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Analysis on the Influence of Computer Technology on Agricultural Development in China

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Abstract Wide application of the computer-leading information technology is promoting tremendous changes in agricultural management, production, sales and agricultural science and technology, and education, showing broad application prospects, bringing unprecedented development opportunities to the information technology industry, greatly driving agricultural modernization, but also bringing challenges to agricultural science and technology workers to meet the agricultural information technology revolution. Information technology, as a kind of resource, is manifesting its functions in agricultural production and operation of agricultural products, and farmers are also paying more attention to the use of information technology to guide production and sales. China should take full advantage of the computer-centered information resources, and take the road of agricultural modernization and information to develop agriculture.

Key words Computer, Information technology, Agricultural development, Analysis of influence

1 Introduction

Computer-based agriculture is the agriculture that uses computer technology, deals with objects and whole process related to the agriculture in accordance with demands of users, directly oriented towards users, with farmers and agriculture-related enterprises as service objects, but the state can realize macro-control through setting goals^[1]. The essence of computer-based agriculture is taking the information technology as element of agricultural productivity, to realize intelligent, digital and visualized agriculture and related fields through the computer and its supporting technology and the integration between agriculture and industrial controllable production and computer-aided design, so as to meet the demands of human and social development. Computer-based agriculture can achieve a full range, real-time, timed, dynamic monitoring, and simulation of the whole process of agricultural production, to maximally increase crop yield and quality, improve agricultural science and technology level, make scientific decisions from macro to micro fields, and make systematic analysis, decision, control, scheduling, and real-time monitoring by computer^[2]. The service objects of computer-based agriculture cover the country to the majority of registered users. Besides, the computer-based agriculture provides users with services such as information, decision analysis, guidance, inquiry and consultation. The decision information comes from geographic information, market information, consumption information, energy information, resource information and national macro-control. The sources of information are wide, and decisions are more advanced and more reliable.

2 Current development situation of computer technology in agriculture

In the world, the development of the application of agricultural

computer technology has gone through three stages: the first stage is radio and telephone communication in the 1950s to 1960s; the second stage is the computer data, text processing and agricultural database development in the 1970s to the 1980s; the third stage is the network, the application of multimedia technology and agricultural production automation control since the 1990s^[3]. From the early 1990s, with the continuous development of computer technology, the application of computer technology in agriculture gradually became a trend, the computer technology was widely used in crop production, livestock production, agricultural machinery, agricultural products processing, agricultural environment monitoring and control, crop yield prediction, agricultural disease and pest forecasting, and agricultural information services. Computer technology brings high efficiency, high benefits, and high quality to agricultural management, production and scientific research, and the computer technology itself also has gradually formed a special branch of agricultural science and technology, which has become a powerful "driver" in agricultural development. Nowadays, the computer-leading information technology is sweeping the world, and human society is transforming from the industrial society to the information society, from the commodity economy to the knowledge economy, from modern agriculture to information agriculture, and we are gradually experiencing changes in the way of thinking, mode of production and lifestyle. And the application of computer technology in agriculture has constituted a complete functional system.

3 Specific application of computer technology in agriculture

3.1 Application of computer database technology in agriculture The Ministry of Agriculture included the application of computer technology in agriculture into the national project for the first time from the Seventh Five-Year Plan period. The application project includes data processing, large-scale database develop-

ment, and MIS system development. Various computer technologies have been widely applied in agricultural production and management, such as mathematical model design and programming, crop production model research, and model cultivation technology research^[4]. The establishment of various types of databases is the one of main tasks of application of agricultural computer in China for decades, and it is also consistent with the development of China's entire computer application. China has established the agricultural scientific research project computer management system; the Chinese Agricultural Literature Database, the Chinese Agricultural Technological Achievements Database, the Chinese Agricultural Research Project Database, Agricultural Practical Technology Database; China is building the national agricultural science and technology information network; meanwhile, China is introducing several world leading agricultural databases, such as the United Nations FAO AGRIS, the AGRICOLA of US National Agricultural Library, and the British International Center for Agricultural and Biological Sciences (CABI). The Network Center of the Chinese Academy of Agricultural Sciences has been built and connected with the Ministry of Agriculture, the State Science and Technology Commission and the International Information Network, which greatly promoted the development of agricultural science and technology and its extension in China. With the aid of computer network, leaders at all levels and agricultural scientific and technical personnel can know the trends of science and technology at home and abroad, master the arrangement and progress of scientific research projects, understand the extension and application of agricultural scientific research results, provide extremely effective means for research projects and cooperation, and make it easy for farmers to obtain desired science and technology information.

3.2 Application of computer technology in precision agriculture

The development of traditional agriculture largely depends on biogenetic breeding technology and increase in fertilizer, pesticide, mineral energy, and mechanical power. Precision agriculture is the new trend of agricultural development in the world. It is a system of modern agricultural operation technology and management supported by information technology to carry out a set of modern farming operation based on spatial variation, location, timing and quantification. Precision agriculture is a farming management concept based on observing, measuring and responding to inter and intra-field variability in crops. The goal of precision agriculture research is to define a decision support system for whole farm management with the goal of optimizing returns on inputs while preserving resources. Its basic meaning is to adjust crop inputs according to the soil properties of crop growth. On the one hand, it makes clear spatial variation of soil properties and productivity within the field; on the other hand, it determines crop production target, carries out systematic diagnosis, optimizes formula, technological assembly and scientific management, mobilizes soil productivity, achieves the same or higher income with the minimum investment, improves the environment, and efficient uses various agricultural resources, to achieve economic and envi-

ronmental benefits. Precision agriculture consists of 10 systems: the global positioning system (GPS), the farmland information collection system, the farmland remote sensing monitoring system, the farmland geographic information system, the agricultural expert system, the intelligent farm machinery system, the environmental monitoring system, the system integration system, the network management system, and the training system. The core of precision agriculture is to establish a perfect farmland geographic information system. Thus, it can be considered that the precision agriculture is a new type of agriculture integrating the information technology and agricultural production. Precision agriculture does not excessively stress high yield. Instead, it emphasizes the efficiency. It brings agriculture into the digital and information age, so it will be an important development in the 21st century.

