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Role of Big Data Based on Information System in Management of Agricultural Economy

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Abstract: *Agriculture is the foundation of the national economy, and Big Data (BD) and cloud computing technology play a vital role in the economic development of society. With the continuous advancement of social informatization, how to use efficient BD technology to obtain massive economic information and conduct reliable analysis and processing has become an important development direction in the current management of agricultural economy field. In order to solve the problems of low collection efficiency, incomplete information sources, insufficient coverage of information elements to determine economic trends, insufficient technical means to obtain and process information, and inability to cope with complex and diverse management of agricultural economy situations in traditional management of agricultural economy processes, this article analyzed the work structure and operational process of information processing in traditional management of agricultural economy processes. Starting from the aspects of information collection, processing, storage, and analysis, this paper summarized the shortcomings of information processing capabilities in traditional management of agricultural economy processes, and tentatively introduced BD technology to optimize the performance of traditional information systems. Finally, to verify the reliability of the optimized agricultural economic information management system with the introduction of BD technology, comparative experiments were conducted on the practical application effects. Based on experimental results, it was shown that optimizing agricultural information management systems required a shorter time for marketing decisions compared to traditional agricultural information management systems. This article evaluated the simplicity of the implementation plan (A), the rationality of resource allocation (B), the effectiveness of the plan practice (C), and the ability to respond to sudden risks (D), with an average improvement of about 10.6%. The optimized agricultural economic information management system in this article had richer data collection methods compared to traditional agricultural economic information management systems. The application of BD technology improved the work efficiency and processing speed of the information management system, which could greatly shorten the time required for information processing under cost control conditions and promote the intelligence level of agricultural economic information management.*

Keywords: *Management Information System, Agricultural Economy, Level of Management, Big Data Technology*

1. Introduction

With the rapid development of BD technology and the advent of the information age, the deep application of BD technology in various fields is gradually becoming popular, and the management of agricultural economy field has also become one of the important fields with huge profits. Agriculture, as an important pillar of the national economy, plays a crucial role in the development and progress of society. However, throughout the development history of management of agricultural economy, it has been found that the management of agricultural economic information has not been optimized and improved in a timely manner by advanced technologies, and information management capabilities are unable to meet the severe information management needs in the increasingly complex agricultural economic situation. Management of agricultural economy faces many problems and challenges, such as incomplete collection of agricultural product supply information, low agricultural production efficiency, asymmetric information in agricultural product markets, and insufficient agricultural information processing capabilities, which restrict the progress and development of the agricultural economy. Therefore, it is necessary to conduct scientific research on the optimization direction of agricultural economic information management systems, in order to enhance the inherent vitality of the agricultural

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economy.

The widespread application of information systems in the management of agricultural economy process provides reliable data support for the management of agricultural information. A reasonably structured data management structure for agricultural information collection, processing, and analysis can effectively improve management of agricultural economy's information management capabilities. The working structure of traditional agricultural information management systems is not perfect, and the analysis of economic trends often only relies on manual judgment by employees and experts with relevant work experience. Such analysis results have a high degree of subjectivity and uncertainty, lack professional scientific basis and theoretical support, and are difficult to determine a clear internal context in the ever-changing trend of agricultural economic development [1-2]. The establishment of an agricultural information management system is based on a massive amount of agricultural related data. The growth conditions of agricultural products, actual soil conditions, real-time meteorological data, and professional planting techniques of farmers need to be collected, stored, and processed to facilitate the analysis of the development trend of agricultural economy [3-4]. By collecting and analyzing massive agricultural data, decision-makers can have a clearer grasp of the development direction of the agricultural economy, thereby developing the potential for land resource utilization to a higher extent, integrating resources more comprehensively, and improving resource allocation plans in crop planting and agricultural product sales [5-6]. In the management of agricultural economy process, the application level of information systems is not widespread enough, and the management mode of traditional information systems does not have the basic performance to comprehensively improve decision-maker information analysis.

