



How Does Digital Technology Help Agricultural Development? ——Taking E-Commerce and Smart Agriculture As Examples

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Abstract. Smart agriculture represents the future trend of modern agricultural production mode, aiming to solve the problems of land resource waste, ecological environment deterioration, and loss of farming culture that exist in the traditional agricultural model. As one of the most active countries in the world in the research of smart agricultural technology, China has made remarkable progress, and is at the forefront of this field along with the United States, Brazil, Spain and Germany. Smart agriculture integrates a variety of technologies, including cloud computing and sensor networks, in order to increase the effective use of resources, improve the rural ecological environment, and realize the inheritance of farming culture. However, the field still needs to overcome challenges of equipment levels and innovation, as well as the skepticism of some farmers towards smart agriculture. Digital technology and large-scale operations provide more opportunities for smart agriculture, which not only promotes agricultural development but also helps to achieve the goal of rural revitalization. By deepening the understanding of the application of smart agriculture in different scenarios, the development and innovation in this field can be better guided and promoted, so that it will no longer stagnate at the beginning stage and bring more possibilities to agriculture and rural areas.

Keywords: Smart agriculture, e-commerce, rural revitalization

1 Introduction

The traditional mode of agricultural production has problems such as waste of land resources, deterioration of ecological environment and loss of farming culture. The development of smart agriculture can improve the utilization of agricultural resources, improve the rural environment, and inherit the farming culture. The development of smart agriculture is not only a process of upgrading agricultural technology, but also an important part of China's efficient use of resources and the promotion of rural revitalization. With the increased emphasis on smart agriculture, China's smart agriculture has made significant progress in technological innovation. The focus of smart agriculture technology research mainly focuses on agricultural sensors, agricultural big data and artificial intelligence, agricultural intelligent control and agricultural robots and other directions. At present, general agricultural sensors in China have been able to do all domestic production, and the application technology of UAV has also reached international leadership. Smart agricultural technology has also been initially applied nationwide, including in the field production areas of the Northeast, Northwest, and the Huang-Huai-Hai Plain, where precision field operations have been realized through the extensive application of remote sensing monitoring and agricultural machinery Beidou navigation operations and other technologies[1].

Smart agriculture integrates the use of cloud computing, sensor networks and other technologies to realize the connection of information support, field information collection, production data collection and other links. The development of smart agriculture cannot be separated from the development of China's digital economy as well as the Internet.[2] The sharing of digital technology and information resources can greatly reduce the cost of training and provide a broader platform for the revitalization of talents. The informatization of China's rural areas promotes the development of smart agriculture, while large-scale operation provides the conditions for the production of smart agriculture. This paper will explore the promotion and application of intelligent and digital production mode in the agricultural industry, focusing on the use of smart agriculture in different scenarios and the combination of digital technology to achieve the effect of helping rural revitalization as well as the possibility of enriching the industry[3]. Currently, smart agriculture can promote the development of agriculture in China, but the level of equipment and innovation in smart agriculture in China is still in the growth stage, and some farmers lack sufficient

understanding of smart agriculture and are skeptical of smart agriculture. The purpose of this paper is to enrich the understanding of smart agriculture in application scenarios and deepen the concept of agricultural digitization for farmers and enterprises[4]. It is hoped that the discussion of the theoretical path mechanism of smart agriculture will guide and stimulate the development and innovation of smart agriculture, so that smart agriculture will no longer remain in the experimental and initial stage.

2 Literature Review

Smart agriculture is very beneficial to the development of the national digital economy. Chunjiang Zhao (2021), in comparing the current status of the development of smart agriculture at home and abroad, used the Yield Company in Australia as an example to illustrate that the foreign company has been able to increase their company's annual output value up to fifty thousand dollars by utilizing big data and artificial self-energy to provide accurate data services for farms[5]. In recent years, the focus of attention in many countries has been on the innovation and development of agricultural sensors. Chunjiang Zhao (2021) mentioned in the same study that sophisticated sensors can enable the monitoring of several characteristic parameters of environmental and plant and animal life information at a time, as well as continuous monitoring of environmental, biological and abiotic hazards, etc., and also the detection of diseases before plants and animals are infected with them, which can help to realize the rapid detection and monitoring of a variety of indicators related to various food and agricultural disciplines. In his report on the collaboration between Qualcomm and CFPA (China Foundation for Poverty Alleviation), Mingwen Deng (2020) mentioned that the two have entered into an innovative collaboration centered on technology-enabled agriculture - the "Smart Agriculture" project. The main purpose of the project is to empower industrial poverty alleviation with technology, and help the cause of poverty alleviation and the construction of a well-off society. The first phase of the "Smart Agriculture" project will be piloted in four distinctive counties in Tongjiang City, Jiamusi City, Heilongjiang Province; Baoxing County, Ya'an City, Sichuan Province; Tiandong County, Baise City, Guangxi Province; and Honghe County, Hani and Yi Autonomous Prefecture, Yunnan Province.

