

Construction and Application Exploration of Smart Agriculture Based on Big Data Technology

Zhongling Li*, Hairui Wang

Liaoning Institute of Science and Engineering, Jinzhou 121000, China

*Corresponding author: Zhongling Li, lizhl_2010@163.com

Copyright: © 2024 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

Abstract: Big data finds extensive application and many fields. It brings new opportunities for the development of agriculture. Using big data technology to promote the development of smart agriculture can greatly improve the effect of agricultural planting, reduce the input of manpower and material resources, and lay a solid foundation for the realization of agricultural modernization. In this regard, this paper briefly analyzes the construction and application of smart agriculture based on big data technology, hoping to provide some valuable insights for readers.

Keywords: Big data technology; Smart agriculture; Construction; Apply

Online publication: June 14, 2024

1. Introduction

Big data technology is widely used in various industries. In terms of the agricultural field, big data technology can be used to build a large agricultural database, improve the degree of agricultural intelligence, help relevant staff understand the current situation and characteristics of agricultural planting, adjust the planting plan according to the data analysis results, predict natural disasters, help farmers understand the market, reduce the manual labor, material and financial resources, improve economic benefits and promote rural economic development. It plays an important role in promoting the implementation of the rural revitalization strategy^[1].

2. Development history of smart agriculture

Smart agriculture utilizes modern technology to optimize and transform traditional agriculture and overcome weather and environmental limitations. Smart agriculture is a new business form formed in the process of agricultural modernization, and it is also an inevitable trend of agricultural development in the era of big data^[2]. Through a variety of science and technology such as sensors and cloud computing, the data collection and information collection of various links of agricultural planting, production, and management are integrated, so as to achieve intelligent control. With the slogan of “Internet+” put forward, smart agriculture with “Internet + agriculture” as the platform has been widely concerned and valued by society. At present, the research on smart agriculture

involves many aspects, such as smart agricultural information service, smart agricultural management, smart agricultural production, etc. With the continuous development and progress of science and technology in our country, smart agriculture has achieved remarkable development and achieved remarkable results.

3. Significance of big data technology in building smart agriculture

(1) Optimizing traditional agricultural production

Smart agriculture based on big data technology offers many advantages compared with traditional agricultural production methods. In the past, agricultural production could be severely impacted by many factors, such as extreme weather, pests and diseases, trade, etc. However, big data technology can collect, analyze, and track data in agricultural production and facilitate management and sales, improving agricultural production. Agricultural production management serves to reduce the impact of pests, diseases, and extreme weather. Data analysis can effectively help farmers control the supply and demand relationship in the market and help safeguard the farmers' interests. Governments at all levels can also leverage big data technology to optimize and adjust the layout of agriculture and effectively enhance the core competitiveness of agricultural products.

(2) Improving the agricultural marketing system

The adoption of big data technology in agriculture allows the integration and analysis of relevant data. In this way, a complete system network can be built, and the purchasing demands and habits of the consumers can be well-understood. This approach effectively connects the sales of agricultural products with agricultural production.

(4) Controlling the planting field

With the improvement of living standards, food safety, ecological protection, diseases, and pests have become pressing issues in society. Crop growth data can be collected using various sensor equipment, and the data can be analyzed to establish agricultural disaster early warning and rescue mechanisms. This approach helps farmers discover problems in time and take relevant measures to minimize the impact of agricultural disasters to ensure a consistent supply of agricultural products. Big data technology can also realize intelligent analysis of the growing environment of crops, to help farmers achieve accurate control of agricultural planting and agricultural management.

4. Practical application of agricultural big data technology in various links of agricultural production

4.1. Application in agricultural production

E-commerce and Internet technology have also been developing rapidly alongside the development of science and technology, and their role in agricultural production has become increasingly prominent^[3]. With Internet technology, farmers began to acquire agricultural knowledge and skills, understand the market situation of different agricultural products, and even choose better seeds and waste e-commerce platforms. However, considering the vast amount of agricultural information on the Internet, some can be questionable, which can mislead farmers. Big data technology enables the collection and analysis of planting area climate, water quality, soil, and market demands. This helps farmers determine the most suitable local crops and the best planting time and sowing quantity^[4]. In addition, it can also analyze the planting experiment data, so as to master the actual vitality of the seeds, improve the emergence rate, and improve the disease resistance and yield of the crops^[5].