The application of BD technology can more comprehensively cover the management elements of agricultural economic information, providing a solid data foundation for the establishment of information systems. The fluctuations and changes in the agricultural economic market are very frequent. Real time collection and analysis of agricultural economic information can improve the understanding of the agricultural economic market to a higher extent. In the case of asymmetric economic information, it greatly affects farmers' understanding of market conditions and cannot accurately determine the trend of price changes [7-8]. The introduction of BD technology has improved the efficiency of information collection for users when conducting management of agricultural economy projects. Based on massive economic data, feature extraction and information analysis can timely clarify the needs of the agricultural market, better plan the economic development path in the face of increasingly complex agricultural economic development situations, and reduce the occurrence of information asymmetry [9-10]. BD technology predicts the development trend of the agricultural economy market by exploring the inherent characteristics of user behavior in the market and summarizing the trend patterns of the agricultural economy market. It helps farmers and enterprises conduct market analysis and business decision-making, promotes the efficiency of user decision-making in agricultural information management systems, and controls costs [11-12]. The application of BD technology in the field of management of agricultural economy has great potential, but further exploration and research are needed.

The work structure of the combination of agricultural information management system and BD is of great significance for promoting the development of agricultural economy. Based on advanced information technology and economic analysis theory, the Market trend prediction ability of the information management system can be improved [13]. This article aims to improve the work level of traditional management of agricultural economy, promote the promotion of agricultural precision management, and enhance the level of intelligence. By collecting and analyzing soil and meteorological data of crop growth, the growth patterns of agricultural products and the average level of agricultural economic market are obtained. This can help users and farmers of information management systems develop more scientific and standardized farming plans and marketing strategies, greatly improving the utilization rate and market share of farmland. At the same time, the optimized agricultural economic information management system based on the application of BD technology can achieve real-time monitoring and detail control in the agricultural production process, improve the level of agricultural product safety management, provide more opportunities and methods for the development of the agricultural economy, and enable small-scale agricultural product enterprises and farmers to have a considerable degree of economic management and market competitiveness.

2. Role of BD Technology in Management of Agricultural Economy

Agricultural economy is an important part of the main body of the national economy, but in the

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process of agricultural development at this stage, the development of agricultural economy is restricted by various factors, and the application of agricultural BD needs more thinking and improvement [14]. The traditional agricultural production and operation mode is often connected by individuals to the agricultural market. There are problems such as low efficiency and blocked industry news, which hinder the sustainable development of agricultural economy. With the progress of BD technology and the call of agricultural reform, the application of agricultural BD has shown a unique role in the management of agricultural economy process.

In the traditional management of agricultural economy process, decisions on crop planting and marketing plans are generally based on the experience and intuition of farmers. This management approach overly relies on subjective opinions of people, lacks data and theoretical support, and is not scientific and accurate enough [15]. BD technology collects objective agricultural data in the management of agricultural economy process, extracts features and analyzes information from a large amount of agricultural related indicator data, helps users of agricultural information management systems improve their understanding of agriculture, and can also integrate resources to scientifically and reasonably develop more scientific farming plans and marketing strategies based on the planting conditions and adaptive resources of different crops.

The supply of agricultural products is an important management link in the agricultural economic chain. The instability of traditional agricultural supply processes is due to the backward supply structure of agricultural products, which leads to asymmetric information in the agricultural economy. It is difficult to accurately summarize the relationships and laws between users, farmers, and the market from complex agricultural supply phenomena. This article introduces BD technology to timely understand market demand and fluctuations in agricultural product prices, greatly reducing the occurrence of information asymmetry between users and farmers. This predicts the demand in the agricultural market, adjusts the supply structure of agricultural products reasonably, and promotes the effective improvement of agricultural product competitiveness.

The process of industrialization and intelligence in the agricultural field is steadily advancing, and improving the level of management of agricultural economy has become an important research task in the field of economic management. With the deep application of BD technology in the management of agricultural economy field, it has helped agricultural enterprises improve their economic management capabilities, and can achieve monitoring and control of various links in the agricultural product production process, effectively promoting the safe parallel level of agricultural product import quality and export efficiency [16-17]. Based on the architecture of agricultural information management system, data collection and storage can be carried out for the import and export process of agricultural products, and the quality of imported and exported agricultural products can be strictly controlled. Combining BD technology, reasonable planning can be carried out for the allocation, sales, and logistics of agricultural products, improving the management level of the supply chain. Figure 1 shows the role of BD technology in management of agricultural economy.