China's scientific and technological development and the growth of the digital economy provide the conditions and environment for the development of smart

agriculture, while providing more innovative and feasible paths for rural revitalization. Rural e-commerce, on the other hand, is a trend formed by smart agriculture under the rapid development of digital economy. Kaikai Guo (2022) argues that rural e-commerce mainly refers to the two-way electronic transaction and management process of rural characteristic products, urban industrial consumer goods or specialized services across time and space, urban and rural areas by e-commerce practitioners, who are mainly farmers, new farmers, new agricultural management subjects, etc., using diversified e-commerce platforms and electronic payment tools, and with the help of modern supply chain system and logistics chain system[6]. In his study on e-commerce as a new driving force for rural agricultural production, Zhexi Zhang (2021) shows that as of August 23, 2021, e-commerce poverty alleviation has driven 7.71 million farmers to start their own businesses locally, and has driven 6.188 million poor people to increase their incomes. In the context of the digital economy, the use of e-commerce as the main business of agriculture has become one of the most direct and effective ways for poor people to escape poverty and increase their income. Guanghui Pang (2021), on the other hand, argues that rural e-commerce helps to reduce the risk of agricultural production and promote the diversification of rural economic development[7]. The network function of e-commerce helps to alleviate the problem of information mismatch and enables farmers to maximize their search for markets. On the basis of communication between the two parties to understand the market information, the production risk can be effectively minimized, to avoid production and price fluctuations caused by economic losses. E-commerce can also lengthen the industrial chain of agricultural production, so that farmers can sell agricultural products without having to leave their homes, improving the limitations of the land for farmers. E-commerce can increase new employment channels and income methods, and at the same time can play a positive role in promoting the development of urbanization, effectively expanding the scale of the town, but also maximizing the solution to the problem of surplus labor employment[8]. It can be seen that the high-quality development of rural e-commerce in the context of rural revitalization focuses on the accumulation of human capital of rural e-commerce business subjects, the application of innovative technologies, industrial and product restructuring, institutional innovation and other measures to crack the dilemma of insufficient internal energy for the development of high-quality rural industry and respond to the real needs of sustainable growth of the rural economy.

Chunjiang Zhao pointed out in his research that, at present, the land transfer in China accounts for more than 40%, and the number of farmers' professional cooperatives, family farms, and dragon-head enterprises reaches more than 3 million, which provides a carrier and demand driving force for the development of smart agriculture. While Ningbo Cui (2023) mentioned in his research on the current status of smart agriculture in China that China's smart agriculture is still in its infancy, and the refined policies and technologies are not perfect enough[9]. Although China has been developing very rapidly in this aspect of smart agriculture in recent years, the fragmentation of agricultural land and the backwardness of machinery make the development of smart agriculture lag behind compared with other countries. The lack of population in rural areas has also led to a shortage of labor, and the ability to apply smart agriculture is also low.

3 Discussion and Analysis

3.1 Application of E-Commerce in Smart Agriculture

In today's world, e-commerce has become an important part of the global economy and also plays an increasingly important role in the field of smart agriculture. In this field, e-commerce platforms play a key role in promoting the circulation of agricultural products and market development.

First, e-commerce provides farmers with broader market opportunities. Traditional agriculture usually faces geographical restrictions and information asymmetry, leading to difficulties in selling agricultural products. E-commerce breaks down geographical restrictions by establishing online markets and direct supply platforms for agricultural products, allowing agricultural products to enter the market more conveniently. Farmers can communicate and sell directly with consumers through the e-commerce platform, effectively reducing the cost of intermediate links and increasing the added value of agricultural products. In addition, e-commerce platforms provide farmers with data analysis tools for market information and demand forecasting, helping them to better adjust their production structure and supply chain and improve market competitiveness.

