

Construction Scheme Study of Smart Agricultural Demonstration Park

Yichuan Zhang, Anguo Qi and Xinzheng Li*

School of Horticulture and Landscape Architecture, Henan Institute of Science and Technology, Xinxiang 453003, China

**Corresponding Author
lixinzheng@hist.edu.cn*

Abstract

As smart agricultural demonstration park construction is inevitable for the development of Chinese agricultural modernization, it is very necessary to study the construction scheme of smart agricultural demonstration park. According to the demand of agriculture production and the development tendency of smart technology, this article, regarding perspectiveness, economy and efficiency as basic principles, following a basic approach of system integration, has built a constructive framework. This framework is composed of integration platform, infrastructures, demonstration modules and application platform. The paper detailed discusses the construction scheme of smart infrastructures, smart production modules, file management modules, smart website modules and smart business modules.

Key words: *Smart, Agricultural Demonstration Park, Construction, Scheme*

1. Introduction

China is a large agricultural country and agriculture is quite important to national food security. However, for a long time, the development of Chinese agriculture is relatively slow. The root cause of this problem is the agricultural land system. Since 1980, China implemented "Household-responsibility system"[1]. This system aroused farmers' incentive to produce in a given period, and promoted the development of agriculture. However, with the development of the economy and the progress of science and technology, this system is no longer adaptable to the development requirement of the agriculture. It is mainly because: this family-based production mode is not only disadvantageous to the mechanized production and the implementation of the advanced science and technology, but also uncontrollable to the quality of the products on the basis of the standard, leading to its inferior position in the market competition under the high producing costs of unit area and the low quality of the products.

Chinese economy has achieved rapid development in recent years and agricultural science technology innovation has also obtained great development. The measures formulated by Chinese government in 2004 to accelerate the agricultural land transfer provided the land guarantee for the development of agricultural scale economy. The Ministry of Agriculture and many provinces and cities all introduced policies and measures to support the development of modern agricultural park. Up to now, a large amount of agricultural parks have been established nationwide in China, with their scales ranging from hundreds to thousands hectares, which generally boast higher science and technology content, and have remarkable economic benefits due to the enhancement of the market competitiveness of the products. Most of these agriculture parks have become the leading agricultural enterprises in local regions. They have boosted the growth of local agricultural economy. However, compared with traditional agriculture, although agricultural park possesses the advantage of high economic benefits, meanwhile it is more

risky. Therefore, how to improve technological content in agricultural park and obtain products of high quality standards at a relatively low cost is the key to the sustainable development of enterprises.

The experience of developed countries shows that information technology plays an important role in agricultural development. With the progress of science and technology, highly integrated information technology of agriculture has become the trend of agricultural development in the future. China is a developing country, and the development of Chinese agriculture is influenced by many factors. Therefore, to study how to combine Chinese agricultural development with information technology is of great significance. Since IBM proposed the concept "Smart City" for the first time [2], smart technology has got a wide application. Smart community [3], smart traffic [4] and so on have developed rapidly. The combination of smart technology and agricultural development will largely increase the production efficiency of the park, and therefore, smart agriculture will be the important direction of future agricultural development [5].

Smart agriculture is an advanced stage of agricultural production and it is integrated into the emerging technologies like the Internet, mobile Internet, cloud computing, and the Internet of things. Based on various sensing nodes and wireless communication networks that are deployed on agricultural production sites, the smart agriculture can realize agricultural production environment's smart sense, smart warning, smart decision, smart analysis, and online expert guidance, and thus provide agricultural production with precision planting, visual management, and smart decisions. The construction of smart agricultural demonstration park is a new thing, and there is no mature demonstration to refer to. Therefore, it's indispensable to study out a development scheme which is scientific and feasible.