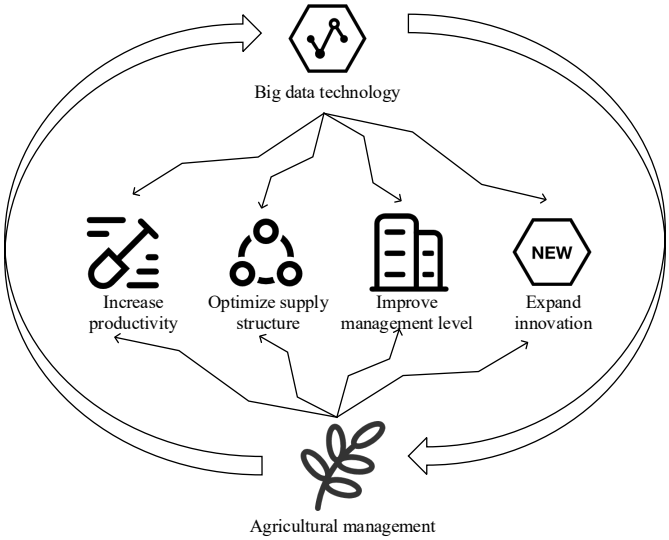

Figure 1: Display of the role of BD technology in management of agricultural economy

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3. Application Strategy of BD Technology in Agricultural Information Management System

In the past era, due to the lack of scientific development concepts and rich optimization experience in the traditional management of agricultural economy model, although it stimulated the development process of the agricultural economy to a certain extent in that era, it seems that the traditional management of agricultural economy model is unable to cope with the increasingly complex needs and challenges of agricultural economic development, and is difficult to meet the current agricultural production needs [18]. However, the integration and application of information systems and BD technology have opened up new development directions in the field of management of agricultural economy. BD technology can help farmers and agricultural enterprises obtain more comprehensive agricultural related information data, objectively and accurately process and analyze the data, and adjust and control agricultural industry processes in real-time based on agricultural economic fluctuations, which can promote the coordination and optimization of various links in agricultural product circulation [19-20]. The application of BD technology requires the establishment of a comprehensive data acquisition system. This article is based on a highly integrated sensor network and sets up several monitoring nodes to collect data from various crops in farmland through remote monitoring methods, recording data such as soil acidity and alkalinity, greenhouse temperature and humidity, and illumination intensity. The analog data collected by the sensor is quantized into digital data through an analog-to-digital converter, facilitating information transmission and calculation. The relevant data collected on crop growth status can reflect the level of crop growth and the probability of disease accidents. Massive agricultural data is exchanged with the control center through wireless sensing technology and uploaded to the cloud platform database for subsequent processing and analysis, providing support for the decision-making of management of agricultural economy plans.

This article proposes an efficient data storage and processing structure to address the significant pressure on computer resources caused by massive agricultural related data during interaction, resulting in frequent network latency and data loss issues. Through BD technology, massive agricultural related data is distributed and stored, and the computing resources of various storage nodes are integrated for targeted data processing and information transmission. The distributed storage data processing structure can achieve precise calculation and high-speed storage of data, analyze the laws of economic development from the massive interactive agricultural related data, and provide data support for the management of agricultural economy. Agricultural economic information often involves private information related to enterprise operations. When using the application strategy of BD technology in agricultural information management systems for decision support and security protection, it is necessary to establish corresponding security mechanisms. While ensuring the security of agricultural data through technical means such as data encryption, permission keys, and firewalls, data mining and machine learning are combined to analyze agricultural economic information, in order to achieve prediction of agricultural economic development trends. The structure of the optimized agricultural information management system is shown in Figure 2.