Secondly, e-commerce plays an important role in logistics and distribution in smart agriculture. Smart agriculture realizes precise monitoring and management of farmland, equipment and agricultural products with the help of IoT technology. By

combining with the e-commerce platform, the picking, packaging, storage and transportation of agricultural products can be carried out more efficiently and precisely. Real-time tracking and transmission of logistics information allows consumers to clearly understand the origin and quality of products, improving the traceability and credibility of agricultural products. At the same time, the distribution network of e-commerce also facilitates the cold-chain transportation of agricultural products and ensures the freshness and quality of the products.

E-commerce also provides a platform and opportunity for scientific and technological innovation in smart agriculture. With the development of new technologies such as the IoT, artificial intelligence and big data, smart agriculture is in a stage of rapid evolution. E-commerce platforms can provide digital and intelligent solutions for the production, processing and sales of agricultural products, and promote the application and promotion of smart agriculture technology. At the same time, e-commerce platforms can also provide channels for the publicity and promotion of innovative agricultural products, help agricultural products achieve branding and differentiated competition, and increase product added value and market share.

E-commerce plays an important role in smart agriculture, which is of great significance for improving the efficiency of agricultural product circulation and promoting agricultural modernization. Through the e-commerce platform, farmers can broaden their sales channels and increase their income; consumers can enjoy more convenient, safe and high-quality agricultural products; and smart agricultural technology can be better applied and promoted. In the future, with the continuous innovation of science and technology and the further development of e-commerce, the role of e-commerce in smart agriculture will be even more far-reaching, and make greater contributions to the sustainable development of agriculture and precise poverty alleviation.

3.2 Application of Digital Technology in Smart Agriculture

"Digital Valley Farm" in Liangping District, Chongqing, China. Qi Gao (2023) pointed out in his report on digital valley farm in Liangping District of Chongqing that intelligent agriculture takes information and knowledge as the core elements, and realizes information perception, intelligent control, precise input, quantitative decision-making and personalized service in the whole process of agricultural

production through the deep cross-border integration of agriculture and biotechnology, information technology and intelligent equipment. Digital valley farm in Liangping District of Chongqing is one of the typical examples[10].

The infrastructure of Digital Valley Farm is mainly built on "one hall, one pavilion, four fields, two gardens and one center". One hall refers to the Rural Revitalization Hall, which contains the main introduction to the digital valley farm. The "One Pavilion" is the Chinese Academy of Agricultural Sciences (CAAS)-Yunteng Pastoral Museum, which showcases the role of science and technology in promoting agriculture. The "four fields" are the Dutch tomato farm using modern greenhouse planting technology, the Israeli flower farm using water-fertilizer integrated irrigation technology, the melon and fruit farm of Chongqing Academy of Sciences, and the strawberry farm of Southwest University using three-dimensional high-efficiency cultivation. These venues will be advanced science and technology, applied to the corresponding vegetable and fruit cultivation, which not only allows visitors to feel the cutting-edge agricultural planting technology, but also allows visitors to enjoy the flowers and experience the fun of picking fruits and vegetables. The "One Center", i.e. the Wisdom Link General Control Center, is the heart of the entire digital valley farm, realizing the visualization, automation and intelligence of agricultural production and operation. In the farm, the main growth factors such as water, fertilizer, light, temperature, humidity and other factors required by crops are monitored in real-time in the form of data in the intelligent master control center.

The Yunteng Field Pavilion embodies smart agriculture by integrating and detecting data to more efficiently grasp the growth status of crops as well as ensure their safety in the production process. The pavilion focuses on the world's leading digital technology, using a variety of soilless cultivation techniques to achieve modernized, patterned and intelligent efficient production. The farm relies on the operation of the Wisdom Link Master Control Center, which is informed of the temperature, humidity, light and other parameters in the greenhouse in a timely manner and realizes real-time regulation and control, providing an excellent environment for the growth of fruits and vegetables. Through the monitoring technology of precise perception, quantitative indicators of vegetable management can be determined, providing a basis for carrying out quantitative diagnosis and precise fertilization. This automatic control not only greatly saves human resources,

but also improves the safety of fruits and vegetables in the growth process. The digital cultivation space breaks the dependence of crops on natural conditions.

