

# Research on the Development Path of Digital Enabled Smart Agriculture in Heilongjiang Province

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**Abstract:** The development of smart agriculture requires the support of digital technology, digital talents, and digital capabilities. Currently, digitalization is developing rapidly in all occupations, and digital technology is rapidly spreading in rural areas of China. As a branch of the digital economy, digital agriculture has promoted the increase of farmers' production and income, as well as the transformation of lifestyle and life philosophy. In terms of developing smart agriculture, Heilongjiang Province has unique natural advantages and agricultural foundation advantages, and will face greater opportunities under the empowerment of digitalization. This article proposes countermeasures to accelerate the integration of agricultural data, accelerate the standardization of agricultural data, accelerate the intelligence of agricultural data, and accelerate the chain of agricultural data to promote the development of smart agriculture in Heilongjiang Province.

**Keywords:** Smart Agriculture; Digitalization; Heilongjiang Province; Data Integration

## 1. Introduction

In China, the digital economy is accelerating its integration with the real economy, becoming an important driving force for deepening the structural reform of the agricultural supply side, promoting innovation-driven development strategies, and promoting high-quality economic development. Against the backdrop of the rapid development of the digital economy, "digital agriculture" has emerged. The development of smart agriculture is a process of upgrading agricultural technology, which will give wings to rural modernization and boost rural

revitalization to a new level [1]. Under the new development pattern of domestic and international dual circulation, rural areas are increasingly becoming the growth pole of China's economic internal circulation and the emerging force of consumption growth. The current period and the "14th Five-Year Plan" period are important strategic opportunities for promoting the digitalization of agriculture and rural areas. We should accelerate the application of digital technology, vigorously enhance digital productivity, seize the commanding heights of digital agriculture and rural areas, promote high-quality agricultural development, and enable large farmers to share the dividends of the development of the digital economy. A series of important documents and speeches in the post-poverty alleviation era have closely integrated the development of "rural revitalization" and "digital agriculture", indicating that "digital agriculture" has become a new path for effectively linking the consolidation and expansion of poverty alleviation results with rural revitalization, which is of great significance for promoting the modernization and transformation of rural information development [2].

## 2. The Current Situation of the Development of Smart Agriculture in Heilongjiang Province under the Background of Digitalization

### 2.1 Development Areas of Smart Agriculture

The "Report on the Analysis of the Digital Economy Situation in China in the First Half of 2022" shows that although the added value of many industries in the digital economy in Heilongjiang Province increased in the first half of 2022, both in terms of the scale of the digital economy and the contribution of the digital economy to the economy, Heilongjiang Province ranked lower than developed

provinces. From the perspective of digital infrastructure level, the mobile phone penetration rate in Heilongjiang Province in 2021 was 120.3%, which was in the middle and upper level of the country, but the number of domain names was only 4.44% of that in Beijing. From the perspective of digital industry application, the turnover of technology market in Heilongjiang Province accounted for 2.20% of GDP in 2021, which was not even 1/7 of that in Beijing. In 2021, the software business income accounted for less than 1/2 of the national software business income [3]. From the perspective of the scale of the digital economy, the number of enterprises with e-commerce activities in Heilongjiang Province was only 0.55% of the national level, and the proportion of the digital economy in Heilongjiang Province to the GDP was only about 30%. Both indicators did not reach the national average.

## **2.2 Smart Agricultural Infrastructure**

Heilongjiang Province is actively responding to the call for the development of the digital economy and striving to achieve the integration of the digital economy and modern agricultural industry. Currently, Heilongjiang Province has built 226 high-standard industrial bases for digital agriculture, and the provincial agricultural Internet of Things has been connected to 13 major agricultural production areas in the province. In terms of agricultural engineering, the comprehensive agricultural mechanization rate has reached 96.8%, ranking among the top in the country. In 2021, the grain output reached 157.35 billion catties, a record high, accounting for 1/9 of the total grain output in the country. According to the statistics of autumn grain in 2022, the province has harvested 10.208 million mu of land, and the harvest area of grain crops is 7.125 million mu, which indicates a good harvest this year. In terms of the development of new agricultural business entities, there are 156,700 agricultural cooperatives, leading enterprises, and family farms in the province, and the intensive operation and moderate scale operation area of land has reached 147 million mu [4].

## **2.3 Overview of Digital Technology Applications in Smart Agriculture**

At present, the agricultural economy in

Heilongjiang Province has achieved remarkable results, and the development of digital agriculture has begun to show results, but the short board is still obvious, and there are still many problems in the transformation and upgrading of agriculture. In terms of infrastructure construction, the hardware facilities of digital technology in Heilongjiang Province have gradually improved. According to the "Heilongjiang Province '14th Five-Year' Digital Economic Development Plan", the "Broadband Longjiang" strategy has been deeply implemented, and the "All-Optical Network Province" has been basically established. Harbin has also become a national Internet backbone direct connection point. By the end of 2020, 18,900 5G base stations had been built, and the number of standard racks in data centers reached 42,900. The data resource system has been initially established, forming a data resource library in the fields of education, science and technology, industry, taxation, geographic information, cultural tourism, etc. Therefore, in recent years, for people living in rural areas, digital technology has become more and more convenient and cheaper, laying a good hardware foundation for the development of digital economy in Longjiang.