3.3 Application of computer simulation technology in agriculture

Agricultural production system is a complex and unique multi-factor dynamic system. Influenced by many factors such as meteorology, soil, variety characteristics, and production technological measures, agricultural production system has significant temporal and spatial variation and regional properties, so that agricultural production management experts have difficulty in considering multi-factor interaction, forecasting the trend of agricultural production, and quantifying technical measures of production management. Agricultural simulation model mainly makes quantitative description and prediction model for biological and non-biological processes in agricultural system and its dynamic relationship with the environment and technology with the aid of the systematic analysis method and computer simulation technology. It can dynamically simulate the agricultural production process and its relationship with climate, soil and management technical measures, so as to overcome the strong regional and temporal and spatial limitations in traditional agricultural production researches, and provide powerful quantitative tools for agricultural production forecast under different conditions. The most important significance of the agricultural simulation model is to integrate the knowledge of the whole agricultural production system, quantify the mechanism process and the mutual relationship, namely, to integrate the knowledge and quantify the relationship. Besides, it uses powerful information processing and computing function of computer, to make systematic analysis and integration of biological and non-biological processes. Essentially, it is equivalent to the accumulation and integration of the latest knowledge of the system under study. Based on the understanding of the relationship between biological and non-biological processes and their variables, it performs quantitative analysis and mathematical modeling, thereby promoting transformation of biological and non-biological laws from qualitative description to quantitative analysis, and accordingly deepening quantitative knowledge and digital expression of agricultural system.

4 Existing problems in application of computer in agriculture

(i) Most laborers engaged in agricultural production have low ed-

educational level. They can skillfully grasp agricultural knowledge but are not aware of the increasing innovation in agricultural science and technology, have weak information awareness, and have no effective information as guide, they are used to traditional work mode and process, resulting in the lack of knowledge of computer application and the low overall level of information technology^[5]. In addition, managers are backward in ideas, have not realized the important advantages of computer technology, some agricultural management of the relevant fields focus on the immediate interest, but neglect long-term interests and the importance of computer technology, and have even little knowledge of the effectiveness of computer technology in agriculture. (ii) The basic conditions of agricultural scientific research are inadequate and the infrastructure is backward. The capital investment of China is insufficient in information technology. Lack of high-level development of agricultural information technology talents also restricts the extension and application of information technology. What's worse, the application of computer technology is not significant in a short period of time. This increases difficulty of agriculture which is weak in foundation. As a result, it leads to low level of agricultural modernization, slow transformation of agricultural science and technology achievements into productivity, long cycle, and low contribution rate of science and technology. (iii) Many existing database systems are not fully utilized, so it is impossible to share; current users of the database are few professional scientific research and technical personnel, and the service items are mainly providing original data, so the information analysis function is poor^[6]. In addition, both the quantity and quality of agricultural information resource databases already built fail to form information industry. With small size, few types, and low network connection level, many databases are only used internally and lack universal data standard. Besides, due to great differences of agricultural information regions, certain data resource databases of certain regions are not well established, and the construction of information resources is far to satisfy demands of agriculture.

5 Conclusions and recommendations

5.1 Conclusions Agriculture is a fundamental industry and also an old industry. In this ancient basic and modern industry, computer-based agriculture will find the latest point of integration and has made considerable achievements in the past few decades. With the development of computer technology and the advent of the information society, it is foreseeable that the application of computer technology will promote revolutionary changes in the agricultural production and management, bring rare opportunities to our agricultural development, which will greatly increase the contribution rate of science and technology, change the growth mode of agricultural benefits, improve resource utilization and labor productivity, and bring the agriculture to realize sustainable and coordinated development with high and stable yield, low consumption and high efficiency.

5.2 Recommendations There are many measures to strengthen the application of computer technology in agriculture. Because ag-

riculture is not perfect enough in many fields, the application of computer technology must be carried out in a step-by-step manner^[6]. (i) The government should take the guiding role in agricultural informationization, strengthen the application and extension of information technology, and actively bring into play the role of social organization, farmers and other social forces in agricultural information development. In strategies, it is required to extend the computer and computer knowledge, cultivate agricultural information market and information industry. More important, it is recommended to help agricultural managers and agricultural workers fully understand the knowledge of computer. Only when people's knowledge level realizes progress, may the wisdom of human beings promote the development of agriculture. Besides, it is recommended to strengthen China's agricultural information technology research and development forces through training senior professionals of agricultural information technology. (ii) China should strengthen the comprehensive integration of agricultural information technology, and enhance networking, multimedia and visualization research of agricultural application software. These measures need more funds, so it is recommended to invest more funds to promote transformation of agricultural scientific and technological achievements into productivity. (iii) Database construction still needs to be more complete. If the data supplied should be more timely and accurate, the management decision will become more effective. When data supply is timely, comprehensive and accurate, the data will be processed, calculated and optimized by the computer, so as to improve the situation of related agricultural fields^[6]. Once the data is not accurate enough, or the relevant data delays during input into system, the obtained scheme will be not optimal, and it will reduce the application efficiency of computer technology in agricultural fields. Furthermore, China should vigorously develop and utilize the agricultural databases of all provinces, cities and counties, promote the process of local agricultural information construction, gradually establish and improve the information resources at all levels, establish standards and data update system, and strengthen the research and application of data update technology.

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