Application of Artificial Intelligence Technology in Smart Agriculture for Control of Invasive Alien Species. Artificial intelligence is an emerging technology that is widely used in the field of smart agriculture. This technology has significant advantages over manual identification in the process of recognizing images and localization.²⁰²³, a research project on invasive alien species used this advantage of AI to design a program to accurately locate the eggs of the *pomacea canaliculata* in a natural environment.

Pomacea canaliculata are omnivorous snails that are not harmful in nature, but under the influence of human activities, they have become one of the important agricultural pests in some areas. *Pomacea canaliculata* feeds heavily on seedlings and young leaves of rice, vegetables, fruits and other crops, resulting in reduced yields and even death. At the same time, *Pomacea canaliculata* will reproduce in the water body and produce a large amount of feces and dead bodies, which will easily cause water quality deterioration and eutrophication. Therefore, it is an urgent task to control the population of *pomacea canaliculata* and their reproduction.

Traditional manual destruction of the eggs of *pomacea canaliculata* is a tedious task. During fieldwork in Donghu Park and Honghu Park, a project team in Shenzhen found that *pomacea canaliculata* preferred to lay their eggs near water sources. These places are generally hidden, and the *pomacea canaliculata* reproduces rapidly, often hiding a large number of *pomacea canaliculata* eggs in a small piece of leaf, which is very tedious for manual removal. By building a convolutional layer neural network, the project team built an artificial intelligence program that can automatically identify the eggs of the *pomacea canaliculata*. By inputting a photo of the natural environment, the program can quickly identify the location of the snail mess in the picture and frame around the eggs, and the accuracy of the program in locating the *pomacea canaliculata* eggs can reach 93% at present. Through subsequent technological development and innovation, the program can be attached to the machine for removing the eggs of *pomacea canaliculata*, realizing the automatic extermination of *pomacea canaliculata* eggs.

The popularization and practice of the program in rural areas can be done through different mediums and applications, such as organizing seminars, training courses and other activities in the field of agriculture to convey the value and

application of AI in solving the problem of the pomacea canaliculata to farmers and agricultural practitioners. In the demonstration farmland, machines equipped with the AI program are deployed to show farmers how to use and experience the convenience of the technology. At the same time, the research can cooperate with agricultural research institutes and agricultural machinery manufacturers to jointly promote the application and dissemination of the technology in actual production. In the process of application, the government can introduce relevant policies to encourage and support farmers to adopt the new technology, and provide funds and subsidies to reduce the cost of promotion. In addition, social media, agricultural websites, rural radio and other channels can be used to publicize the advantages and effects of the technology to the majority of farmers to enhance the visibility and recognition of the technology.

4 Conclusions

The close integration of smart agriculture and e-commerce opens up a brand new prospect for rural economic development, stimulates the potential of rural development, and provides infinite possibilities for society to build a beautiful and livable countryside. The introduction of smart agriculture makes the production and management of crops more scientific and precise. The application of advanced sensor technology, big data analysis, and artificial intelligence algorithms allows farmers to better monitor and manage key indicators such as soil moisture, temperature, and light, and to achieve precise fertilization, irrigation, and pest prevention and control to maximize yield and quality. At the same time, smart agriculture also provides farmers with more knowledge and technical support, enabling them to better adapt to market demands and changes, and enhancing farmers' profitability and productivity.

The joint promotion of smart agriculture and e-commerce has brought new opportunities for the development of the rural economy. Rural areas are no longer closed in the traditional sense, but have a broader space for development. The promotion of smart agriculture and the popularization of e-commerce have not only injected new vitality and power into the rural economy, but also brought new possibilities for the integrated development of urban and rural areas. The use of digital technology can break the boundaries of traditional agriculture, realize the optimal allocation of agricultural resources and intelligent management of production, promote the diversified development of rural industries, and improve the quality of life and well-being of rural residents.

However, the promotion of smart agriculture and e-commerce faces a series of challenges and dilemmas. Digital infrastructure and talent cultivation in rural areas need to be strengthened, and farmers' scientific and technological awareness and information literacy need to be improved to ensure that rural areas can successfully keep pace with the information age. In summary, the combination of smart agriculture and e-commerce has brought great opportunities and challenges for rural economic development. Only by keeping pace with the times, strengthening scientific and technological innovation and talent cultivation, and promoting the popularization and application of digital technology can we realize the sustainable development of the rural economy, build a prosperous and affluent new countryside, and move towards a better future.

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