## **3. Problems in the Development of Smart Agriculture in Heilongjiang Province**

### **3.1 The Information and Data Resource Sharing Mechanism is not Sound**

At present, although Heilongjiang Province has accumulated a certain amount of agricultural big data, due to the widespread data barriers among government departments, scientific research institutions, enterprises, and among the three, as well as the lagging development of laws and regulations, the lack of public platforms and sharing channels, and other factors, agricultural data are mostly scattered in different departments and fields, resulting in a large number of government data problems of "unwilling to disclose, dare not disclose, cannot disclose, will not disclose", causing information islands of data departments, making it difficult to share agricultural big data resources in the era of big data.

### **3.2 Insufficient Access to Data on the Entire**

### **Agricultural Industry Chain**

The lack of uniform data acquisition standards has resulted in poor data usability. In the past, data acquisition, storage, processing, and application were all in an inefficient and disorganized state. Some research institutions have not established a data acquisition standard system internally, and different researchers cannot fully agree on the understanding of data, resulting in frequent problems such as data statistical deviation and deviation between system development and actual needs in their work. In addition, the inconsistency of data acquisition standards between units also easily leads to difficulties in data integration and application between different systems.

### **3.3 Lack of Data and Intelligence in the Research and Development of Key Technologies**

Although Heilongjiang Province has developed digital agriculture and stored a certain amount of data, it has not achieved fine management for most of the "small data" or "limited samples". Although it is not lagging behind in big data applications, it is far behind in underlying technology compared to foreign countries. Many technologies, such as key technologies in the fields of massive data storage, data cleaning, data analysis and mining, and data visualization, are derived from large foreign companies, and it is impossible to break through the technological barriers, especially in terms of process sorting, indicator monitoring, problem diagnosis, and effect evaluation. It is impossible to maximize the role of data-driven decision-making.

### **3.4 The Integration Degree of Agricultural Information Data Needs to be Improved**

Smart agriculture, supported by big data, Internet of Things, artificial intelligence, remote sensing and other technologies, in the agricultural production, management, transportation and sales processes, agricultural data information is controlled by different departments, and the operations between departments are independent of each other, unable to integrate digital, computational, spatial and other disciplines with traditional agricultural science, meteorological environment, business management and other

information data, resulting in a waste of information data resources.

### **3.5 Low Level and Small Scope of Application of Information Technology**

To achieve the professionalization and digitalization of agricultural production, management and service in Heilongjiang Province, it is inseparable from the corresponding intelligent equipment, systems, software and supporting services. However, it is currently facing the problems of lagging research and development of key core technologies, high cost of information equipment and services, and weak ability to solve practical problems. For example, there is no dedicated smart chip and growth model for the research and development of plant sensors for animals and plants. The efficiency of agricultural Internet of Things products such as plant protection drones is 40-60 times that of manual operation, but the purchase unit price is beyond the affordability of most farmers, making it difficult to improve the informatization and mechanization of agriculture on a large scale. The integration of technologies such as global positioning system and remote sensing communication system is low, and the operability is poor, which has certain barriers to entering the agricultural market. Agricultural digitalization also lacks new technologies for deep processing of agricultural products. At present, most of them are still based on the sale of raw materials and primary processing, with low technical level and low added value, and lack of competitiveness in the market.

## **4. Development Path of Smart Agriculture under the Background of Digitalization in Heilongjiang Province**

### **4.1 Accelerate the Integration of Agricultural Data**

Focusing on the key development areas of agricultural supply-side structural reform and high-quality agricultural development, we should adhere to the principles of demand-oriented, problem-oriented, application-oriented, systematic, holistic, and collaborative, firmly establish the concept of "public data, shared appreciation", break down the data barriers between departments, and effectively build an integrated agricultural

system integration pattern of "sky-ground". We should promote the interconnection and sharing of agricultural digital infrastructure and data resources. We should start to build the agricultural resource big data cloud center in Heilongjiang Province as soon as possible, actively carry out data resource docking and platform development, and effectively build the cloud center into an "agricultural brain" integrating

"perception-analysis-decision-making" [5]. We should achieve a multi-level information acquisition network architecture at the provincial, municipal, county, township, and village levels, promote the construction of a new type of think tank for the development of green economy, provide data support for the policy formulation and regulatory decision-making of all levels of government, and promote the better implementation of the rural revitalization strategy [6].

#### **4.2 Accelerate the Standardization of Agricultural Data**

The agricultural big data standard system is a complex and huge system engineering, which requires the participation of multiple departments and multidisciplinary personnel to form a unified agricultural big data standard system, so as to scientifically and systematically carry out agricultural big data standardization work [7]. It is necessary to establish and improve the "Internet plus" agricultural standard system in Heilongjiang Province, strengthen the overall planning of agricultural informatization standards from data collection, cleaning, analysis, management to sharing and application, carry out the much-needed development of provincial standards and industrial standards for agricultural big data, establish a standard compliance evaluation system, and ensure the comparability between the collection results of various equipment and instruments, compatibility between multi-source data. The integration of multiple data analysis systems, as well as the quality of global agricultural products and the coherence between different production and business processes, support the construction of smart agriculture and greatly improve agricultural production efficiency [8].