2. Methods

The construction of smart agricultural demonstration park should follow the principles of sustainable development and meet the following requirements. **Perspectiveness:** Facing the development of agricultural production techniques and smart information technology, the planning should be able to meet the requirements of future production management; **Economy:** the hardware and software construction of smart agricultural demonstration park construction needs an infuse of massive funds, and improvement of the coordination of system when constructing; **high efficiency:** various links of smart technology should match reasonably to improve the overall efficiency.

The basic framework of smart agricultural demonstration park including integration platform, display module, infrastructure and application platform is used to connect before-production, during-production and post-production with the whole production process, and to provide decisions for the decision makers of the park and services for groups of government, the public, managers, experts, markets, technicians, *etc.*, (Figure 1).

3. The Establishment of Constructing Framework System

3.1. Smart Infrastructure

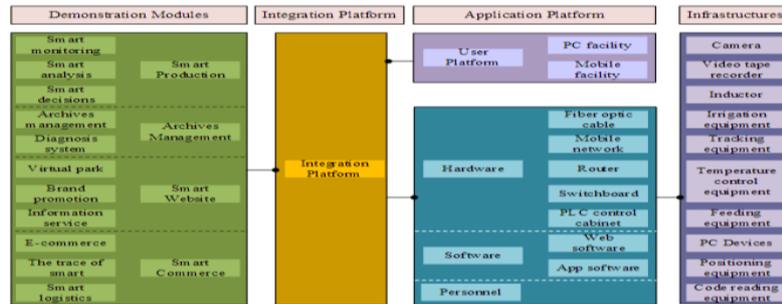


Figure 1. The Basic Framework of Smart Agricultural Demonstration Park

The smart equipment is the basis of the construction of the smart agricultural park, and mainly includes the construction of hardware and software and the matching of technical staff. The construction of hardware mainly consists of various environmental sensors (the illumination, temperature and humidity of the environment; Moisture, nutrient and PH value in soil; Carbon dioxide content) and its control equipment, label readers (two-dimensional code label and recognizer, RFID label and reader), image perception equipment and various computing service equipment mainly used to identify objects and to collect all kinds of information. It can conduct transmission and automatic control through cable, network, switcher, control box and so on. Besides operation system software and network communication software, Web software and App software can realize the agreement transmission and control between hardware's. Smart agriculture is the application of smart technology in agriculture, therefore production management personnel experienced in information technology must be equipped to realize agriculture informatization and greatly improve agriculture production and efficiency.

3.2. Smart Production Module

3.2.1. Smart Monitoring: Smart monitoring of production greenhouse: in the greenhouse, make use of the most advanced biological simulation technology to simulate the most suitable environment for plant growth in the greenhouse. Using temperature, humidity, CO₂ and light intensity sensor and so on to perceive the environmental indicators of the greenhouse and after the data analysis by microcomputer, the water curtain, wind turbine, sun visor and other facilities inside the greenhouse are monitored by the microcomputer, thus changing the biological growth environment inside the greenhouse.

The smart monitoring of the smart greenhouse: the smart greenhouse is usually made up of signal collection system, central computer and control system. Equipped with such automated facilities as computer-controlled movable roof, shading system, insulation, wet-curtain /fan cooling system, spraying and drip irrigation system, drip irrigation system, movable seedbeds and so on, it can help improve production efficiency and quality.

Smart monitoring of open field production: the smart monitoring of open field production is mainly of the monitoring and automatic adjustment on the index of soil environment. The moisture content, temperature, salt content and other parameters of soil can be sensed through the soil environment sensors, and the appropriate regulatory apparatus are automatically opened and closed according to the set indicators.

Smart monitoring for livestock and poultry production: make each livestock and poultry wear electronic labels as its only identity. Carry out all-round tracking and management in links like feed, immunization, breeding, slaughter, process, etc. through electronic labels. Customers can also understand the whole cultivation, processing, transportation and marketing process of products of animal husbandry through the labels.