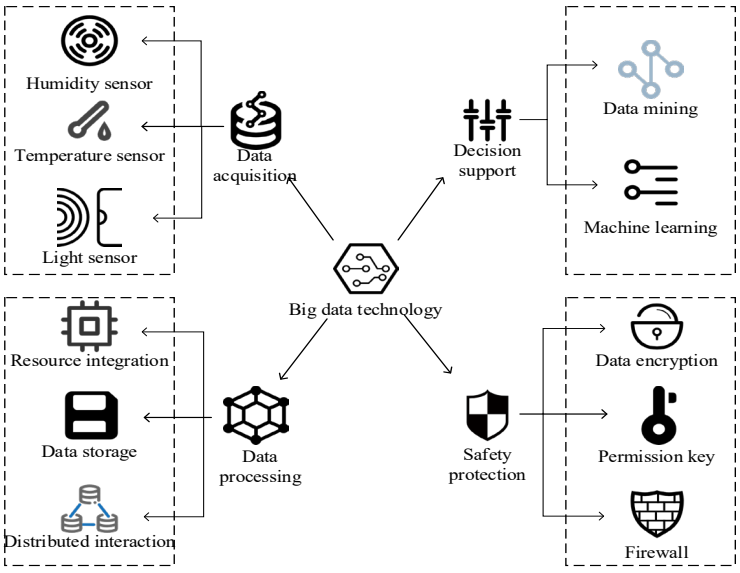

Figure 2: Optimizing the structure of agricultural information management system

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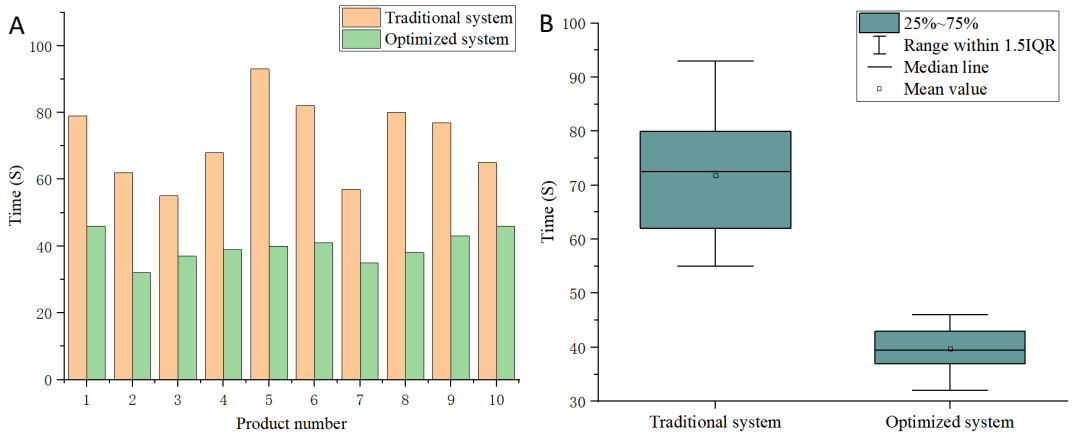
4. Optimizing the Application Practice of Agricultural Information Management System

This article explores the optimization of traditional agricultural information management systems based on BD technology. By establishing a comprehensive data collection system to enrich the collection methods of agricultural related data, a secure data storage database has been constructed. Data analysis and information mining techniques are used to extract features and summarize patterns from information data, and provide support for sales plan decision-making while ensuring the security of agricultural data. The basic framework for optimizing the agricultural information management system has been reconstructed based on BD technology, which helps to achieve the improvement of management of agricultural economy level in universities and sustainable development. However, further experiments are needed to verify the application effect of optimizing the agricultural information management system.

To verify the application effect of optimizing the agricultural information management system in this article, a comparative experiment was conducted on the application effect of the agricultural information management system in a certain agricultural product sales enterprise. Ten agricultural product information catalogs were randomly sampled. The content includes information elements such as agricultural product names, agricultural product inventory, agricultural product market prices, and agricultural product shelf life. Two groups of staff used traditional and optimized agricultural information management systems to conduct data analysis and information mining on 10 agricultural product information catalogs, and provided business strategies for 10 agricultural products. The decision-making time of the two groups of staff was recorded and compared separately. Among them, the experiment that applied the traditional agricultural information management system was set as the control group, and the experiment that applied the optimized agricultural information management system was set as the experimental group. Figure 3 shows the comparison of decision-making time between the traditional and optimized systems.