#### **4.3 Accelerate the Promotion of Agricultural Data Intelligence**

Promote agricultural information frontier to lead technological breakthroughs, strengthen agricultural industry transformation trend prediction and agricultural monitoring and early warning, build agricultural big data intelligent processing and analysis technology system, strengthen the strategic frontier technology layout of artificial intelligence, crop production simulation, blockchain + agriculture, big data cognitive analysis, etc., integrate the research and development of frontier technology and disruptive technology, and increase the comparative advantage and absolute advantage of agriculture in Heilongjiang Province; strengthen the breakthrough of key common technology, take "data-knowledge-decision-making" as the main line, strengthen the innovation of precise perception and data acquisition technology, carry out the research of data acquisition, input, summary, application and management technology, improve the ability of obtaining and processing original data, and solve the basic problem of "where the data comes from, how to use, and how to manage"; improve the technological innovation of precise control and information service, build a data-enabled agricultural and rural intelligent decision-making and management technology system, accelerate the digital transformation of industry management and service process, and solve the export problem of "how to serve the data" [9].

#### **4.4 Improve Data Management Performance**

Introduce technology enterprises to deploy smart agricultural technologies such as Beidou agricultural machinery automatic navigation driving, drone plant protection, high-end agricultural environmental sensors, and plant and animal growth models in the agricultural production and agricultural product processing and circulation processes [10]. With the mission of "digital empowerment for rural industrial revitalization" and the main means of "focusing on technology empowerment, project incubation, industrial investment attraction, talent introduction and cultivation, and platform support", introduce technology enterprises to accelerate the deployment of smart agriculture. With the main business of empowering digital agriculture, transforming scientific and technological achievements, and

consulting think tanks, we are committed to creating agricultural big data services. Promote the comprehensive digitalization of farmland and the digitalization of production, processing, and circulation. Establish efficient agricultural databases and data sets, mine and analyze natural resource information data such as soil, climate, moisture, plant protection, animal protection, and administrative information data such as agricultural materials, circulation, and governance, to form a standardized, systematic, and shared data foundation, and improve data management capabilities [11].

#### **4.5 Strengthen the Construction of Agricultural Big Data**

The types of agricultural big data in Heilongjiang Province are complex and diverse, with multiple sources, involving information from all aspects of the "three rural issues". Therefore, it is necessary to accelerate the integration of existing data resources, explore the establishment of agricultural production environment monitoring system, agricultural production material monitoring system, agricultural product circulation management system, agricultural product quality and safety and traceability management system, agricultural disaster early warning and emergency management system, which can cover the entire industry chain data collection and management system, and create a "one-map" service and application of agricultural information resources [12]. In order to achieve the sharing and exchange of various information data resources, data integration and analysis decision-making applications, effectively lead the digital transformation of agriculture and the construction of digital villages in Heilongjiang Referred to the principles and methods issued by the Ministry of Agriculture and Rural Affairs, combined the lines and blocks, constructed the agricultural big data collection, analysis, and application cycle system, and built the "line data" of the whole industry chain of key agricultural products. In the preparation stage, the sensor is used to collect soil information in real time for the growers to refer to and choose the planting type. In the planting and cultivation stage, the Internet of Things technology can grasp the temperature, humidity, light, CO<sub>2</sub> and other information in real time, and after analyzing

the information data, a series of intelligent operations will be carried out, such as automatic irrigation, spraying, fertilization, cooling and light supplement. In the growth stage, the Internet of Things technology monitors the environment, nutrients, and pests in real time, combines the information data and expert experience to deal with environmental changes, thereby improving the growth environment, supplementing nutrients, and controlling pests and diseases. In the harvest stage, the harvest information can be calculated more accurately. Based on the agricultural Internet of Things data system, Heilongjiang Province should continue to build systems for intelligent monitoring of rice production environment, information collection, remote video control, product quality traceability, etc.

#### **5. Conclusion**

Science and technology are regarded as the core driving force for the digital transformation of agriculture. The reason why China's agricultural technology level is generally low is also the lagging of key core technologies. Therefore, it is necessary to optimize the innovation environment, increase policy support, funding investment, talent expansion, and property rights protection. At present, big data has gradually penetrated into all aspects of the development of smart agriculture. Accelerating digital development and comprehensively promoting rural revitalization are two major strategies in the 14th Five-Year Plan. Grasping the new advantages of the digital economy and promoting the deep integration of information technology, especially Internet technology, big data technology, Internet of Things technology, and artificial intelligence technology with the development of agriculture and rural areas in Heilongjiang Province is an important path to help rural revitalization. In the context of the digital economy, industrial digitalization and digital industrialization are the direction of future economic development. Agricultural development is transforming from traditional agriculture to modern agriculture, and smart agriculture is not only the key to agricultural modernization transformation, but also the focus of agricultural modernization construction.

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