3.2.2. Smart Analysis: This system automatically judges its status according to the set parameter and forms data report or conveys it to automatic control system by means of graphical representation or table. Smart Decision Supporting System is the combination of Artificial Intelligence and Decision Supporting System(DSS), applying Expert System to enable DSS to more fully apply human knowledge, such as descriptive knowledge about decision-making problem, the procedural knowledge in the decision-making process, and inference knowledge about solving problems, and help solve complex decision-making problems and assist decision-making system by logic inference.

3.2.3. Smart Decision: The smart decision consists of the automatic decision and the decision made by experts. The former one bases on the management system, and automatically triggers operation of all systems with the help of data which come from the sensor. When some information cannot be decided by the system automatically, experts will evaluate it and input related instructions for the system to operate.

3.3. File Management Module

File management of the agriculture park is a crucial part of improving management level. By recording the whole operation process and making the comparative analysis, the existing problems can be found in the production management, marketing, etc., providing a scientific basis for the adjustment of the operation plan. The module automatically generates reports with drawing or tabular forms, which enables managers or agricultural experts to make decisions conveniently.

3.4. Smart Website Module

3.4.1. Virtual Park: It is accessible for smart agricultural demonstration park to build a full three-dimensional district based on virtual reality technology, so as to break through the conventional district management mode based on manual management. It is combined with Internet technology, radio frequency identification sensor, video monitoring system, image recognition system, data warehouse and data mining technology to make the management of the park smarter and more convenient.

3.4.2. Park Brand and Information Promotion: An agricultural park only takes the roads of industrialization, branding and scale, and the development of modern agriculture will win the initiative in the market competition. Website is an important media for brand promotion. Therefore the operation maintenance quality of website will directly affect the impression of customers towards the enterprises.

3.5. Smart Business Module

3.5.1. Electronic Commerce: E-commerce is the business activity conducted through electronic data transmission technology, which could eliminate the time and space barriers to transfer and exchange information in traditional business activities. Developing agricultural e-commerce and changing traditional agricultural trading manners will push forward the agricultural industrialization effectively. Users can choose officially certified merchants directly through farming business pass authorization system provided by the website, and also can choose funds trading, which not only will increase the funds safety but also save time effectively.

3.5.2. Smart Tracing: Smart tracing function can meet the public's demands for the safety and quality of farm products. Information collecting devices and systems including MEMS sensor, two-dimension code, RFID, multimedia information, etc. can highly integrate agricultural products' information (like characteristics, growth, environment, management, etc.) into the labels, which makes it easy for the general public to check the information and facilitates the improvement of agricultural products' market recognition and additional economic benefits.

3.5.3. Smart Logistics: Compared with industrial products, agricultural products have features of perishability and bulkiness, and large difference in quality and big fluctuations in price, which increase the difficulty of storage, transportation, packaging, handling, distribution, etc. of agricultural products logistics management. Smart logistics module is used to coordinate the butting between picking, gathering, freezing, warehousing, transportation and markets and agricultural products so as to save energy, workplace and labor cost. The smart logistics system can also help to increase the profit of the products by saving time and reducing product losses and maintaining the quality of agricultural products.

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Authors



Yichuan Zhang, He received a M.S. degree from Central South University of Forestry and Technology, Changsha, China, in 2008, now he is an associate professor in the School of Horticulture and Landscape Architecture, Henan Institute of Science and Technology, Xinxiang, China. His current research interests include the landscape evaluation and the application of mathematical models in landscape optimization. E-mail: zhangyichuan2002@gmail.com.



Anguo Qi, He received a bachelor degree from Central South University of Forestry and Technology, Changsha, China, in 2001, now he is an associate professor in the School of Horticulture and Landscape Architecture, Henan Institute of Science and Technology, Xinxiang, China. His current research interests include the floral design and floriculture. E-mail: 79986166@qq.com.



Xinzheng Li, male, professor, School of Horticulture and Landscape Architecture, Henan Institute of Science and Technology, mainly engaged in the research about planning of Agricultural Demonstration Park. E-mail: lixinzheng@hist.edu.cn.