In addition, big data technology can also be used to improve the soil. There is a direct relationship between

crop cultivation and soil environment. Therefore, it is very important to improve the soil environment and fertility for crop growth. The soil conditions can be understood and optimal fertilization strategies can be formulated according to the needs of different crops ^[6]. Big data and new media technology can also be used to build an intelligent soil improvement platform. Through this platform, farmers get to be updated on the condition of the soil, set soil parameters and transmit fertilization parameters to the chip of the fertilization machine through the wireless network. This measure realizes intelligent fertilization and improves fertilization efficiency and soil fertility.

4.2. Application in agricultural production

The traditional planting industry requires a lot of manpower and material resources, but in recent years, with the large loss of the rural population, the agricultural population has decreased sharply, which has caused serious obstacles to agricultural development. Big data technology reduces the dependence on manpower and material resources. For example, a reasonable planting plan can be formulated using big data technology before planting vegetables, the growing environment of crops can be monitored and the related information can be relayed to the farmers in real time. Farmers can view the growth data of various crops through mobile devices in time to understand their growth conditions. This approach helps farmers achieve remote irrigation and temperature control, reduce labor consumption, and improve work efficiency ^[7]. However, due to limited knowledge and technology, their efforts often yield suboptimal results, and the indiscriminate use of pesticides can waste both human and financial resources. Leveraging the benefits of big data technology, a platform for real-time monitoring and early warning can be established to track crop growth continuously. This platform can provide timely early warning information to farmers, offer scientifically sound prevention and control measures, and enhance disaster prevention and control capabilities. Additionally, it can monitor weather conditions effectively, enabling farmers to adjust their agricultural activities promptly and mitigate the impact of adverse weather conditions ^[8].

4.3. Post-agricultural production application

Firstly, the quality of agricultural products can be traced to the source. Through the use of big data technology, the entire sales process can be tracked. RFID tags and QR codes are added to related agricultural products to realize effective tracking of the sales process by timely scanning and updating the data of each link. Besides, consumers can access information about agricultural products and assess their quality by scanning a QR code. This technology also enables precise marketing of agricultural products. Market information asymmetry significantly affects agricultural product sales. To address this, a sales database for agricultural products can be established, allowing for comprehensive analysis of relevant agricultural and market data with the support of big data technology. This facilitates an effective connection between agricultural production and the market, helping farmers plan planting and production rationally and achieve resource balance. Additionally, by collecting consumer information through channels like WeChat, Weibo, and e-commerce platforms, a consumer demand model for agricultural products can be developed. This model analyzes consumer preferences to predict market demand, enabling appropriate pricing and packaging based on production conditions, thereby enhancing farmers' economic benefits ^[9].

5. Smart agriculture construction based on big data technology

With the gradual development of smart agriculture, there are still many problems to be solved. To maximize the benefits of big data technology in the construction of smart agriculture, several optimizations and innovative

measures need to be taken.

5.1. Building a big data agricultural service platform

The construction and development of smart agriculture require the collection and integration of a large amount of information and data. In this regard, it is necessary to build an agricultural service platform, strengthen early warning technology, provide timely data analysis and risk early warning services for farmers, and realize agricultural data sharing, so as to enhance the vitality of agricultural development. At the same time, the cultivation and sales of agricultural products also need to be standardized and scientific, focusing on improving the quality of agricultural products and establishing excellent brands, so as to give full play to the brand effect and promote agricultural development ^[10]. At the same time, the relevant government departments can also comprehensively supervise all aspects of agriculture through the agricultural service platform, so as to improve the quality of agricultural products.

5.2. Developing key technologies

In addition to building an agricultural service platform, it is also necessary to strengthen the development of key technologies. The construction and development of smart agriculture is based on science and technology. In recent years, with the continuous development of science and technology, it has provided strong technical support for smart agriculture and injected a stimulant into agricultural modernization. In this regard, it is necessary to strengthen the development of science and technology, combining advanced technologies such as AI technology and cloud computing with agricultural development, provide scientific and technological support for agricultural development, and thus promote the construction and development of smart agriculture ^[11].

5.3. Strengthening the training of professional personnel

Human resources are a crucial foundation and prerequisite for industry development. The loss of rural talent has become a significant factor impacting the construction and progress of smart agriculture. To address this, it is essential to leverage the advantages of discipline construction, develop scientific research projects, and enhance personnel training. This involves optimizing training methods, utilizing school-enterprise cooperation, and integrating industry with education to improve talent proficiency in using big data. Establishing an industrial chain within vocational colleges and integrating agriculture with software engineering and other disciplines can create an effective model for personnel training ^[12].

5.4. Ensuring the security of agricultural production data

To fully utilize big data in smart agriculture, it is essential to safeguard agricultural production data, ensure the secure application of big data in command agriculture, and protect data information. Additionally, the government should play a pivotal role by conducting precise monitoring of agricultural data, establishing a comprehensive database, and promoting data sharing. These efforts will support the comprehensive development of smart agriculture ^[13].

