Through these measures, the potential of the digital economy to empower agricultural development will be more fully unleashed, providing solid guarantees for achieving high-quality agricultural development, rural industrial revitalization and common prosperity goals.

2. Application of Digital Economy in Agriculture

2.1. Agricultural Production

The rapid development of the digital economy has led to the advancement of smart agriculture, which is an important application of digital technology in agricultural production. In rural China, the government should cooperate with agricultural enterprises, scientific researchers, etc. The government encourages the application of various technologies such as precision seeding, intelligent disaster warning, drones, GPS, Beidou satellite navigation in smart agriculture from a policy level, and covers multiple links of the agricultural industry, thus achieving good governance results. Agricultural enterprises and scientific researchers provide farmers with corresponding production materials and scientific research support to help farmers carry out precise operations such as intelligent pesticide application, intelligent irrigation, and intelligent agricultural machinery driving, thereby improving farmers' work efficiency and agricultural production profits [1].

2.2. Agricultural Product Circulation and Marketing

The development of the digital economy has led to the increasing prevalence of virtual platform transactions. For the development of rural characteristic industries, this can more directly connect with market demand entities, achieve remote product sales with the help of developed logistics networks, and then expand the scale and radius of self-sales. Specifically, in China's online environment, with the help of online applications such as JD and Taobao, agricultural products with local characteristics have broken through geographical limitations and begun to be sold to the whole society. The current widespread online live streaming has enabled the widespread publicity of the advantages and characteristics of specialty agricultural products. That is, in transactions on digital platforms, society's tolerance for products increases and the sales process becomes more open, thereby enhancing the exchange of in-depth information between the two parties. This can help agricultural product production and innovation keep up with changes in social demand and fully connect with the market [2]. Therefore, the development of the digital economy has gradually improved China's online platform, making the circulation and marketing of agricultural products more convenient and efficient.

3. The enabling role of digital economy in agricultural development

With the continuous improvement of today's information facilities, digital technology is spreading rapidly into the agricultural sector, releasing the diffusion effect, spillover effect and inclusive benefit of the digital economy, promoting the increase in farmers' entrepreneurship probability, farmers' income growth, agricultural production, system optimization, agricultural quality and efficiency, and competitiveness [3].

3.1. Improve Agricultural Production Efficiency

The application of digital technology has significantly improved agricultural production efficiency. Digital technology enables improved production efficiency. In traditional agricultural forms, subjective experience-based decisions are blind and often lead to inefficient and erroneous decisions and large production fluctuations. The integration of artificial intelligence, big data, and cloud computing technologies can enable agricultural production to shift from an experience-based model

to a data-supported model. By automatically collecting and processing agricultural data, it can provide producers with all-dimensional feasible decisions [4].

3.2. Reduce Agricultural Production Risks

Traditional agricultural production is easily affected by external risks and involves many uncertainties. Digital technology has great advantages in controlling natural disaster risks. Li and Li pointed out that agricultural dynamic monitoring and natural risk early warning and prevention mechanisms based on remote sensing and big data technology can analyze and predict climate and environmental changes in advance and provide digital prevention and control for major natural risks in advance, thus ensuring that production losses are minimized [5].

3.3. Promote the Upgrading of Agricultural Industry Chain

Digital technology has promoted the overall upgrading of the agricultural industry chain. The implementation of the rural revitalization strategy emphasizes further stimulating the vitality and momentum of the rural market, aiming to guide and inspire farmers to no longer be limited to traditional agricultural planting, but to more actively and exploratorily realize the expansion of the industrial chain [6]. Research by Xia et al. shows that the "Internet + Agriculture" model has significantly improved the market competitiveness of farmers. Farmers can take advantage of the online market brought about by the development of the digital economy and use software and live streaming to target national and even global markets to achieve real-time sales of local specialty agricultural products [5].