A. Duration comparison column display *B. Time comparison box line display*

Figure 3: Comparison of traditional and optimized decision durations

From Figures A and B in Figure 3, it could be seen that in the control group experiment using traditional agricultural information management systems, the average decision-making time for 10 agricultural product marketing schemes was 71.8 seconds. In the experimental group experiment that applied the optimization of agricultural information management system, the average decision plan was 39.7S. Compared to the average decision-making time of traditional agricultural information management systems, the average decision-making time of the optimized system was shortened by 32.1 seconds, greatly reducing the time required for data analysis and information mining of agricultural product information.

The duration of the decision plan can to some extent reflect the efficiency of the system, while the effectiveness of the decision plan reflects the reliability of the system to some extent. The relevant staff of two groups of experiments were invited to evaluate the effectiveness of the decision plan from four aspects: the simplicity of executing the plan (A), the rationality of resource allocation (B), the effectiveness of plan practice (C), and the ability to respond to sudden risks (D). The evaluation upper limit of the indicators was 9, with 1-3 being poor, 4-6 being good, and 7-9 being excellent. Table 1 shows the reliability evaluation analysis of traditional and optimized systems.

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Table 1: Reliability evaluation analysis of traditional and optimized systems

	A		B		C		D	
	Traditional system	Optimized system	Traditional system	Optimized system	Traditional system	Optimized system	Traditional system	Optimized system
1	6.52	7.61	7.05	7.88	6.03	7.40	6.36	7.43
2	6.56	7.22	7.07	8.34	7.25	7.06	6.05	7.59
3	6.84	6.95	7.13	7.00	6.10	7.28	6.07	6.35
4	6.40	7.32	7.65	8.89	7.09	7.95	6.03	7.39
5	6.62	7.74	7.96	7.82	6.57	7.98	6.09	7.84
6	6.67	7.30	7.28	8.37	7.76	7.41	6.54	7.58
7	6.45	6.59	7.62	8.91	6.03	7.09	6.96	6.99
8	6.22	7.70	7.33	8.36	6.02	7.68	6.74	7.45
9	6.82	6.00	7.89	8.14	6.07	7.44	6.70	6.82
10	6.64	6.26	7.87	8.20	7.91	7.99	6.69	6.87

From Table 1, it could be seen that in the control group experiment where traditional agricultural information management systems were applied, the average indices of the evaluation of the traditional agricultural information management system by relevant staff in four aspects: the simplicity of the implementation plan (A), the rationality of resource allocation (B), the effectiveness of plan practice (C), and the ability to respond to sudden risks (D) were 6.57, 7.49, 6.68, and 6.42, respectively. In the experimental group experiments that applied the optimization of agricultural information management systems, the average evaluation indices were 7.07, 8.19, 7.53, and 7.23, respectively. Compared with the evaluation indices of traditional agricultural information management systems, the evaluation indices of the optimization of agricultural information management systems increased by an average of about 10.6% in four aspects.

Although this article gained some understanding of the application of BD technology in management of agricultural economy and conducted reliability verification experiments to optimize agricultural information management systems based on experiments, there were still certain limitations and shortcomings. Due to the influence of experimental environment and time, the experimental period of this experiment was relatively short, and only the information mining and scheme decision-making aspects of agricultural information management systems for crop data were considered during the experimental process. However, with the rapid development of the information age and the continuous progress of human society, it was necessary to further integrate traditional theoretical frameworks and advanced information technologies.

5. Conclusions

The application and promotion of advanced BD technology are stimulating the transformation of the agricultural economic situation. With the development of technology and social progress, higher requirements have been put forward for the traditional management of agricultural economy model. This article was based on BD technology and combined with the traditional management of agricultural economy framework to tentatively optimize the traditional agricultural information management system, and reconstructed the working structure of the information management system through wireless sensor networks and artificial intelligence technology. Finally, the reliability of the optimized agricultural information management system was verified through time application experiments. Compared to traditional agricultural information management systems, the optimized agricultural information management system had higher work efficiency and streamlined process links, promoting efficient management and sustainable development of the agricultural economy while saving a lot of costs.

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