5.5. Improving the agricultural product traceability system

As people's quality of life improves, food safety issues have garnered extensive attention across all sectors of society. There is heightened concern regarding the planting, production, and processing of agricultural products. The agricultural product traceability mechanism can effectively track the whole process of agricultural products from planting to sales, which provides an effective guarantee for food safety. Although the agricultural product traceability system has been initially established and has achieved some success, challenges remain. To address

these, the government must play a guiding role by formulating and improving relevant policies and promoting the comprehensive development of smart agriculture. Governments at all levels should explore optimal development paths for smart agriculture based on local conditions, optimize agricultural development plans, and promote the effective advancement of smart agriculture while boosting farmers' economic income^[14]. Additionally, it is crucial to focus on the training and education of smart agriculture. Building a complete and effective training system, providing farmers with diverse training channels, and leveraging the resources of local colleges and vocational institutions can enhance farmers' knowledge and skills, laying a solid foundation for the development of smart agriculture^[15].

6. Conclusion

In short, with the continuous development of science and technology, big data technology has been widely used in the field of agricultural production. At present, smart agriculture based on big data technology has gradually replaced the traditional agricultural model, effectively reducing the waste of resources, improving the efficiency and output of agricultural production, and providing people with safer and high-quality food.

Funding

Basic Scientific Research Project of universities in 2023: Application of Big Data Technology in Smart Agriculture of Liaoning Region in 2023 (Project number: JYTMS20230966)

Disclosure statement

The authors declare no conflict of interest.

References

- [1] Mou X, 2024, Composition and Development of Intelligent Agricultural Management System. *Agricultural Machinery Use and Maintenance*, 2024(01): 84–87.
- [2] Fu Y, Pan C, Yu Xing, et al., 2023, Smart Agriculture and Rural Revitalization Based on the Internet of Things in the Context of Big Data. *Value Engineering*, 42(34): 160–162.
- [3] Zhao Y, 2023, Research on the Development Path of Intelligent Agricultural Products Logistics in Guizhou Province under the Background of Big Data. *Logistics Engineering and Management*, 45(11): 96–98 + 131.
- [4] Ye X, Xiao H, 2023, The Status Quo and Countermeasures of Intelligent Agriculture in China. *Intelligent Agriculture Guide*, 3(21): 1–4.
- [5] Xu J, Han G, 2023, Evaluation of Smart Agriculture in Qixing Farm. *Agricultural Disaster Research*, 13(10): 133–135.
- [6] Ni Z, Li Z, 2023, Design and Construction of Smart Agriculture Platform Based on Radio and Television 5G. *Radio and Television Technology*, 50(10): 14–17.
- [7] Ge F, 2023, Application of Big Data Technology in Farmland Planning and Design. *Guide of Smart Agriculture*, 3(19): 6–9.
- [8] Xia J, Mu W, Xu R, et al., 2023, Research and Exploration on Practical Teaching of Big Data Technology Based on College Students' Innovation and Entrepreneurship Training Program. *Theoretical Research and Practice of Innovation and Entrepreneurship*, 6(16): 36–39.

- [9] Hou X, Zhang G, 2023, Application of Big Data Technology in Rural Revitalization. *Modern Agricultural Science and Technology*, 2023(16): 204–206 + 210.
- [10] Hou X, 2023, Application Research of Big Data Technology in Implementing Rural Revitalization Strategy. *Shanghai Agricultural Science and Technology*, 2023(04): 48–49.
- [11] Li Q, 2023, Construction and Application Analysis of Smart Agriculture Based on Big Data Technology. *Hebei Agricultural Machinery*, 2023(14): 63–65.
- [12] Han E, Wang Z, 2023, Application of Big Data in the Development of Smart Agriculture. *Southern Agricultural Machinery*, 54(15): 43–45.
- [13] He L, 2023, Research on the Path of Rural Revitalization and Development Enabled by Big Data Technology. *Anhui Agricultural Sciences*, 51(13): 248–250.
- [14] Nong L, Wei Y, Zhang L, et al., 2023, Big Data Technology of Internet of Things Enables High-Quality Development of Jasmine Industry in Hengzhou. *Agricultural Technology and Equipment*, 2023(06): 28–30.
- [15] Tian C, Wang T, Lu X, 2023, Application of Internet of Things and Big Data Technology in Greenhouse Agricultural Production. *Journal of Agricultural Engineering Technology*, 43(17): 22–23.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.