3.4. Promoting Green and Low-carbon Development of Agriculture

Traditional agriculture relies on chemical fertilizers and pesticides, leading to negative consequences such as environmental pollution and resource degradation, while modern agriculture based on digital technology provides a feasible path for green and low-carbon production. By fully integrating technical and physical systems, we can develop eco-friendly agriculture by reducing fertilizer use and carbon emissions while ensuring the balance of agricultural production factor inputs. For example, the comprehensive monitoring system for air, soil and agricultural non-point source pollution established based on big data can accurately trace the source of pollution in real time, issue environmental warnings in a timely manner, and provide effective decision-making support for green production models such as agricultural carbon sink development and farmland conservation tillage. Fully automated and data-intensive closed production systems, as well as digital traceability and monitoring systems for agricultural production materials, can curb the abuse of pesticides and fertilizers based on standardized specifications, promote the recycling of water and nutrients, and thus ensure green and energy-saving agricultural production [5-7].

4. Factors Limiting the Development of Digital Agriculture

4.1. Rural Digital Infrastructure Construction Lags Behind

With the continuous progress of social economy, digital agriculture is also developing continuously. As of June 2024, the number of Internet users in China has reached nearly 1.1 billion, and the Internet penetration rate is 78.0%. Among them, the number of rural Internet users remains at around 300 million. There is a large gap in digitalization between urban and rural areas. Digital supporting facilities and related industries in urban areas are developing rapidly, while the number of Internet users and Internet penetration rate in rural areas are relatively low. Overall, compared with cities, the level of digital construction in rural areas is still relatively weak. Du pointed out that there are two reasons that restrict the development of digital agriculture. First, network facilities are the prerequisite for the digital transformation of agriculture, and the promotion of agricultural product e-commerce sales channels needs to be implemented through network channels. At present, the level

of digital information construction in rural areas seriously hinders agricultural production and sales. Secondly, there is the issue of smooth logistics and transportation. At present, the agricultural product transportation industry is diverse and small in scale, lacks unified and standardized market management and organization, and lacks effective integration of logistics resources, making it difficult to form economies of scale and complementary advantages. The rural logistics market is characterized by disorder. At the same time, the application of modern logistics equipment and technology is relatively rare, and there is a lack of advanced logistics management models and technical means in warehousing, transportation, informatization and other links, which limits the efficient operation of rural logistics [8,9].

4.2. Insufficient Integration of Agricultural Data Resources

Current agricultural data is scattered and poorly standardized, and digital agricultural services do not match farmers' actual needs, resulting in limited applications of big data analysis and low service quality and efficiency. Unstable rural networks and lack of agricultural resources have seriously restricted the application of the Internet of Things. Extreme weather is more likely to cause intelligent monitoring equipment to malfunction, increasing the difficulty of inspection and maintenance. Another point is that although technologies such as computers, the Internet of Things, and digital smart agriculture have made certain progress, there are still challenges of uneven development in the application process. In order to promote the comprehensive development of these technologies, it is necessary to increase investment, strengthen technological research and development, optimize resource allocation, and strengthen talent training and the promotion and popularization of smart agriculture [8].

4.3. There is a Lack of Professional Talent Resources in the Field of Digital Agriculture

According to the latest population census and agricultural census data, my country's rural areas are facing a severe talent shortage, which poses a challenge to the development of digital agriculture. The accelerated urbanization process has led to a large number of rural people migrating to cities, and the proportion of rural population has dropped to 36.11%. At the same time, the aging level in rural areas is much higher than that in urban areas, with the proportion of people aged 60 and above reaching 23.81%. More seriously, the education level of rural labor is generally low, with only 1.2% of agricultural production and management personnel having college degree or above. This imbalance in population structure and talent structure makes it difficult for rural areas to meet the growing demand for high-quality professional talents in the development of digital agriculture and has become an important factor restricting the development of modern agriculture [8].

5. Policy Recommendations for Promoting Digital Economy to Empower Agricultural Development

To achieve high-quality development from traditional agriculture to digital agriculture and smart agriculture, we must change our concepts, promote the deep integration of mechanized planting and information technology, and continuously improve agricultural production efficiency. On the one hand, satellite remote sensing, geographic information systems and other technologies can be used to achieve intelligent planting. At the same time, big data technology is used to predict the supply and demand of agricultural products, weather changes, and prevent natural disasters. On the other hand, we should build an integrated development model of "Internet + Agriculture + Rural Tourism", rely on local resource characteristics, promote through the Internet, and promote the deep integration of characteristic agriculture and tourism.

5.1. Strengthening Digital Infrastructure Construction

The government should increase investment in rural digital infrastructure. The development of digital agriculture needs to rely on big data information and make precise arrangements for network

coverage, number of Internet users, agricultural product production status and sales data [9]. Du proposed three solutions. First, improve the rural big data information sharing platform to realize the real-time release and update of agricultural product quality information, and make digital information controllable and visible throughout the entire production and consumption chain. Secondly, through the rural revitalization strategy, a digital agricultural development model with urban-rural integration and industrial integration will be established to enhance the application of rural digital information and promote the transformation and upgrading of the agricultural economy. Finally, improve the quality of network equipment and operation in rural areas, solve the problem of weak information infrastructure in economically backward areas, improve network quality through cooperation or increased investment, and achieve common prosperity and overall development.

5.2. Promote the Integration and Sharing of Agricultural Data Resources

Promoting the integration and sharing of agricultural data resources and establishing a digital agricultural database are key measures for the high-quality development of modern agriculture. By establishing a unified data platform and standards, formulating a reasonable database architecture, collecting high-quality data and managing it effectively, we can provide a solid foundation for agricultural production and management. This database is not only an important way to obtain agricultural productivity, but also a driving force for rapid and sustainable development of the rural economy. It deeply integrates technologies such as big data, artificial intelligence, monitoring and remote sensing to optimize agricultural production and business matching and reshape the agricultural development model. At the same time, the database provides a reliable basis for agricultural scientific production, covering information on the entire process from breeding to consumption, and supporting scientific decision-making. By integrating and applying these data, new digital agricultural technologies can help traditional agriculture upgrade and transform, achieve sustainable and efficient agricultural development, and lay a solid foundation for modern agriculture [9].

5.3. Digital Agricultural Talent Training: Multiple Approaches to Help Rural Revitalization

Building a digital agricultural talent team requires innovative training models and optimized talent structure. First of all, we should break the traditional training methods and establish a flexible and diverse education system, combining online courses, distance education, simulation and practical teaching and other forms to provide personalized learning paths for agricultural talents. At the same time, we will strengthen cooperation between industry, academia and research to form a closely integrated talent training model. Secondly, we focus on the hierarchical and professional development of talent training and formulate differentiated training plans for different links in the agricultural industry chain. For grassroots practitioners, the focus is on training digital technology application skills, while for outstanding talents, the focus is on cultivating innovation capabilities and leadership. Through this tiered training approach, we can build a talent team with a reasonable structure and complementary capabilities, use digital technology as an engine, continuously improve the quality of talents, and provide a solid talent guarantee for the high-quality development of digital agriculture [10].

6. Conclusion

Digital technology is not only an important tool to drive agricultural development, but also a key stage in comprehensively promoting the rural revitalization strategy. With its advantages in big data information, integration, and technological intelligence, the digital economy has shown great potential in leading economic development and plays a key role in promoting the modernization, transformation, and upgrading of agriculture and rural areas as well as high-quality development. It breaks the information barriers in the process of rural revitalization, improves the development level in all aspects, and reduces the risks and uncertainties of traditional agricultural planting. Therefore, it is crucial to utilize the technological forms of the digital economy to improve the level of the

agricultural industry, reshape the modern agricultural system, and achieve the transformation to smart agriculture.

However, although China's digital agriculture development has achieved certain results, there is still a gap compared with developed countries and it faces many challenges. In the future, the government, enterprises and farmers need to work together to promote the in-depth application of digital technology in the agricultural field and promote the digital transformation and high-quality development of agriculture. This is not only the general trend, but also an important way to achieve agricultural modernization and rural revitalization. Through the deep integration of the digital economy and agriculture, we hope to reshape the modern agricultural system, realize the transformation from the traditional model to a modern, information-based smart agricultural form, and provide an important driving force for national innovation and development.

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